

# First Principles

1. In each of the following situations, identify which of the twelve principles is at work.
  - a. You choose to shop at the local discount store rather than paying a higher price for the same merchandise at the local department store.
  - b. On your spring break trip, your budget is limited to \$35 a day.
  - c. The student union provides a website on which departing students can sell items such as used books, appliances, and furniture rather than giving them away to their roommates as they formerly did.
  - d. After a hurricane did extensive damage to homes on the island of St. Crispin, homeowners wanted to purchase many more building materials and hire many more workers than were available on the island. As a result, prices for goods and services rose dramatically across the board.
  - e. You buy a used textbook from your roommate. Your roommate uses the money to buy songs from iTunes.
  - f. You decide how many cups of coffee to have when studying the night before an exam by considering how much more work you can do by having another cup versus how jittery it will make you feel.
  - g. There is limited lab space available to do the project required in Chemistry 101. The lab supervisor assigns lab time to each student based on when that student is able to come.
  - h. You realize that you can graduate a semester early by forgoing a semester of study abroad.
  - i. At the student union, there is a bulletin board on which people advertise used items for sale, such as bicycles. Once you have adjusted for differences in quality, all the bikes sell for about the same price.
  - j. You are better at performing lab experiments, and your lab partner is better at writing lab reports. So the two of you agree that you will do all the experiments, and she will write up all the reports.
  - k. State governments mandate that it is illegal to drive without passing a driving exam.
  - l. Your parents' after-tax income has increased because of a tax cut passed by Congress. They therefore increase your allowance, which you spend on a spring break vacation.

## Solution

1.
  - a. People usually exploit opportunities to make themselves better off. In this case, you make yourself better off by buying merchandise at a lower price.
  - b. Resources are scarce. Since you have only \$35 a day, your resources are limited (scarce).
  - c. Markets usually lead to efficiency. The market here is represented by the buyers and sellers who use the student union website to trade goods, in contrast to the “nonmarket” of simply giving items away to one’s roommate. The market is efficient because it enables people who want to sell items to find those who want to buy those items. This is in contrast to a system in which items are simply left with a roommate, who may have little or no desire to have them.

- d. Overall spending sometimes gets out of line with the economy's productive capacity. The spending by St. Crispin homeowners on building materials and workers fell short of the economy's ability to produce those goods and services. As a result, prices on the island rose across the board (inflation).
  - e. One person's spending is another person's income. Your spending on the used textbook is your roommate's income.
  - f. "How much" is a decision at the margin. Your decision is one of "how much" coffee to consume, and you evaluate the trade-off between keeping yourself awake and becoming more jittery from one more cup of coffee.
  - g. Resources should be used as efficiently as possible to achieve society's goals. Allocating scarce lab space according to when each student can use that space is efficient.
  - h. The real cost of something is what you must give up to get it. The real cost of a semester abroad is giving up the opportunity to graduate early.
  - i. Markets move toward equilibrium. Any bicycle a buyer chooses will leave him or her equally well off. That is, a buyer who chooses a particular bicycle cannot change actions and find another bicycle that makes him or her better off. Also, no seller can take a different action that makes him or her better off: no seller can charge a higher price for a bicycle of similar quality, since no one would buy that bicycle.
  - j. There are gains from trade. If each person specializes in what he or she is good at (that is, in comparison with others that person has an advantage in producing that good), then there will be gains from specialization and trade.
  - k. When markets don't achieve efficiency, government intervention can improve society's welfare. Unsafe drivers don't take into account the dangers they pose to others and often to themselves. So when unsafe drivers are allowed to drive, everyone is made worse off. Government intervention improves society's welfare by assuring a minimum level of competence in driving.
  - l. Government policies can change spending. In this case, a tax cut has increased spending.
2. Describe some of the opportunity costs when you decide to do the following.
- a. Attend college instead of taking a job
  - b. Watch a movie instead of studying for an exam
  - c. Ride the bus instead of driving your car

## Solution

2. a. One of the opportunity costs of going to college is not being able to take a job. By choosing to go to college, you give up the income you would have earned on the job and the valuable on-the-job experience you would have acquired. Another opportunity cost of going to college is the cost of tuition, books, supplies, and so on. Alternatively, the benefit of going to college is being able to find a better, more highly paid job after graduation in addition to the joy of learning.
- b. Watching the movie gives you a certain benefit, but allocating your time (a scarce resource) to watching the movie also involves the opportunity cost of not being able to study for the exam. As a result, you will likely get a lower grade on the exam—and all that that implies.
- c. Riding the bus gets you where you need to go more cheaply than, but probably not as conveniently as, driving your car. That is, some of the opportunity costs of taking the bus involve waiting for the bus, having to walk from the bus stop to where you need to go rather than parking right outside the building, and probably a slower journey. If the opportunity cost of your time is high (your time is valuable), these costs may be prohibitive.

3. Liza needs to buy a textbook for the next economics class. The price at the college bookstore is \$65. One online site offers it for \$55 and another site, for \$57. All prices include sales tax. The accompanying table indicates the typical shipping and handling charges for the textbook ordered online.

Shipping method	Delivery time	Charge
Standard shipping	3–7 days	\$3.99
Second-day air	2 business days	8.98
Next-day air	1 business day	13.98

- a. What is the opportunity cost of buying online instead of at the bookstore? Note that if you buy the book online, you must wait to get it.
- b. Show the relevant choices for this student. What determines which of these options the student will choose?

### Solution

3. a. The opportunity cost of buying online is whatever you must give up to get the book online. So the opportunity cost of buying online is the sum of the shipping charges plus the opportunity cost of your time spent waiting for the book to arrive (at the bookstore the book is available immediately) minus the cost saving you receive by buying online versus buying at the bookstore.

