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Chapter 2

THE ECONOMIC PROBLEM

Answers to the Review Quizzes

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1. How does the production possibilities frontier illustrate scarcity?

The unattainable combinations of production that lie *beyond* the *PPF* illustrate the concept of *scarcity*. There simply are not enough resources to produce any of these combinations of outputs. Additionally, while moving along the *PPF* to increase the production of one good requires that the production of another good be reduced, which also illustrates scarcity.

2. How does the production possibilities frontier illustrate production efficiency?

The combinations of outputs that lie on the *PPF* illustrate the concept of production efficiency. These points are the maximum production points possible and are attained only by producing the goods and services at the lowest possible cost. Any point inside the frontier reflects production where one or both outputs may be increased without decreasing the other output level. Clearly, such points cannot be production efficient.

3. How does the production possibilities frontier show that every choice involves a tradeoff?

Movements along the *PPF* frontier illustrate that producing more of one good requires producing less of other good. This observation reflects the result that a *tradeoff* must be made when producing output efficiently.

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4. How does the production possibilities frontier illustrate opportunity cost?

The negative slope of the production possibility curve illustrates the concept of *opportunity cost*. Moving along the production possibility frontier, producing additional units of a good requires that the output of another good must fall. This sacrifice is the opportunity cost of producing more of the first good.

5. Why is opportunity cost a ratio?

The slope of the *PPF* is a *ratio* that expresses the quantity of lost production of the good on the *y*-axis to the increase in the production of the good on the *x*-axis moving downward along the *PPF*. The steeper the slope, the greater ratio, and the greater is the opportunity cost of increasing the output of the good measured on the horizontal axis.

6. Why does the *PPF* bow outward and what does that imply about the relationship between opportunity cost and the quantity produced?

Some resources are better suited to produce one type of good or service, like pizza. Other resources are better suited to produce other goods or services, like DVDs. If society allocates resources wisely, it will use each resource to produce the kind of output for which it is best suited. Consider a *PPF* with pizza measured on the *x*-axis and DVDs measured on the *y*-axis. A small increase in pizza output when pizza production is relatively *low* requires only a small increase in the use of those resources still good at making pizza and not good at making DVDs. This yields a small decrease in DVD production for a large increase in pizza production, creating a relatively *low opportunity cost* reflected in the gentle slope of the *PPF* over this range of output. However, the same small increase in pizza output when pizza production is relatively *large* will require society to devote to pizza production those resources that are less suited to making pizza and more suited to making DVDs. This reallocation of resources yields a relatively small increase in pizza output for a large decrease in DVD output, creating a relatively *high opportunity cost* reflected in the steep

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slope of the *PPF* over this range of output. The opportunity cost of pizza production increases with the quantity of pizza produced as the slope of the *PPF* becomes ever steeper. This effect creates the *bowed out* effect (the concavity of the *PPF* function) and means that as more of a good is produced, the opportunity cost of producing additional units increases.

7. On the global *PPF* of healthcare supplies and other goods and services, how did the production point change as the Covid-19 pandemic spread across the globe?

The production point moved along the global *PPF* so that more healthcare supplies were produced and fewer other goods and services were produced.

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1. What is marginal cost? How is it measured?

Marginal cost is the opportunity cost of producing *one more unit* of a good or service. Along a *PPF* marginal cost is reflected in the absolute value of the slope of the *PPF*. In particular, the magnitude of the slope of the *PPF* is the marginal cost of a unit of the good measured along the *x*-axis. As the magnitude of the slope changes moving along the *PPF*, the marginal cost changes.

2. What is marginal benefit? How is it measured?

The *marginal benefit* of a good or service is the benefit received from consuming one more unit of it. It is measured by what an individual is willing to give up (or pay) for an additional that last unit.

3. How does the marginal benefit of a good change as the quantity produced of that good increases?

As the more of a good is consumed, the marginal benefit received from each unit is smaller than the marginal benefit received from the unit consumed immediately before it, and is larger than the marginal benefit of the unit consumed immediately after it. This set of results is known as the principle of *decreasing marginal benefit* and is often assumed by economists to be a common characteristic of an individual's preferences over most goods and services in the economy.

4. What is allocative efficiency and how does it relate to the production possibilities frontier?

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Production efficiency occurs when production takes place at a point on the *PPF*. This indicates that all available resources are being used for production and society cannot produce additional units of one good or service without reducing the output of another good or service. *Allocative efficiency*, however, requires that the goods and services produced are those that provide the greatest possible benefit. This definition means that the allocative efficient level of output is the point on the *PPF* (and hence is a production efficient point) for which the marginal benefit equals the marginal cost.

5. What conditions must be satisfied if resources are used efficiently?

Resources are used efficiently when more of one good or service cannot be produced without producing less of some of another good or service that is *valued more highly*. This is known as *allocative efficiency* and it occurs when: 1) production efficiency is achieved, and 2) the marginal benefit received from the last unit produced is equal to the marginal cost of producing the last unit.

6. How do you think Covid-19 pandemic changed the marginal benefit of an effective vaccine?

The Covid-19 pandemic drastically increased the marginal benefit of an effective vaccine. With the pandemic, people were willing to give up more for an effective vaccine.

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1. What gives a person a comparative advantage?

A person has a comparative advantage in an activity if that person can perform the activity at a lower opportunity cost than anyone else, If the person gives up the least amount of other goods and services to produce a particular good or service, the person has the lowest opportunity cost of producing that good or service.

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2. Distinguish between comparative advantage and absolute advantage.

A person has a *comparative advantage* in producing a good when he or she has the lowest opportunity cost of producing it. *Comparative advantage is based on the output forgone.* A person has an *absolute advantage* in production when he or she uses the least amount of *time or resources* to produce one unit of that particular good or service. *Absolute advantage is a measure of productivity in using inputs.*

3. Why do people specialize and trade?

People can compare consumption possibilities from producing all goods and services through *self-sufficiency* against specializing in producing only those goods and services that reflect their comparative advantage and trading their output with others who do the same. People can then see that the consumption possibilities from specialization and trade are greater than under self-sufficiency. Therefore it is in people's own *self-interest* to specialize. It was Adam Smith who first pointed out in the *Wealth of Nations* how individuals *voluntarily* engage in this socially beneficial and cooperative activity through the pursuit of their own self-interest, rather than for society's best interests.

4. What are the gains from specialization and trade?

From society's standpoint, the total output of goods and services available for consumption is greater with specialization and trade. From an individual's perspective, each person who specializes enjoys being able to consume a larger bundle of goods and services after trading with others who have also specialized, than would otherwise be possible under self-sufficiency. These increases are the gains from specialization and trade for society and for individuals.

5. What is the source of the gains from trade?

As long as people have different opportunity costs of producing goods or services, total output is higher with specialization and trade than if each individual produced goods and services under self-sufficiency. This increase in output is the gains from trade.

6. Why does specialization and the gains from trade make the economy's *PPF* outward bowed?

Specialization and the gains from trade make the economy's *PPF* bow outward because the resources that have the comparative advantage in producing a good or service are the first to be utilized to produce that good or service. Consequently when the good or service is first produced, its opportunity cost—the amount of the other good or service forgone—is small and so the *PPF* is relatively flat. Ultimately, when so much of the good or service is produced such that resources without a comparative advantage in it must be utilized, the opportunity cost becomes larger so that the *PPF* becomes steeper. When the *PPF* starts out flatter and becomes steeper, it bows outward.

7. Why is not specializing and reaping the gains from trade inefficient?

By not specializing and trading, some suppliers are not producing the good in which they have a comparative advantage. Consequently production occurs inside the *PPF* at a production inefficient point. All of the economy's resources might be employed but they are misallocated.

8. How do you think the Covid-19 pandemic influenced Liz's and Joe's gains from trade? Explain your answer.

If Liz's and Joe's restaurants were closed due to the pandemic, their gains from trade would vanish. Presuming their stores were allowed to remain open, if there is a decrease in the resources necessary to produce one or both goods, then both their *PPF*s would have shifted inward which means the Liz-Joe Economy *PPF* also shifts inward. This change reduces the gains from trade because the total production of one or both of the goods decreases with the inward shift of the *PPF*.

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1. What generates economic growth?

The two key factors that generate economic growth are *technological change* and *capital accumulation*. Technological change allows an economy to produce more with the same amount of limited resources,

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Capital accumulation, the growth of capital resources including human capital, means that an economy has increased its available resources for production.

2. **How does economic growth influence the production possibilities frontier?**
   Economic growth shifts the *PPF* outward. Persistent outward shifts in the production possibility frontier—economic growth—are caused by the accumulation of resources, such as more capital equipment or by the development of new technology.

3. **What is the opportunity cost of economic growth?**
   When a society devotes more of its scarce resources to research and development of new technologies, or devotes additional resources to produce more capital equipment, both decisions lead to increased consumption opportunities in future periods at the cost of less consumption today. The loss of consumption today is the opportunity cost borne by society for creating economic growth.

4. **Explain why Singapore has experienced faster economic growth than the United States.**
   Singapore chose to devote a greater proportion of its available resources to the production of capital than the United States. This allowed Singapore to grow at a faster rate than the United States. By foregoing production of some consumption goods and producing a greater proportion of capital goods over the last few decades, Singapore was able to achieve output per person equal to 150 percent of that in the United States.

5. **Does economic growth overcome scarcity?**
   Scarcity reflects the inability to satisfy all our wants. Regardless of the amount of economic growth, scarcity will remain present because it will never be possible to satisfy all our wants. For instance, it will never be possible to satisfy all the wants of the several thousand people who all would like to ski the best slopes on Vail with only their family and a few best friends present. So economic growth allows more wants to be satisfied but it does not eliminate scarcity.

6. **How does economic growth change the patterns of production?**
   In low-income nations a large fraction of production is agriculture with distinctly less devoted to industry. For example, in Ethiopia agriculture accounts for 35 percent of production and industry for 22 percent. As the nation grows to middle income, investment in capital and new technology leads to an increase in the fraction of production that is industrial and a decrease in the fraction that is agricultural. For example, in China 8 percent of production is agriculture and 41 percent is industry. Finally, in high-income nations, services becomes an increasingly large proportion of production. In the United States, for example, services account for 80 percent of production while industry and agriculture together account for 20 percent of production.

7. **Why does economic growth destroy some jobs and create new jobs?**
   Economic growth leads to changes in the pattern of production—some sectors and products increase while others decrease. In the areas that increase in size, new jobs are created while in those that decrease, jobs are destroyed. Often workers who lose their jobs in the declining sectors need to acquire new skills for the new jobs and/or uproot their life to move to a new location. Some unemployed workers are unwilling to incur these costs and, as a result, remain unemployed, leading the economy to produce at a point inside its *PPF*.

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1. **Why are social institutions such as firms, markets, property rights, and money necessary?**
   These social institutions factors necessary for a decentralized economy to coordinate production. *Firms* are necessary to allow people to specialize. Without firms, specialization would be limited because a person would need to specialize in the *entire* production of a good or service. With firms people are able to specialize in producing particular bits of a good or service. For a society to enjoy the fruits of specialization and trade, the individuals who comprise that society must voluntarily desire to specialize in the first place. Discovering trade opportunities after a person has specialized in his or her comparative advantage in production is what allows that person to gain from his or her own specialization efforts. Trading

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opportunities can only take place if a *market* exists where people observe prices to discover available trade opportunities. *Money* is necessary to allow low-cost trading in markets. Without money, goods would need to be directly exchanged for other goods, a difficult and unwieldy situation. Finally people must enjoy social recognition of and government protection of *property rights* to have confidence that their commitments to trade arrangements will be respected by everyone in the market.

2. What are the main functions of markets?

The main function of a market is to enable buyers and sellers to get information and to do business with each other. Markets have evolved because they facilitate trade, that is, they facilitate the ability of buyers and sellers to trade with each other.

3. What are the flows in the market economy that go from firms to households and the flows from households to firms?

On the real side of the economy, goods and services flow from firms to households. On the monetary side of the economy, payments for factors of production, wages, rent, interest, and profits, flow from firms to households. Flowing from households to firms on the monetary side of the economy are the expenditures on goods and services and on the real side are the factors of production, labor, land, capital, and entrepreneurship.