- b. Below is a list of all of Liza's options and their purely monetary costs:

Buy from bookstore	\$65
Buy from first site (price \$55), 1-day delivery	$\$55 + \$13.98 = \$68.98$
Buy from first site (price \$55), 2-day delivery	$\$55 + \$ 8.98 = \$63.98$
Buy from first site (price \$55), 3- to 7-day delivery	$\$55 + \$ 3.99 = \$58.99$
Buy from second site (price \$57), 1-day delivery	$\$57 + \$13.98 = \$70.98$
Buy from second site (price \$57), 2-day delivery	$\$57 + \$ 8.98 = \$65.98$
Buy from second site (price \$57), 3- to 7-day delivery	$\$57 + \$ 3.99 = \$60.99$

It is clear that Liza would never buy from the second site, where the book costs \$57: for each delivery time, she is better off buying the book from the first site, where the book costs \$55. It is also clear that she would never buy the book from the first site and have it delivered the next business day: it costs more that way (\$68.98) than getting it from the bookstore (assuming that it is costless to get to and from the bookstore). But it is not clear whether she will buy the book from the bookstore or the first site with delivery times of 2 or 3–7 days: this depends on her opportunity cost of time. The higher the cost of waiting, the more likely she is to buy the book from the bookstore, where she does not need to wait.

4. Use the concept of opportunity cost to explain the following.
- a. More people choose to get graduate degrees when the job market is poor.
- b. More people choose to do their own home repairs when the economy is slow and hourly wages are down.
- c. There are more parks in suburban than in urban areas.
- d. Convenience stores, which have higher prices than supermarkets, cater to busy people.
- e. Fewer students enroll in classes that meet before 10:00 A.M.

## Solution

4. a. The worse the job market, the lower the opportunity cost of getting a graduate degree. One of the opportunity costs of going to graduate school is not being able to work. But if the job market is bad, the salary you can expect to earn is low or you might be unemployed—so the opportunity cost of going to school is also low.
- b. When the economy is slow, the opportunity cost of people's time is also lower: the wages they could earn by working longer hours are lower than when the economy is booming. As a result, the opportunity cost of spending time doing your own repairs is lower—so more people will decide to do their own repairs.
- c. The opportunity cost of parkland is lower in suburban areas. The price per square foot of land is much higher in urban than in suburban areas. By creating parkland, you therefore give up the opportunity to make much more money in cities than in the suburbs.
- d. The opportunity cost of time is higher for busy people. Driving long distances to supermarkets takes time that could be spent doing other things. Therefore, busy people are more likely to use a nearby convenience store.
- e. Before 10:00 A.M. the opportunity cost of time for many students is very high—it means giving up an extra hour's sleep. That extra hour is much more valuable before 10:00 A.M. than later in the day.
5. In the following examples, state how you would use the principle of marginal analysis to make a decision.
- Deciding how many days to wait before doing your laundry
  - Deciding how much library research to do before writing your term paper
  - Deciding how many bags of chips to eat
  - Deciding how many lectures of a class to skip

## Solution

5. a. Each day that you wait to do your laundry imposes a cost: you have fewer clean clothes to choose from. But each day that you wait also confers a benefit: you can spend your time doing other things. You will wait another day to do your laundry if the benefit of waiting to do the laundry that day is greater than the cost.
- b. The more research you do, the better your paper will be. But there is also an opportunity cost: every additional hour you spend doing research means you cannot do other things. You will weigh the opportunity cost of doing one more hour of research against the benefit gained (in terms of an improved paper) from doing research. You will do one more hour of research if the benefit of that hour outweighs the cost.
- c. Each bag of chips you eat gives you a benefit: it satisfies your hunger. But it also has a cost: the money spent for each bag (and, if you are weight-conscious, the additional calories). You will weigh the cost against the benefit of eating one more bag. If the cost is less than the benefit, you will eat that one more bag of chips.
- d. Each lecture that you skip implies a cost: getting further behind with the material and having to teach it to yourself just before the exam. But each skipped lecture also means you can spend the time doing other things. You will continue to skip lectures if the cost of skipping is lower than the benefit of spending that time doing other things.
6. This morning you made the following individual choices: you bought a bagel and coffee at the local café, you drove to school in your car during rush hour, and you typed your roommate's term paper because you are a fast typist—in return for which she will do your laundry for a month. For each of these actions, describe how your individual choices interacted with the individual choices made by others. Were other people left better off or worse off by your choices in each case?

## Solution

6. When you bought the bagel and coffee, you paid a price for them. You would not have bought that breakfast if your enjoyment of it (your welfare) had not been greater than the price you paid. Similarly, the café owner would not have sold you the bagel and coffee if the price he received from you were less than the cost to him of making them. This is an example of how everybody gains from trade: both you and the café owner are better off.

When you chose to drive your car during the rush hour, you added to the congestion on the road. Your choice had a side effect for other motorists: your driving slowed everybody else down just a little bit more. Your choice made other motorists worse off.

Typing your roommate's term paper in exchange for her doing your laundry is another example of the gains that come from trade. Both of you voluntarily agreed to specialize in a task that each is comparatively better at because you expected to gain from this interaction. Your choice made both you and your roommate better off.

7. The Hatfield family lives on the east side of the Hatatoochie River, and the McCoy family lives on the west side. Each family's diet consists of fried chicken and corn-on-the-cob, and each is self-sufficient, raising their own chickens and growing their own corn. Explain the conditions under which each of the following would be true.
- The two families are made better off when the Hatfields specialize in raising chickens, the McCoys specialize in growing corn, and the two families trade.
  - The two families are made better off when the McCoys specialize in raising chickens, the Hatfields specialize in growing corn, and the two families trade.

## Solution

7. a. Gains from trade usually arise from specialization. If the Hatfields (compared to the McCoys) are better at raising chickens and the McCoys (compared to the Hatfields) are better at growing corn, then there will be gains from specialization and trade.
- b. Similar to the answer to part a, if the McCoys (compared to the Hatfields) are better at raising chickens and the Hatfields (compared to the McCoys) are better at growing corn, then there will be gains from specialization and trade.
8. Which of the following situations describes an equilibrium? Which does not? If the situation does not describe an equilibrium, what would an equilibrium look like?
- Many people regularly commute from the suburbs to downtown Pleasantville. Due to traffic congestion, the trip takes 30 minutes when you travel by highway but only 15 minutes when you go by side streets.
  - At the intersection of Main and Broadway are two gas stations. One station charges \$3.00 per gallon for regular gas and the other charges \$2.85 per gallon. Customers can get service immediately at the first station but must wait in a long line at the second.
  - Every student enrolled in Economics 101 must also attend a weekly tutorial. This year there are two sections offered: section A and section B, which meet at the same time in adjoining classrooms and are taught by equally competent instructors. Section A is overcrowded, with people sitting on the floor and often unable to see what is written on the board at the front of the room. Section B has many empty seats.