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Answers to the Study Plan Problems and Applications

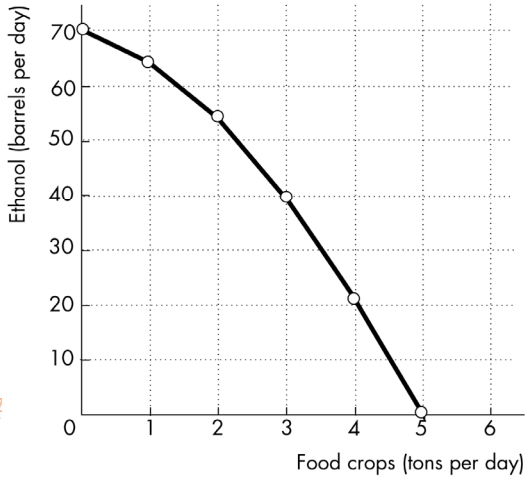
Use the following data to work Problems 1 to 3.
Brazil produces ethanol from sugar, and the land used to grow sugar can be used to grow food crops. The table to the right sets out Brazil's production possibilities for ethanol and food crops.

Ethanol (barrels per day)		Food crops (tons per day)
70	and	0
64	and	1
54	and	2
40	and	3
22	and	4
0	and	5

1. a. Draw a graph of Brazil's *PPF* and explain how your graph illustrates scarcity.

Figure 2.1 shows Brazil's *PPF*. The production possibilities frontier indicates scarcity because it shows the limits to what can be produced. In particular, production combinations of ethanol and food crops that lie outside the production possibilities frontier are not attainable.

FIGURE **2.1**
Problem 1



b. If Brazil produces 40 barrels of ethanol a day, how much food must it produce to achieve production efficiency?

If Brazil produces 40 barrels of ethanol per day, it achieves production efficiency if it also produces 3 tons of food per day.

c. Why does Brazil face a tradeoff on its *PPF*?

Brazil faces a tradeoff on its *PPF* because Brazil's resources and technology are limited. For Brazil to produce more of one good, it must shift factors of production away from the other good. Therefore to increase production of one good requires decreasing production of the other, which reflects a tradeoff.

2. a. If Brazil increases ethanol production from 40 barrels per day to 54 barrels per day, what is the opportunity cost of the additional ethanol?

When Brazil is production efficient and increases its production of ethanol from 40 barrels per day to 54 barrels per day, it must decrease its production of food crops from 3 tons per day to 2 tons per day. The opportunity cost of the additional ethanol is 1 ton of food per day for the entire 14 barrels of ethanol or 1/14 of a ton of food per barrel of ethanol.

b. If Brazil increases food production from 2 tons per day to 3 tons per day, what is the opportunity cost of the additional food?

When Brazil is production efficient and increases its production of food crops from 2 tons per day to 3 tons per day, it must decrease its production of ethanol from 54 barrels per day to 40 barrels per day. The opportunity cost of the additional 1 ton of food crops is 14 barrels of ethanol.

c. What is the relationship between your answers to parts (a) and (b)?

The opportunity costs of an additional barrel of ethanol and the opportunity cost of an additional ton of food crop are reciprocals of each other. That is, the opportunity cost of 1 ton of food crops is 14 barrels of ethanol and the opportunity cost of 1 barrel of ethanol is 1/14 of a ton of food crops.

3. Does Brazil face an increasing opportunity cost of ethanol? What feature of Brazil's *PPF* illustrates increasing opportunity cost?

Brazil faces an increasing opportunity cost of ethanol production. For instance, when increasing ethanol production from 0 barrels per day to 22 barrels the opportunity cost of a barrel of ethanol is 1/22 of a ton of food while increasing ethanol production another 18 barrels per day (to a total of 40 barrels per day) has

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an opportunity cost of 1/18 of a ton of food per barrel of ethanol. The *PPF*'s bowed outward shape reflects the increasing opportunity cost.

Use the above table (for Problems 1 to 3) to work Problems 4 and 5.

4. Define marginal cost and calculate Brazil's marginal cost of producing a ton of food when the quantity produced is 2.5 tons per day.

The marginal cost of a good is the opportunity cost of producing one more unit of the good. When the quantity of food produced is 2.5 tons, the marginal cost of a ton of food is the opportunity cost of increasing the production of food from 2 tons per day to 3 tons per day. The production of ethanol falls from 54 barrels per day to 40 barrels per day, a decrease of 14 barrels per day. The opportunity cost of increasing food production is the decrease in ethanol product, so the opportunity cost of producing a ton of food when 2.5 tons of food per day are produced is 14 barrels of ethanol per day.

5. Define marginal benefit. Explain how it is measured and why the data in the table does not enable you to calculate Brazil's marginal benefit of food.

The marginal benefit of a good is the benefit received from consuming one more unit of the good. The marginal benefit of a good or service is measured by the most people are willing to pay for one more unit of it. The data in the table do not provide information on how much people are willing to pay for an additional unit of food. The table has no information on the marginal benefit of food.

6. Distinguish between *production efficiency* and *allocative efficiency*. Explain why many production possibilities achieve production efficiency but only one achieves allocative efficiency.

Production efficiency occurs when goods and services are produced at the lowest cost. This definition means that production efficiency occurs at any point *on* the *PPF*. Therefore *all* of the production points on the *PPF* are production efficient. Allocative efficiency occurs when goods and services are produced at the lowest cost *and* in the quantities that provide the greatest possible benefit. The allocatively efficient production point is the *single* point on the *PPF* that has the greatest possible benefit.

Use the following data to answer questions 7 and 8.

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In an hour, Sue can produce 40 caps or 4 jackets and Tessa can produce 80 caps or 4 jackets.

7. a. Calculate Sue's opportunity cost of producing a cap.

Sue forgoes 4 jackets to produce 40 caps, so Sue's opportunity cost of producing one cap is (4 jackets)/(40 caps) or 0.1 jacket per cap.

b. Calculate Tessa's opportunity cost of producing a cap.

Tessa forgoes 4 jackets to produce 80 caps, so Tessa's opportunity cost of producing one cap is (4 jackets)/(80 caps) or 0.05 jacket per cap.

c. Who has a comparative advantage in producing caps?

Tessa's opportunity cost of a cap is lower than Sue's opportunity cost, so Tessa has a comparative advantage in producing caps.

d. If Sue and Tessa specialize in producing the good in which they have a comparative advantage, and they trade 1 jacket for 15 caps, who gains from the specialization and trade?

Tessa specializes in caps and Sue specializes in jackets. Both Sue and Tessa gain from trade. Sue gains because she can obtain caps from Tessa at a cost of (1 jacket)/(15 caps), which is 0.067 jacket per cap, a cost that is lower than what it would cost her to produce caps herself. Tessa also gains from trade because she trades caps for jackets for 0.067 jacket per cap, which is higher than her cost of producing a cap.