## Solution

8. a. This is not an equilibrium. Assume that all people care about is the travel time to work (not, for instance, how many turns they need to make or what the scenery is like). Some people could be better off using the side streets, which would cut down their travel time. Eventually, as the situation moves to equilibrium (that is, as more people use the side streets), travel times on the highway and along the side streets will equalize.

- b. This might be an equilibrium. Those who buy gas at the first station would be worse off by buying gas at the second if the value of their time spent waiting exceeded the savings at the pump: they would save 15 cents per gallon but would incur the opportunity cost of waiting in a long line. You should expect very busy people (a high opportunity cost of time) to buy gas at the first station. Those who buy gas at the second station might be worse off by buying gas at the first: they would not have to wait in line but would pay 15 cents more per gallon. You should expect people with a lot of free time (a low opportunity cost of time) to buy gas at the second station.
  - c. This is not an equilibrium. If students from section A attended section B instead, they would be better off: they could get seats and see the board without incurring any cost (since the section meets at the same time and is taught by an equally competent instructor). Over time, you should expect students to switch from section A to section B until equilibrium is established.
9. In each of the following cases, explain whether you think the situation is efficient or not. If it is not efficient, why not? What actions would make the situation efficient?
- a. Electricity is included in the rent at your dorm. Some residents in your dorm leave lights, computers, and appliances on when they are not in their rooms.
  - b. Although they cost the same amount to prepare, the cafeteria in your dorm consistently provides too many dishes that diners don't like, such as tofu casserole, and too few dishes that diners do like, such as roast turkey with dressing.
  - c. The enrollment for a particular course exceeds the spaces available. Some students who need to take this course to complete their major are unable to get a space even though others who are taking it as an elective do get a space.

## Solution

9. a. This is not efficient. If the lights were turned off, some students could be made better off without making other students worse off because the college would save money on electricity that it could spend on student programs. By leaving lights and appliances on when leaving their rooms, residents do not take into account the negative side effect they impose on their college—the higher cost of electricity. If students were forced to pay their own individual electricity costs (that is, if they fully took into account the cost of their actions), then they would turn the lights and appliances off when leaving their rooms. This situation would be efficient.
- b. This is not efficient. Instead of serving dishes that many diners do not like, the cafeteria should serve more of the equal-cost dishes that diners do like. That way, some students could be made better off without other students being made worse off.
- c. This is not efficient. In an efficient scheme, spaces would be allocated to those students who value them most. In this case, however, some spaces are allocated to students who value them less (those who take the course as an elective) than other students (those who need the course to graduate). Efficiency could be improved as follows: if a student who is not currently enrolled in the course values it more than a student who is enrolled, then the unenrolled student should be willing to pay the enrolled student to give up his or her space. At some price, this trade would make both students better off and the outcome would be efficient.
10. Discuss the efficiency and equity implications of each of the following policies. How would you go about balancing the concerns of equity and efficiency in these areas?
- a. The government pays the full tuition for every college student to study whatever subject he or she wishes.
  - b. When people lose their jobs, the government provides unemployment benefits until they find new ones.

## Solution

- 10.**
- a. Although this policy is equitable, it may not be efficient, depending on the beneficial side effects of education. It does allow everyone, regardless of ability to pay, to attend college. But it may not be efficient: subsidizing the full cost of tuition for everyone lowers the opportunity cost of going to college, and this might lead some people to go to college when they could more productively follow a career that does not require a college education. And since resources (including government money) are scarce, paying tuition for these people has an opportunity cost: some other (possibly more worthwhile) government projects cannot be undertaken. One way of getting around this problem is to award scholarships based on academic ability.
  - b. Although this policy may be equitable (it guarantees everyone a certain amount of income), it may not be efficient. People respond to incentives. If unemployment becomes more attractive because of the unemployment benefit, some unemployed people may no longer try to find a job or may not try to find one as quickly as they would without the benefit. Ways to get around this problem are to provide unemployment benefits only for a limited time or to require recipients to prove that they are actively searching for a new job.
- 11.** Governments often adopt certain policies in order to promote desired behavior among their citizens. For each of the following policies, determine what the incentive is and what behavior the government wishes to promote. In each case, why do you think that the government might wish to change people's behavior, rather than allow their actions to be solely determined by individual choice?
- a. A tax of \$5 per pack is imposed on cigarettes.
  - b. The government pays parents \$100 when their child is vaccinated for measles.
  - c. The government pays college students to tutor children from low-income families.
  - d. The government imposes a tax on the amount of air pollution that a company discharges.

## Solution

- 11.**
- a. This policy creates an incentive to smoke less by making a pack of cigarettes more costly. This is exactly what policy makers wish to promote. Cigarettes have undesirable side effects on other people, which smokers do not (or only insufficiently) take into account. One is that other people have to breathe in second-hand smoke. Another is the cost of health care: when smokers who need treatment for lung cancer are covered by Medicare or Medicaid, the rest of society has to foot the bill. Since individuals do not take these costs (costs that arise for other people) into account in deciding whether or not (or how much) to smoke, the amount of cigarettes smoked will be inefficiently high. The tax is a way to make people take these costs into account in deciding whether or not to smoke.
  - b. This policy creates an incentive to have children vaccinated: it increases the benefit to parents from vaccination of their children. Getting vaccinated means not only that a child will not contract the measles but also that he or she cannot pass the measles on to other children. That is, there is a side effect for other people (their children get sick less often) that parents do not take into account in their decision of whether or not to have their own child vaccinated. The subsidy is a way to make individuals take into account in their decisions the benefit they can create for other people.
  - c. This policy creates incentives for low-income families to get college students to tutor their children, since getting a tutor is now cheaper or free. This results in better performance in school by these children and higher levels of educational attainment. This has positive side effects for the rest of society: the better children do in school, the more productive, happier, and healthier citizens they will be.

- d. This tax creates the incentive to emit fewer air pollutants. Pollution has a negative side effect for others: it decreases air quality (for instance, it contributes to the formation of ozone smog) and results in a variety of health complications (for instance, asthma). In deciding how much pollution to discharge, a company does not take these negative side effects sufficiently into account. The tax is a way to make pollution more expensive, that is, to make the company face the cost it imposes on others.
- 12.** In each of the following situations, explain how government intervention could improve society's welfare by changing people's incentives. In what sense is the market going wrong?
- Pollution from auto emissions has reached unhealthy levels.
  - Everyone in Woodville would be better off if streetlights were installed in the town. But no individual resident is willing to pay for installation of a streetlight in front of his or her house because it is impossible to recoup the cost by charging other residents for the benefit they receive from it.