8. Suppose that Tessa buys a new machine that enables her to make 20 jackets an hour. (She can still make only 80 caps per hour.)

a. Who now has a comparative advantage in producing jackets?

Sue forgoes 40 caps to produce 4 jackets, so Sue's opportunity cost of producing one jacket is (40 caps)/(4 jackets) or 10 caps per jacket. Tessa forgoes 80 caps to produce 20 jackets, so Tessa's opportunity cost of

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producing one jacket is (80 caps)/(20 jackets) or 4 caps per jacket. Tessa has the comparative advantage in producing jackets because her opportunity cost of a jacket is lower than Sue's opportunity cost.

b. Can Sue and Tessa still gain from trade?

Tessa and Sue can still gain from trade because Tessa (now) has a comparative advantage in producing jackets and Sue (now) has a comparative advantage in producing caps. Tessa will produce jackets and Sue will produce caps.

c. Would Sue and Tessa still be willing to trade 1 jacket for 15 caps? Explain your answer.

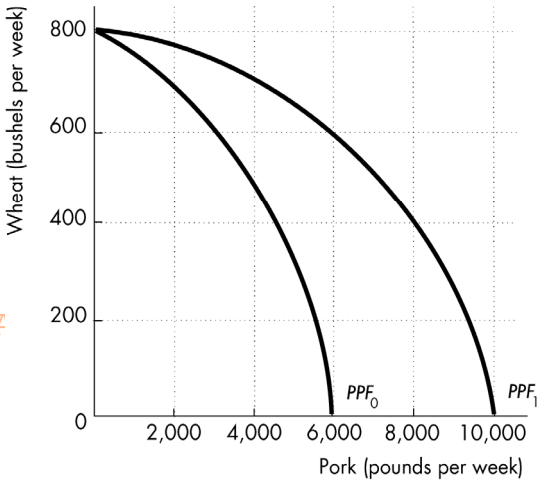
Sue and Tessa will not be willing to trade 1 jacket for 15 caps. In particular, Sue, whose comparative advantage lies in producing caps, can produce 1 jacket at an opportunity cost of only 10 caps. So Sue will be unwilling to pay any more than 10 caps per jacket.

9. A farm grows wheat and produces pork. The marginal cost of producing each of these products increases as more of it is produced.

a. Make a graph that illustrates the farm's *PPF*.

The *PPF* is illustrated in Figure 2.2 as PPF_0. Because the marginal cost of both wheat and pork increase as more of the good is produced, the *PPF* displays increasing opportunity cost so it has the "conventional" bowed-outward shape.

FIGURE **2.2**
Problem 9



b. The farm adopts a new technology that allows it to use fewer resources to fatten pigs. On your graph sketch the impact of the new technology on the farm's *PPF*.

The new technology rotates the *PPF* outward from PPF_0 to PPF_1.

c. With the farm using the new technology in part (b), has the opportunity cost of producing a ton of wheat changed? Explain and illustrate your answer.

The opportunity cost of producing wheat has increased. The opportunity cost of a bushel of wheat is equal to the magnitude of 1/(slope of the *PPF*). As illustrated in Figure 2.2, for each quantity of wheat the slope of PPF_1 has a smaller magnitude than the slope of PPF_0 so the opportunity cost of a bushel of wheat is higher along PPF_1. For a specific example, the opportunity cost of increasing wheat product from 600 bushels per week to 800 bushels per week along PPF_1 is 6,000 pounds of pork but is only 3,000 pounds of pork along PPF_0.

d. Is the farm more efficient with the new technology than it was with the old one? Why?

The farm is able to produce more with the new technology than with the old, but it is not necessarily more efficient. If the farm was producing on its *PPF* before the new technology and after, the farm was production efficient both before the new technology and after.

10. For 50 years, Cuba has had a centrally planned economy in which the government makes the big decisions on how resources will be allocated.

a. Why would you expect Cuba's production possibilities (per person) to be smaller than those of the United States?

Cuba's economy is almost surely less efficient than the U.S. economy. The Cuban central planners do not know people's production possibilities or their preferences. The plans that are created wind up wasting resources and/or producing goods and services that no one wants. Because firms in Cuba are owned by the government rather than individuals, no one in Cuba has the self-interested incentive to operate the firm

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efficiently and produce goods and services that consumers desire. Additionally, Cuba does not actively trade so Cuba produces most of its consumption goods rather than buying them from nations with a comparative advantage. Because Cuba uses its resources to produce consumption goods, it cannot produce many capital goods, so its economic growth rate has been low.

b. What are the social institutions that Cuba might lack that help the United States to achieve allocative efficiency?

Of the four social institutions, firms, money, markets, and property rights, Cuba's economy has firms and money. Markets, however, are less free of government intervention in Cuba. But the major difference is the property rights in the Cuban economy. In Cuba the government owns most of the firms; that is, the government has the property right to run the producers. Because the firms are not motivated to make a profit, the managers of these firms have little incentive to operate the firm efficiently or to produce the goods and services that consumers desire. In the United States, firms are owned by individuals; that is, people have the property right that allows them to run firms. These owners have the self-interested incentive to operate the firm efficiently and to produce the goods and services people want, an incentive sorely lacking in the Cuban economy.

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Answers to Additional Problems and Applications

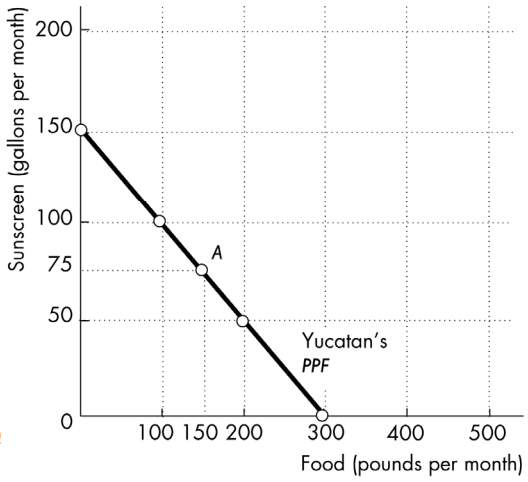
Use the table to work Problems 11 and 12. Suppose that Yucatan's production possibilities are given in the table.

Food (pounds per month)		Sunscreen (gallons per month)
300	and	0
200	and	50
100	and	100
0	and	150

11. a. Draw a graph of Yucatan's *PPF* and explain how your graph illustrates a tradeoff.

Yucatan's *PPF* is illustrated in Figure 2.3. The figure illustrates a tradeoff because moving along Yucatan's *PPF* producing more of one good requires producing less of the other good. Yucatan trades off more production of one good for less production of the other.

FIGURE **2.3**
Problem 11a



b. If Yucatan produces 150 pounds of food per month, how much sunscreen must it produce if it achieves production efficiency?

If Yucatan produces 150 pounds of food per month, then the point labeled *A* on the *PPF* in Figure 2.11 shows that Yucatan must produce 75 gallons of sunscreen per month to achieve production efficiency.

c. What is Yucatan's opportunity cost of producing (i) 1 pound of food and (ii) 1 gallon of sunscreen?

Yucatan's *PPF* is linear so the opportunity cost of producing 1 pound of food is the same at all quantities. Calculate the opportunity cost of producing 1 pound of food when increasing the production of food from 0 to 100 pounds per month. Between these two ranges of production, the quantity of sunscreen produced falls from 150 gallons per month to 100 gallons per month, a decrease of 50 gallons. The opportunity cost is 50 gallons of sunscreen to gain 100 pounds of food. The opportunity cost per pound of food equals (50 gallons of sunscreen)/(100 pounds of food), or an opportunity cost of 0.5 gallon of sunscreen per pound of food.

Yucatan's *PPF* is linear so the opportunity cost of producing 1 gallon of sunscreen is the same at all quantities. Calculate the opportunity cost of producing 1 gallon of sunscreen when increasing the production of sunscreen from 0 to 50 gallons per month. Between these two ranges of production, the quantity of food produced falls from 300 pounds per month to 200 pounds per month, a decrease of 100 pounds. The opportunity cost is 100 pounds of food to gain 50 gallons of sunscreen, or (100 pounds of food)/(50 gallons of sunscreen) which yields an opportunity cost of 2.0 pounds of food per gallon of sunscreen.

e. What is the relationship between your answers to part (c)?

Answers (c) and (d) reflect the fact that opportunity cost is a ratio. The opportunity cost of gaining a unit of a good moving along the *PPF* equals the quantity of the other good or service forgone divided by the quantity of the good or service gained. The opportunity cost of one good, food, is equal to the inverse of the opportunity cost of the other good, sunscreen.

12. What feature of a *PPF* illustrates increasing opportunity cost? Explain why Yucatan's opportunity cost does or does not increase.

If opportunity costs increase, the *PPF* bows outward. Yucatan's *PPF* is linear and along a linear *PPF* the opportunity cost is constant. Yucatan does not face an increasing opportunity cost of food because the

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opportunity cost remains constant, equal to 0.5 gallons of sunscreen per pound of food. Yucatan's resources must be equally productive in both activities.

13. In problem 11, what is the marginal cost of 1 pound of food in Yucatan when the quantity produced is 150 pounds per day? What is special about the marginal cost of food in Yucatan?

The marginal cost of a pound of food in Yucatan is constant at all points along Yucatan's *PPF* and is equal to 0.5 gallons of sunscreen per pound of food. The special point about Yucatan's marginal cost is the fact that the marginal cost is constant. This result reflects Yucatan's linear *PPF*.

14. The table describes the preferences in Yucatan.

Sunscreen (gallons per month)	Willingness to pay (pounds of food per gallon)
25	3
75	2
125	1

a. What is the marginal benefit of sunscreen and how is it measured?

The marginal benefit of sunscreen is the benefit enjoyed by the person who consumes one more gallon of sunscreen. It is equal to the willingness to pay for an additional gallon. For example, in the table when 75 gallons of sunscreen are produced, the marginal benefit of a gallon is 2 pounds of food per gallon.

b. Using the table in Problem 11, what does Yucatan produce to achieve allocative efficiency?

To achieve allocative efficiency, the marginal benefit of a gallon of sunscreen must equal the marginal cost of a gallon of sunscreen. Yucatan's marginal cost of a gallon of sunscreen is 2 pounds of food per gallon. When Yucatan produces 75 gallons of sunscreen, the table shows that Yucatan's marginal benefit is 2 pounds of food per gallon. Therefore, allocative efficiency is achieved when 75 gallons of sunscreen and, from the *PPF*, 150 pounds of food are produced.

15. Up To 10,000 Retail Stores Could Close This Year

Up to 10,000 U.S. storefronts could disappear by the end of 2021. Consumers prefer the safety of shopping online during the Covid-19 pandemic.

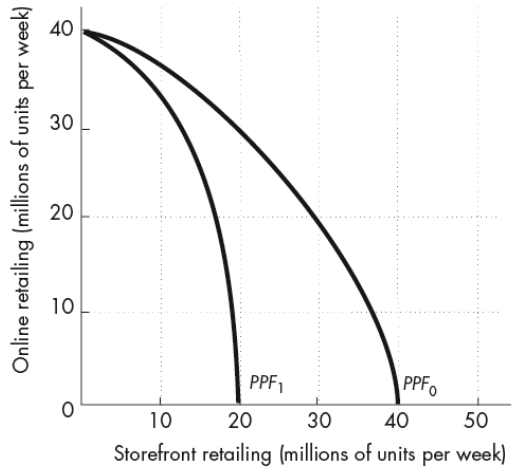
Source: *CBS News*, January 28, 2021

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a. Draw the *PPF* curves for storefront and online retailers before and after the Covid-19 pandemic.

Before the Covid-19 pandemic, the production possibilities frontier was PPF_0 in Figure 2.4. With thousands of storefronts closing, the *PPF* shifts inward along the horizontal axis to PPF_1.

FIGURE **2.4**
Problem 15a



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b. Draw the marginal cost and marginal benefit curves for storefront retailers and online retailers before and after the Internet became available.

The marginal benefit for the goods is the same regardless of whether they came from an online store or a storefront retailer. Therefore in Figure 2.5 the marginal benefit curve for retail goods is *MB*. The marginal cost of storefront retailing increases as the quantity increases, so both pre- and post-Internet, the storefront marginal cost curve is MC_{STORE}. Before the Internet, no online retailing could occur so the marginal cost curve is the vertical marginal cost curve $MC_{PRE\text{-}INT}$ running along the *y*-axis. After the Internet was developed online retailers have a lower marginal cost than do brick-and-mortar retailers, so the marginal cost curve of online retailers is $MC_{POST\text{-}INT}$.