### Solution

- 12.** a. In deciding how much to drive, each driver does not take into account the cost of auto emissions he or she imposes on others. That is, the market will lead to there being too much pollution. One way for governments to intervene would be to tax fuel or to tax cars that get low gas mileage. Or governments could subsidize new and cleaner fuels or technologies, such as hybrid cars. This would create incentives for people to switch to cars that use less polluting gas or to drive less.
- b. The market in this situation leads to too few (or no) streetlights in Woodville. Governments could improve residents' welfare by paying for streetlight installation from the taxes paid by residents.
- 13.** In 2010, Tim Geithner, Treasury secretary at the time, published an article defending the administration's policies. "The recession that began in late 2007 was extraordinarily severe," he declared, "but the actions we took at its height to stimulate the economy helped arrest the freefall, preventing an even deeper collapse and putting the economy on the road to recovery. Which two of the three principles of economy-wide interaction are at work in this statement?"

### Solution

- 13.** The Obama stimulus is an example of government policy aimed at changing spending: by cutting taxes and also by directly increasing government spending, the package sought to boost overall spending in the economy. And as spending rises, firms increase production. This is an example of the principle that one person's spending is another person's income.
- 14.** In August 2007, a sharp downturn in the U.S. housing market reduced the income of many who worked in the home construction industry. A *Wall Street Journal* news article reported that Walmart's wire-transfer business was likely to suffer because many construction workers are Hispanics who regularly send part of their wages back to relatives in their home countries via Walmart. With this information, use one of the principles of economy-wide interaction to trace a chain of links that explains how reduced spending for U.S. home purchases is likely to affect the performance of the Mexican economy.



- 14.** The correct principle in this case is that one person's spending is another person's income. Here, a reduction in spending for U.S. home purchases leads to a fall in the income of workers in the home construction industry. This, in turn, leads to a reduction in funds sent by workers to relatives in Mexico, which leads to a reduction in spending by Mexican households. This, in turn, leads to less business for Mexican firms and job losses in Mexico. Ultimately, the Mexican economy is likely to be adversely affected by the downturn in the U.S. housing market.
- 15.** In 2012, Hurricane Sandy caused massive destruction to the northeast United States. Tens of thousands of people lost their homes and possessions. Even those who weren't directly affected by the destruction were hurt because businesses and jobs dried up. Using one of the principles of economy-wide interaction, explain how government intervention can help in this situation.

- 15.** The destruction caused by Hurricane Sandy caused a reduction in spending by residents in the area. This, in turn, led to reduced income as businesses failed or contracted and employment suffered. The government can help remedy the situation by spending more in the area—say, by employing people for cleanup and construction—to counterbalance the reduced spending by private residents. This is an example of the principle that government policies can change spending.
- 16.** During the Great Depression, food was left to rot in the fields or fields that had once been actively cultivated were left fallow. Use one of the principles of economy-wide interaction to explain how this could have occurred.

- 16.** During the Great Depression, spending fell far short of the country's capacity to produce. This reflects the principle that overall spending sometimes gets out of line with the economy's productive capacity. As a result of the plunge in spending during the Great Depression, farmers could not find enough buyers for food that had already been produced, so it was left to rot. Likewise, some farmers left their fields fallow.

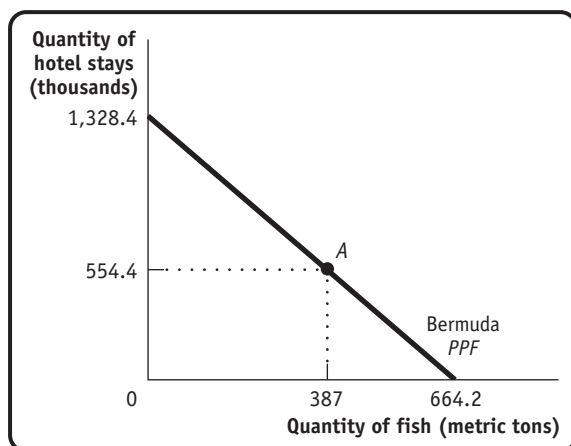


# Economic Models: Trade-offs and Trade

- 1.** Two important industries on the island of Bermuda are fishing and tourism. According to data from the Food and Agriculture Organization of the United Nations and the Bermuda Department of Statistics, in 2009 the 306 registered fishermen in Bermuda caught 387 metric tons of marine fish. And the 2,719 people employed by hotels produced 554,400 hotel stays (measured by the number of visitor arrivals). Suppose that this production point is efficient in production. Assume also that the opportunity cost of 1 additional metric ton of fish is 2,000 hotel stays and that this opportunity cost is constant (the opportunity cost does not change).
- If all 306 registered fishermen were to be employed by hotels (in addition to the 2,719 people already working in hotels), how many hotel stays could Bermuda produce?
  - If all 2,719 hotel employees were to become fishermen (in addition to the 306 fishermen already working in the fishing industry), how many metric tons of fish could Bermuda produce?
  - Draw a production possibility frontier for Bermuda, with fish on the horizontal axis and hotel stays on the vertical axis, and label Bermuda's actual production point for the year 2009.

## Solution

- 1. a.** Forgoing the production of 1 metric ton of fish allows Bermuda to produce 2,000 additional hotel stays. Therefore, forgoing the production of 387 metric tons of fish allows Bermuda to produce  $2,000 \times 387 = 774,000$  additional hotel stays. If all fishermen worked in the hotel industry, Bermuda could produce  $554,000 + 774,000 = 1,328,400$  hotel stays.
- b.** Forgoing the production of 2,000 hotel stays allows Bermuda to produce 1 additional metric ton of fish, so giving up 554,400 hotel stays allows Bermuda to produce  $554,400/2,000 = 277.2$  additional metric tons of fish. If all hotel employees worked in the fishing industry, Bermuda could produce  $387 + 277.2 = 664.2$  metric tons of fish.
- c.** The accompanying diagram shows the production possibility frontier for Bermuda. Note that it is a straight line because the opportunity cost is constant. Point A is Bermuda's actual production point.



- 2.** According to data from the U.S. Department of Agriculture's National Agricultural Statistics Service, 124 million acres of land in the United States were used for wheat or corn farming in a recent year. Of those 124 million acres, farmers used 50 million acres to grow 2.158 billion bushels of wheat and 74 million acres to grow 11.807 billion bushels of corn. Suppose that U.S. wheat and corn farming is efficient in production. At that production point, the opportunity cost of producing 1 additional bushel of wheat is 1.7 fewer bushels of corn. However, because farmers have increasing opportunity costs, additional bushels of wheat have an opportunity cost greater than 1.7 bushels of corn. For each of the following production points, decide whether that production point is (i) feasible and efficient in production, (ii) feasible but not efficient in production, (iii) not feasible, or (iv) unclear as to whether or not it is feasible.
- Farmers use 40 million acres of land to produce 1.8 billion bushels of wheat, and they use 60 million acres of land to produce 9 billion bushels of corn. The remaining 24 million acres are left unused.
  - From their original production point, farmers transfer 40 million acres of land from corn to wheat production. They now produce 3.158 billion bushels of wheat and 10.107 bushels of corn.
  - Farmers reduce their production of wheat to 2 billion bushels and increase their production of corn to 12.044 billion bushels. Along the production possibility frontier, the opportunity cost of going from 11.807 billion bushels of corn to 12.044 billion bushels of corn is 0.666 bushel of wheat per bushel of corn.

## Solution

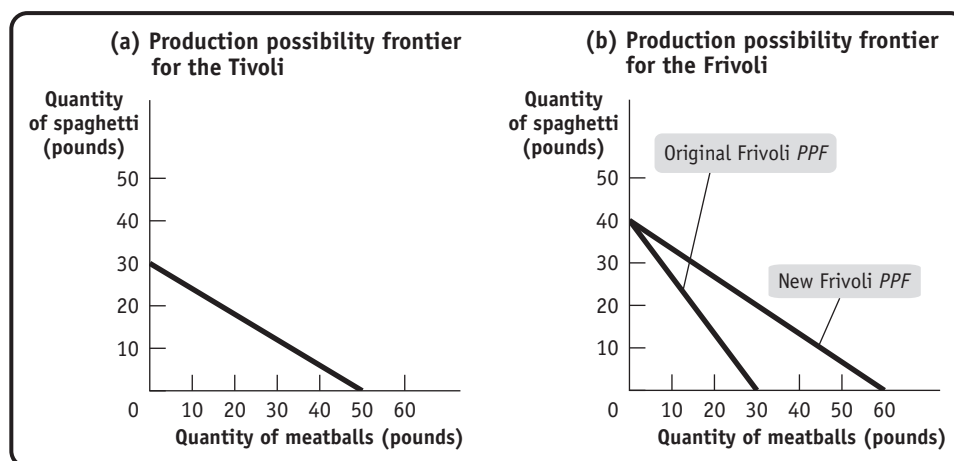
- 2.**
- This point is feasible but not efficient in production. Producing 1.8 billion bushels of wheat and 9 billion bushels of corn is less of both wheat and corn than is possible. They could produce more if all the available farmland were cultivated.
  - At this new production point, farmers would now produce 1 billion more bushels of wheat and 1.7 billion fewer bushels of corn than at their original production point. This reflects an opportunity cost of 1.7 bushels of corn per additional bushel of wheat. But, in fact, this new production point is not feasible because we know that opportunity costs are increasing. Starting from the original production point, the opportunity cost of producing 1 more bushel of wheat must be higher than 1.7 bushels of corn.
  - This new production point is feasible and efficient in production. Along the production possibility frontier, the economy must forgo 0.666 bushel of wheat per additional bushel of corn. So the increase in corn production from 11.807 billion bushels to 12.044 billion bushels costs the economy  $(12.044 - 11.807)$  billion bushels of corn  $\times$  0.666 bushel of wheat per bushel of corn = 0.158 bushel of wheat. This is exactly equal to the actual loss in wheat output: the fall from 2.158 billion to 2 billion bushels of wheat.
- 3.** In the ancient country of Roma, only two goods, spaghetti and meatballs, are produced. There are two tribes in Roma, the Tivoli and the Frivoli. By themselves, the Tivoli each month can produce either 30 pounds of spaghetti and no meatballs, or 50 pounds of meatballs and no spaghetti, or any combination in between. The Frivoli, by themselves, each month can produce 40 pounds of spaghetti and no meatballs, or 30 pounds of meatballs and no spaghetti, or any combination in between.
- Assume that all production possibility frontiers are straight lines. Draw one diagram showing the monthly production possibility frontier for the Tivoli and another showing the monthly production possibility frontier for the Frivoli. Show how you calculated them.
  - Which tribe has the comparative advantage in spaghetti production? In meatball production?

In A.D. 100 the Frivoli discover a new technique for making meatballs that doubles the quantity of meatballs they can produce each month.

- c. Draw the new monthly production possibility frontier for the Frivoli.
- d. After the innovation, which tribe now has an absolute advantage in producing meatballs? In producing spaghetti? Which has the comparative advantage in meatball production? In spaghetti production?

## Solution

3. a. The accompanying diagram shows the production possibility frontier for the Tivoli in panel (a) and for the Frivoli as the line labeled “Original Frivoli PPF” in panel (b).



The production possibility frontier for the Tivoli was calculated as follows: the Tivoli can produce either 30 pounds of spaghetti and no meatballs, or they can produce no spaghetti but 50 pounds of meatballs. That is, the opportunity cost of 1 pound of meatballs is  $\frac{3}{5}$  of a pound of spaghetti: in order to produce 1 more pound of meatballs, the Tivoli have to give up  $\frac{3}{5}$  of a pound of spaghetti. This means that the slope of their production possibility frontier is  $-\frac{3}{5}$ . A similar argument for the Frivoli shows that their production possibility frontier has a slope of  $-\frac{4}{3}$ .