FIGURE **2.5**
Problem 15b



c. Explain how changes in production possibilities, preferences, or both have changed the way in which goods are retailed.

The change in production possibilities, which created lower-cost online retailers, have changed the way retail goods are produced. In addition, the Covid-19 pandemic changed people's preferences in favor of online retailing. With the lower cost of online retailing and the increased preferences for online retailing, the quantity of online retailing increased.

Use the following news clip to work Problems 16 and 17.

Defeat Malaria in a Generation—Here's How

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The world could be free of malaria within a generation, a major report says. Malaria eradication within a generation is ambitious, achievable, and necessary. The report estimates around $4.3bn is spent on malaria every year. But it would need a further $2bn a year to rid the world of malaria by 2050.

Source: *BBC News*, September 9, 2019

16. Does the report describe *production efficiency* or *allocative efficiency* or both?

The report describes both allocative efficiency and production efficiency. The allocatively efficient quantity occurs when marginal cost equals marginal benefit. The assessment that malaria eradication is "necessary" indicates that it this is allocatively efficient quantity of malaria cases. It also discusses production efficiency when it suggests that spending an additional $2 billion a year is necessary to eliminate malaria. This increased spending represents a movement along the *PPF*.

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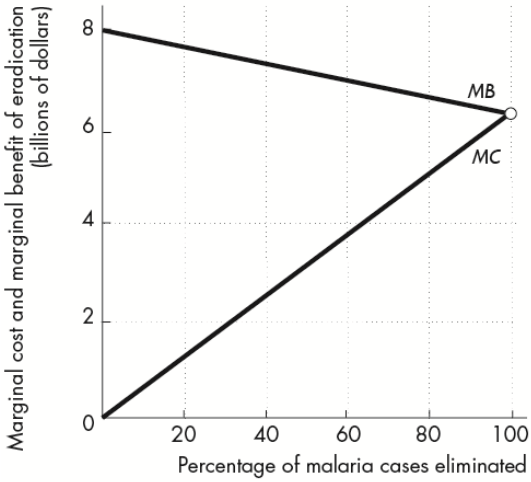
17. Make a graph with the percentage of malaria cases eliminated on the *x*-axis and the marginal cost and marginal benefit of driving down malaria cases on the *y*-axis. On your graph,

(i) Draw curves to show the marginal cost and marginal benefit of malaria eradication.

(ii) Identify the quantity of malaria eradicated that achieves allocative efficiency.

Figure 2.6 shows a marginal cost curve and a marginal benefit curve that are consistent with the report. The allocatively efficient quantity is the percentage of malaria cases eliminated for which the marginal benefit equals the marginal cost. The figure shows this allocatively efficient quantity to be 100 percent of malaria cases eliminated but because the article did not present enough detail, it the allocatively efficient quantity might less than 100 percent.

FIGURE **2.6**
Problem 17



Use the following data to work Problems 18 and 19.
Kim can produce 40 pies or 400 cakes an hour. Liam can produce 100 pies or 200 cakes an hour.

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18. a. Calculate Kim's opportunity cost of a pie and Liam's opportunity cost of a pie.

If Kim spends an hour baking pies, she gains 40 pies but forgoes 400 cakes. Kim's opportunity cost of 1 pie is (400 cakes)/(40 pies), or 10 cakes per pie. If Liam spends an hour baking pies, he gains 100 pies but forgoes 200 cakes. Liam's opportunity cost of 1 pie is (200 cakes)/(100 pies), or 2 cakes per pie.

b. If each spends 30 minutes of each hour producing pies and 30 minutes producing cakes, how many pies and cakes does each produce?

Kim produces 20 pies and 200 cakes. Liam produces 50 pies and 100 cakes. The total number produced is 70 pies and 300 cakes.

c. Who has a comparative advantage in producing (i) pies and (ii) cakes?

Liam has the comparative advantage in producing pies because his opportunity cost of a pie is less than Kim's opportunity cost. Kim has the comparative advantage in producing cakes because her opportunity cost of a cake is less than Liam's opportunity cost.

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19. a Draw a graph of Kim's *PPF* and Liam's *PPF* and show the point at which each produces when they spend 30 minutes of each hour producing pies and 30 minutes producing cakes.

FIGURE **2.7**
Problem 19a

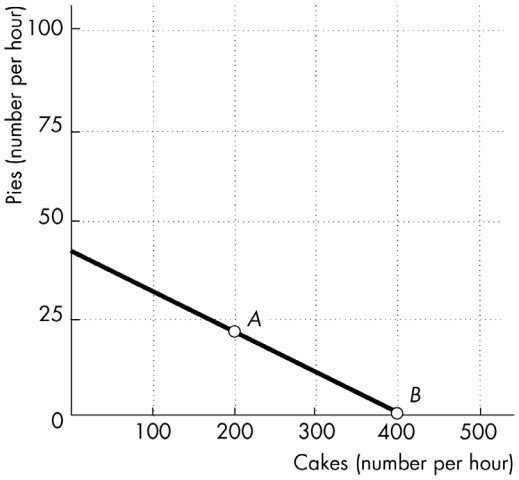
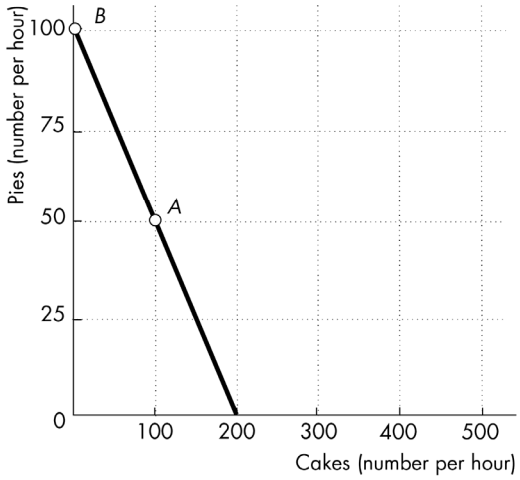


FIGURE **2.8**
Problem 19a



Kim's *PPF* is illustrated in Figure 2.7; Liam's *PPF* is illustrated in Figure 2.8.
Point *A* in both figures shows their production points when each spends 30 minutes making cakes and 30 minutes making pies.

b. On your graph, show what Kim produces and what Liam produces when they specialize.
Kim will specialize in cakes and Liam will specialize in pies. Point *B* in both figures shows the production points when each specializes.

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c. When they specialize and trade, what are the total gains from trade?
Kim will specialize in cakes and Liam will specialize in pies. If they specialize and trade, the total production of *both* cakes and pies increase. When each spends 30 minutes making cakes and 30 minutes making pies, together they produce 300 cakes and 70 pies. When they specialize, together they produce 400 cakes and 100 pies. The 100 increase in cakes and the 30 increase pies is the gains from trade.

d. If Kim and Liam share the total gains equally, what trade takes place between them?
Kim will trade 50 cakes (half of the gain in cake production) to Liam in exchange for 15 pies (half of the increase in pie production).

Tony's Production Possibilities		
Snowboards (units per week)		Skis (units per week)
25	and	0
20	and	10
15	and	20
10	and	30
5	And	40
0	And	50

Patty's Production Possibilities		
Snowboards (units per week)		Skis (units per week)
20	and	0
10	and	5
0	and	10

20. Tony and Patty produce skis and snowboards. The tables show their production possibilities. Tony produces 5 snowboards and 40 skis a week; Patty produces 10 snowboards and 5 skis a

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week.

a. Who has a comparative advantage in producing (i) snowboards and (ii) skis?

(i) Tony's opportunity cost of a snowboard is (10 skis)/(5 snowboards), or 2 skis per snowboard. Patty's opportunity cost of a snowboard is (5 skis)/(10 snowboards), or 0.5 skis per snowboard. Patty's opportunity cost of a snowboard is lower than Tony's opportunity cost, so Patty has the comparative advantage.

(ii) Tony's opportunity cost of a ski is (5 snowboards)/(10 skis), or 0.5 snowboards per ski. Patty's opportunity cost of a ski is (10 snowboards)/(5 skis), or 2.0 snowboards per ski. Tony's opportunity cost of a ski is lower than Patty's opportunity cost, so Tony has the comparative advantage.

b. If Tony and Patty specialize and trade 1 snowboard for 1 ski, what are the gains from trade?

Tony has a comparative advantage in producing skis, so he specializes in producing skis. Patty has a comparative advantage in producing snowboards, so she specializes in snowboards. Tony now produces 50 skis and Patty produces 20 snowboards. Before specializing they produced a total of 45 skis (Tony's 40 plus Patty's 5) and 15 snowboards (Tony's 5 plus Patty's 10). By specializing, the total production of skis increases by 5 and the total production of snowboards increases by 5. This increase in total production is the gains from trade. By trading 1 ski for 1 snowboard, they can share these gains. Tony obtains snowboards from Patty for less than it costs him to produce them and Patty obtains skis from Tony for less than it costs her to produce them.

21. Capital accumulation and technological change bring economic growth: Production that was unattainable yesterday becomes attainable today; production that is unattainable today will become attainable tomorrow. Why doesn't economic growth bring an end to scarcity one day?

Scarcity is always being defeated yet will never suffer defeat. Scarcity reflects the existence of unmet wants. People's wants are infinite—regardless of what a person already possesses, everyone can easily visualize something else he or she wants, if only more time in the day to enjoy their possessions. Because people's wants are insatiable, scarcity will always exist regardless of economic growth.

22. SpaceX Plans to Send Three Tourists to the International Space station Next Year

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SpaceX CEO Elon Musk announced that SpaceX has plans to send three tourists on a 10-day trip to the International Space station in 2021.

Source: *The Verge*, March 5, 2020

a. What is the opportunity cost of creating the technology for trips to the International Space Station?

The opportunity cost of creating the technology is the next best alternative forgone by the resources used to develop this technology. For example, the engineers who are working to develop SpaceX's technology might otherwise be assisting in the production of technology used to more powerful batteries, so the opportunity cost is the decrease in production of the more powerful battery.

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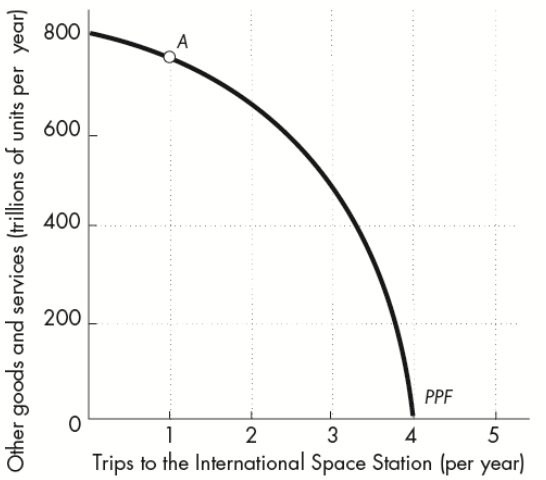
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b. Sketch SpaceX's *PPF* for trips to the International Space Station and other goods and services and show Space X's planned production in 2021.

Figure 2.9 shows SpaceX's *PPF*. In 2021, SpaceX planned a trip to send three tourists to the International Space Station. Its planned production point in 2021 is labeled *A*, where it sends one trip to the International Space Station.

FIGURE **2.9**
Problem 22b

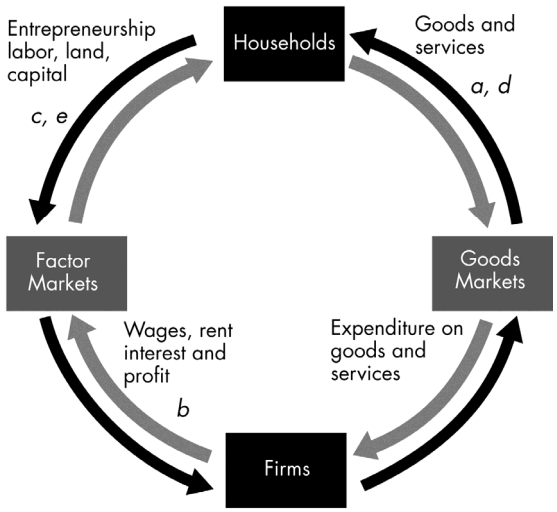


23. On a graph of the circular flows in the market economy, indicate the real and money flows in which the following items belong:

a. You buy an iPad from the Apple Store.