- b. For the Tivoli, the opportunity cost of 1 pound of meatballs is  $\frac{3}{5}$  of a pound of spaghetti. For the Frivoli, the opportunity cost of 1 pound of meatballs is  $\frac{4}{3}$  pounds of spaghetti. That is, the Tivoli have a comparative advantage in meatball production because their opportunity cost is lower. For the Tivoli, the opportunity cost of 1 pound of spaghetti is  $\frac{5}{3}$  pounds of meatballs. For the Frivoli, the opportunity cost of 1 pound of spaghetti is  $\frac{3}{4}$  pound of meatballs. That is, the Frivoli have a comparative advantage in spaghetti production because their opportunity cost is lower.
- c. The Frivoli's new production possibility frontier is the line labeled “New Frivoli PPF” in panel (b) of the diagram. Instead of producing 30 pounds of meatballs (if they produce no spaghetti), they can now produce 60 pounds.
- d. Now the Frivoli have the absolute advantage in both meatball production and spaghetti production. The Frivoli's opportunity cost of meatballs has now fallen to  $\frac{4}{6} = \frac{2}{3}$ ; that is, for each pound of meatballs that the Frivoli now produce, they have to give up producing  $\frac{2}{3}$  of a pound of spaghetti. Since the Frivoli's opportunity cost of meatballs ( $\frac{2}{3}$ ) is still higher than the Tivoli's ( $\frac{3}{5}$ ), the Tivoli still have the comparative advantage in meatball production. The Frivoli's opportunity cost of spaghetti is  $\frac{3}{2}$  pounds of meatballs and the Tivoli's is  $\frac{5}{3}$  pounds of meatballs, so the Frivoli have the comparative advantage in spaghetti production.

4. One July, the United States exported aircraft worth \$1 billion to China and imported aircraft worth only \$19,000 from China. During the same month, however, the United States imported \$83 million worth of men's trousers, slacks, and jeans from China but exported only \$8,000 worth of trousers, slacks, and jeans to China. Using what you have learned about how trade is determined by comparative advantage, answer the following questions.
- Which country has the comparative advantage in aircraft production? In production of trousers, slacks, and jeans?
  - Can you determine which country has the absolute advantage in aircraft production? In production of trousers, slacks, and jeans?

### Solution

4. a. Since countries gain from specializing in production of the goods and services in which they have a comparative advantage, the United States must have the comparative advantage in aircraft production, and China must have the comparative advantage in production of trousers, slacks, and jeans.
- b. Since trade has nothing to do with absolute advantage, we cannot determine from these data which country has an absolute advantage in either of these goods.
5. Peter Pundit, an economics reporter, states that the European Union (EU) is increasing its productivity very rapidly in all industries. He claims that this productivity advance is so rapid that output from the EU in these industries will soon exceed that of the United States and, as a result, the United States will no longer benefit from trade with the EU.
- Do you think Peter Pundit is correct or not? If not, what do you think is the source of his mistake?
  - If the EU and the United States continue to trade, what do you think will characterize the goods that the EU exports to the United States and the goods that the United States exports to the EU?

### Solution

5. a. Peter Pundit is not correct. He confuses absolute and comparative advantage. Even if the EU had an absolute advantage over the United States in every product it produced, the United States would still have a comparative advantage in some products. And the United States should continue to produce those products: trade will make both the EU and the United States better off.
- b. You should expect to see the EU export those goods in which it has the comparative advantage and the United States export those goods in which it has the comparative advantage.
6. You are in charge of allocating residents to your dormitory's baseball and basketball teams. You are down to the last four people, two of whom must be allocated to baseball and two to basketball. The accompanying table gives each person's batting average and free-throw average.

Name	Batting average	Free-throw average
Kelley	70%	60%
Jackie	50%	50%
Curt	10%	30%
Gerry	80%	70%

- Explain how you would use the concept of comparative advantage to allocate the players. Begin by establishing each player's opportunity cost of free throws in terms of batting average.

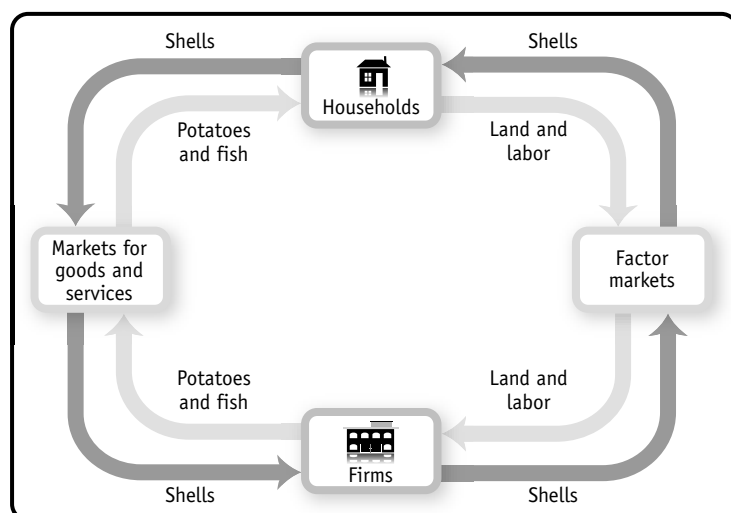
- b. Why is it likely that the other basketball players will be unhappy about this arrangement but the other baseball players will be satisfied? Nonetheless, why would an economist say that this is an efficient way to allocate players for your dormitory's sports teams?

## Solution

6. a. Let's begin by establishing the opportunity cost of free throws for each player. If you allocate Kelley to the basketball team, the team gains a player with a 60% free-throw average and the baseball team loses a player with a 70% batting average. That is, the opportunity cost of allocating Kelley to the basketball team is  $\frac{7}{6}$ . Similarly, Jackie's opportunity cost of playing basketball is 1; Curt's opportunity cost of playing basketball is  $\frac{1}{3}$ , and Gerry's opportunity cost of playing basketball is  $\frac{8}{7}$ . Jackie and Curt have the lowest opportunity costs of playing basketball; that is, they have the comparative advantage in basketball. Therefore, they should be allocated to the basketball team. Kelley and Gerry have the comparative advantage in baseball and should therefore play on the baseball team.
- b. It is likely that the basketball team will be unhappy with this arrangement. Both Jackie and Curt have an absolute disadvantage at playing basketball, compared to the other two players. (They also have an absolute disadvantage at playing baseball, but they are comparatively less bad at basketball than at baseball.) The baseball team is likely to be happy about this allocation because both Kelley and Gerry have an absolute advantage at playing baseball. However, if you are concerned with the total number of wins for the dormitory (as an economist would be concerned about efficiency), this allocation is the best one: it maximizes the overall chances of the dormitory winning at any sport.
7. The inhabitants of the fictional economy of Atlantis use money in the form of cowry shells. Draw a circular-flow diagram showing households and firms. Firms produce potatoes and fish, and households buy potatoes and fish. Households also provide the land and labor to firms. Identify where in the flows of cowry shells or physical things (goods and services, or resources) each of the following impacts would occur. Describe how this impact spreads around the circle.
- a. A devastating hurricane floods many of the potato fields.
- b. A very productive fishing season yields a very large number of fish caught.
- c. The inhabitants of Atlantis discover Shakira and spend several days a month at dancing festivals.

## Solution

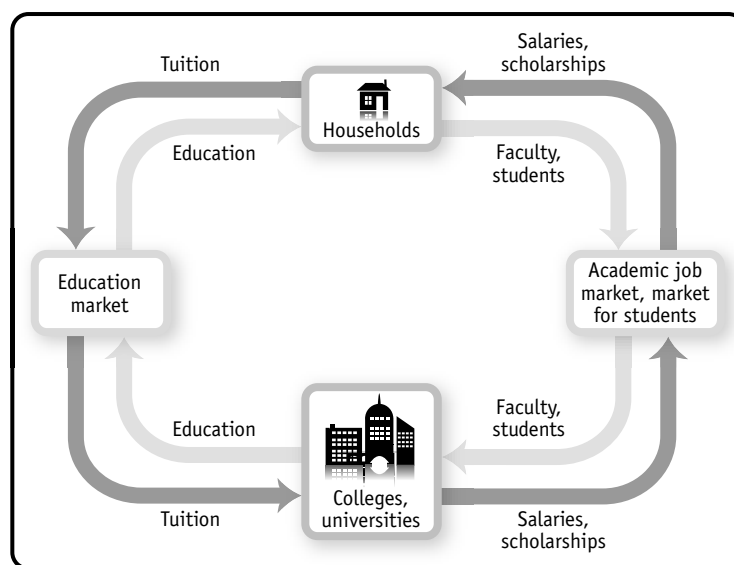
7. The accompanying diagram illustrates the circular flow for Atlantis.



- a. The flooding of the fields will destroy the potato crop. Destruction of the potato crop reduces the flow of goods from firms to households: fewer potatoes produced by firms now are sold to households. An implication, of course, is that fewer cowry shells flow from households to firms as payment for the potatoes in the market for goods and services. Since firms now earn fewer shells, they have fewer shells to pay to households in the factor markets. As a result, the amount of factors flowing from households to firms is also reduced.
  - b. The productive fishing season leads to a greater quantity of fish produced by firms to flow to households. An implication is that more money flows from households to firms through the markets for goods and services. As a result, firms want to buy more factors from households (the flow of shells from firms to households increases) and, in return, the flow of factors from households to firms increases.
  - c. Time spent at dancing festivals reduces the flow of labor from households to firms and therefore reduces the number of shells flowing from firms to households through the factor markets. In return, households now have fewer shells to buy goods with (the flow of shells from households to firms in the markets for goods and services is reduced), implying that fewer goods flow from firms to households.
8. An economist might say that colleges and universities “produce” education, using faculty members and students as inputs. According to this line of reasoning, education is then “consumed” by households. Construct a circular-flow diagram to represent the sector of the economy devoted to college education: colleges and universities represent firms, and households both consume education and provide faculty and students to universities. What are the relevant markets in this diagram? What is being bought and sold in each direction? What would happen in the diagram if the government decided to subsidize 50% of all college students’ tuition?

### Solution

8. The accompanying diagram shows the circular flow for the education sector.



Colleges and universities buy faculty on the academic job market and attract students from the market for students. (Many colleges and universities actively try to attract good students by offering scholarships and the like.) They sell education to households in the market for education, and households buy education in that market from one (or sometimes several) of the sellers.



If the government subsidized half of all students' tuition, households would demand more education. As a result, colleges and universities would hire more faculty and accept more students, meaning that more money in terms of salaries and scholarships would flow from universities and colleges to the households.

9. Your dormitory roommate plays loud music most of the time; you, however, would prefer more peace and quiet. You suggest that she buy some earphones. She responds that although she would be happy to use earphones, she has many other things that she would prefer to spend her money on right now. You discuss this situation with a friend who is an economics major. The following exchange takes place:
- He: How much would it cost to buy earphones?*  
*You: \$15.*  
*He: How much do you value having some peace and quiet for the rest of the semester?*  
*You: \$30.*  
*He: It is efficient for you to buy the earphones and give them to your roommate. You gain more than you lose; the benefit exceeds the cost. You should do that.*  
*You: It just isn't fair that I have to pay for the earphones when I'm not the one making the noise.*
- Which parts of this conversation contain positive statements and which parts contain normative statements?
  - Construct an argument supporting your viewpoint that your roommate should be the one to change her behavior. Similarly, construct an argument from the viewpoint of your roommate that you should be the one to buy the earphones. If your dormitory has a policy that gives residents the unlimited right to play music, whose argument is likely to win? If your dormitory has a rule that a person must stop playing music whenever a roommate complains, whose argument is likely to win?

## Solution

9. a. "It is efficient for you to buy the earphones" is a positive statement (it is either right or wrong); that is, it is about description. "You should do that" (that is, buy the earphones) is strictly speaking a normative statement; that is, it is about prescription (although you would find all economists agree that all trades that improve efficiency should be made). "It just isn't fair" is a normative statement—that is, it is about prescription—and you would likely find much disagreement about the fairness of the proposed trade.
- b. One argument that your roommate should buy the earphones is that everyone has the right to peace and quiet. If your roommate therefore wants to listen to music, she should have to be responsible for making sure that others' peace and quiet is not disturbed. Your roommate might argue that since she has the right to play as much music as she wants, it is your responsibility to make sure that you are not disturbed—for instance, by buying her earphones. If the dormitory has a policy that establishes the right to unlimited music, your roommate's argument wins. If the rule is that there is a right to peace and quiet, your argument wins.
10. A representative of the American clothing industry recently made the following statement: "Workers in Asia often work in sweatshop conditions earning only pennies an hour. American workers are more productive and as a result earn higher wages. In order to preserve the dignity of the American workplace, the government should enact legislation banning imports of low-wage Asian clothing."
- Which parts of this quote are positive statements? Which parts are normative statements?
  - Is the policy that is being advocated consistent with the preceding statements about the wages and productivities of American and Asian workers?

- c. Would such a policy make some Americans better off without making any other Americans worse off? That is, would this policy be efficient from the viewpoint of all Americans?
- d. Would low-wage Asian workers benefit from or be hurt by such a policy?