Figure 2.10 shows the circular flows in a market economy. Your purchase of an iPad from Apple is the purchase of a good from a firm. This flow is in the black arrow indicated by point *a* in the figure. When you pay for the iPad, the corresponding money flow is in the grey arrow in the opposite direction to the black arrow labeled *a*.

FIGURE **2.10**
Problem 23



b. Apple Inc. pays the designers of the iPad.

Apple's payment to the designers of the iPad is the payment of a wage to a factor of production. This flow is in the grey arrow indicated by point *b* in the figure. The flow of design services from the designer to Apple is in the black arrow in the opposite direction to the grey arrow labeled *b*.

c. Apple Inc. decides to expand and rents an adjacent building.

Apple's decision to expand by renting a building means that Apple is increasing the capital it uses. This flow is in the black arrow indicated by point *c* in the figure. The flow of the payment for the rental services of the building is in the grey arrow in the opposite direction to the black arrow labeled *c*.

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d. You buy a new e-book from Amazon.

Your purchase of an e-book from Amazon is the purchase of a good from a firm. This flow is in the black arrow indicated by point *d* in the figure. When you pay for the e-book, the corresponding money flow is in the grey arrow in the opposite direction to the black arrow labeled *d*.

e. Apple Inc. hires a student to work as an intern.

Apple's decision to hire a student intern is Apple increasing the labor it uses. The flow of labor services is in the black arrow indicated by point *e* in the figure. The flow of the payment for the labor services is in the grey arrow in the opposite direction to the black arrow labeled *c*.

Economics in the News

24. After you have studied *Reading Between the Lines* on pp. 50–51, answer the following questions.

a. How did Covid-19 change U.S. production possibilities in 2020?

Covid-19 decreased the U.S. production possibilities and shifted the U.S *PPF* inward.

b. How did the rapid development and rollout of vaccines change the U.S. production possibilities in 2021?

The rapid development and rollout of vaccines increased U.S. production possibilities and shifted the U.S. *PPF* outward.

c. How do productive resources get reallocated between private and government goods and services?

Productive resources are reallocated so that the economy is producing at the allocatively efficient point.

d. How might the Biden spending packages change U.S. production possibilities after 2021?

Some of the items in the $6 trillion Biden plan are productivity enhancing capital goods, such as transportation infrastructure, research and development, and education. The increase in the production of these items increases production possibilities, which would result in an increase in U.S. production possibilities after 2021.

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25. Disney Hopes Wall Street Bets on New Global Streaming Service

Walt Disney Co. unveiled details of a family-friendly streaming service on Thursday with TV shows and movies from some of the world's most popular entertainment franchises. Disney says its new streaming service, Disney Plus, will cost $6.99 US per month.

Source: Reuters, April 11, 2019

a. How has live streaming changed the production possibilities of video entertainment and other goods and services?

b. Live streaming has increased the production possibilities. For any quantity of other goods and services, now more video entertainment can be produced. The production possibilities frontier has changed so that the maximum quantity of video entertainment has increased but the maximum quantity of other goods and services has not changed.

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b. Sketch a *PPF* for video entertainment and other goods and services before live streaming.

The *PPF* should have video entertainment on one axis and other goods and services on the other as illustrated in Figure 2.11. The *PPF* is bowed outward as a conventional *PPF*.

c. Show how the arrival of inexpensive live streaming has changed the *PPF*.

The arrival of inexpensive live streaming shifts the *PPF* outward as shown by the change from PPF_0 to PPF_1 in Figure 2.11. The intersection of the new *PPF* along the axis measuring video entertainment increases and the intersection of the new *PPF* along the axis measuring other goods and services does not change.

d. Sketch a marginal benefit curve and marginal cost curve for video entertainment before and after live streaming.

In Figure 2.12, the marginal benefit and marginal cost from video entertainment is measured along the vertical axis and the quantity of video entertainment is measured along the horizontal axis. As the figure shows, the marginal benefit curve is a conventional downward-sloping marginal benefit curve and the marginal cost curve is a conventional upward-sloping marginal cost curve. The introduction of low cost live streaming does not change the marginal benefit curve—it remains *MB*. But it lowers the marginal cost and shifts the marginal cost curve from MC_0 to MC_1.

e. Explain how the efficient quantity of video entertainment has changed.

As Figure 2.12 shows, the allocatively efficient quantity of video entertainment increases. In Figure 2.12, the allocatively efficient quantity increases from 4 million units per year to 6 million units per year

FIGURE **2.11**
Problem 25b and 25c

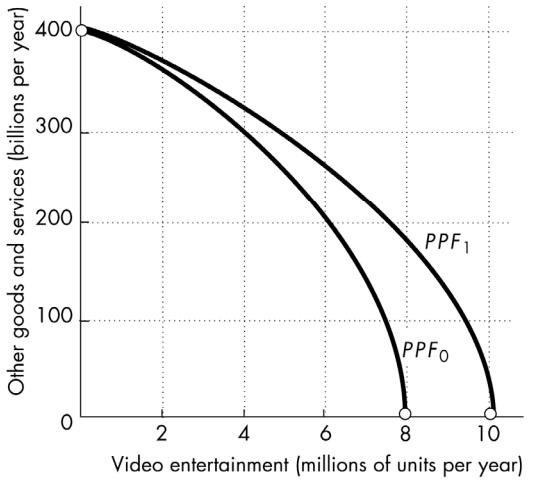
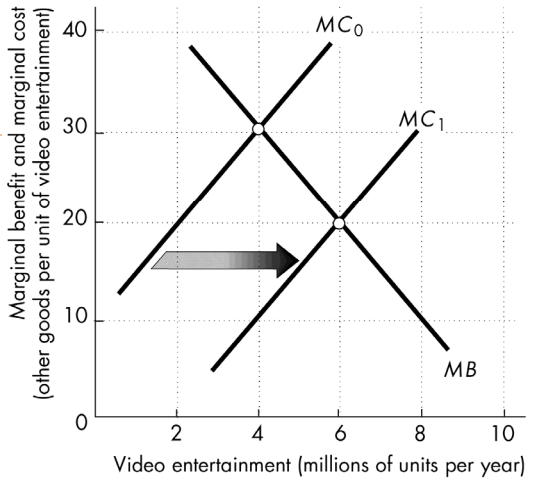


FIGURE **2.12**
Problem 25d



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