## Solution

- 10.** a. The positive statements are:
- workers in Asia . . . [are] earning only pennies an hour
  - American workers are more productive
  - American workers are more productive and as a result earn higher wages
- The normative statement is:
- the government should enact legislation banning imports of low-wage Asian clothing
- b. It is not. The statement about the productivity of American and Asian workers is about the absolute advantage that American workers have over Asian workers. However, Asian workers may still have a comparative advantage. And if that is the case, then banning imports would result in inefficiency.
  - c. If America channeled more of its productive resources into producing clothing, it would have to give up producing other goods. As a result, America would be able to consume less of all goods. And this would make some Americans clearly worse off. Therefore, this policy would not be efficient.
  - d. Low-wage Asian workers would also be hurt by this policy. The Asian country would channel its resources away from producing clothing toward producing other goods that it previously imported from America. But since it does not have the comparative advantage in those other goods, the Asian country would be able to consume less of all goods.

- 11.** Are the following statements true or false? Explain your answers.
- a. “When people must pay higher taxes on their wage earnings, it reduces their incentive to work” is a positive statement.
  - b. “We should lower taxes to encourage more work” is a positive statement.
  - c. Economics cannot always be used to completely decide what society ought to do.
  - d. “The system of public education in this country generates greater benefits to society than the cost of running the system” is a normative statement.
  - e. All disagreements among economists are generated by the media.

## Solution

- 11.** a. True. This is a positive statement. It has a factual answer; that is, it is either right or wrong. There has been some debate about whether the statement is actually true or false, but in principle there is only one answer.
- b. False. This is a statement about what we should do, and this statement has no clearly right or wrong answer. Your view will depend on whether you think encouraging more work is a good or a bad idea.
- c. True. Economics is best at giving positive answers, for instance, answers about what the most efficient way is of achieving a certain aim. The question of how society ought to be organized is mostly decided in the realm of politics.
- d. False. This is a positive statement. In principle, it has an answer that is either right or wrong.
- e. False. Some disagreements among economists arise from the fact that in building a model, one economist thinks that a certain abstraction from reality is admissible but another economist may think that that abstraction is not admissible. Some disagreements arise from the fact that economists sometimes disagree about values.

- 12.** Evaluate the following statement: “It is easier to build an economic model that accurately reflects events that have already occurred than to build an economic model to forecast future events.” Do you think this is true or not? Why? What does this imply about the difficulties of building good economic models?

**12.** True. With hindsight it is easier to see the important features of the situation that a model should have captured. For predictive purposes, a model needs to anticipate which features of reality are important (and so should be included) and which are unimportant (and so can be ignored). This is why the famed British economist John Maynard Keynes referred to economics as an art as well as a science.

- 13.** Economists who work for the government are often called on to make policy recommendations. Why do you think it is important for the public to be able to differentiate normative statements from positive statements in these recommendations?

**13.** Positive statements are those based on fact—or at least on our best estimate of what the facts are. Therefore, these statements are also those that do not depend on the political views of the economist. Normative statements may sometimes be influenced by the economist’s own values. Whether someone agrees with an economist’s normative statement may depend on whether they share values. It is therefore important that the public be able to distinguish normative from positive statements.

- 14.** The mayor of Gotham City, worried about a potential epidemic of deadly influenza this winter, asks an economic adviser the following series of questions. Determine whether a question requires the economic adviser to make a positive assessment or a normative assessment.

- a. How much vaccine will be in stock in the city by the end of November?
- b. If we offer to pay 10% more per dose to the pharmaceutical companies providing the vaccines, will they provide additional doses?
- c. If there is a shortage of vaccine in the city, whom should we vaccinate first—the elderly or the very young? (Assume that a person from one group has an equal likelihood of dying from influenza as a person from the other group.)
- d. If the city charges \$25 per shot, how many people will pay?
- e. If the city charges \$25 per shot, it will make a profit of \$10 per shot, money that can go to pay for inoculating poor people. Should the city engage in such a scheme?

**14.**

- a. Positive
- b. Positive
- c. Normative
- d. Positive
- e. Normative

- 15.** Assess the following statement: “If economists just had enough data, they could solve all policy questions in a way that maximizes the social good. There would be no need for divisive political debates, such as whether the government should provide free medical care for all.”

## Solution

- 15.** What is true is that if economists had enough data, they could predict precisely what the outcome would be of any proposed policy (such as free medical care). That is, economists can answer positive questions. But no amount of data can lead to a determination about what a society should do—that is a normative question. An economist can predict how much it will cost to provide free medical care and what effects different ways of raising taxes will have on people's behavior (for instance, a sales tax will reduce consumption behavior; an income tax may discourage workers from working as much as before). But whether this is a trade-off worth making is a question that can be answered only in political discourse.

## WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



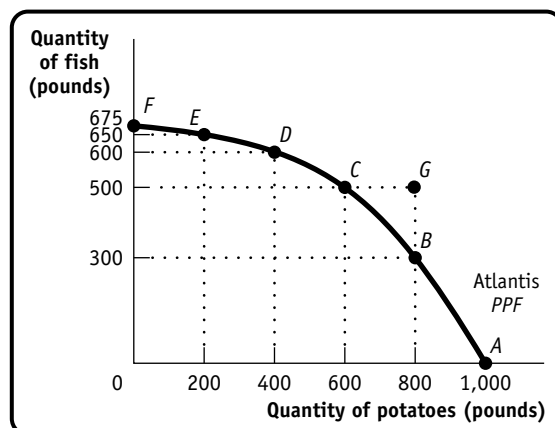
- 16.** Atlantis is a small, isolated island in the South Atlantic. The inhabitants grow potatoes and catch fish. The accompanying table shows the maximum annual output combinations of potatoes and fish that can be produced. Obviously, given their limited resources and available technology, as they use more of their resources for potato production, there are fewer resources available for catching fish.

Maximum annual output options	Quantity of potatoes (pounds)	Quantity of fish (pounds)
A	1,000	0
B	800	300
C	600	500
D	400	600
E	200	650
F	0	675

- Draw a production possibility frontier with potatoes on the horizontal axis and fish on the vertical axis illustrating these options, showing points A-F.
- Can Atlantis produce 500 pounds of fish and 800 pounds of potatoes? Explain. Where would this point lie relative to the production possibility frontier?
- What is the opportunity cost of increasing the annual output of potatoes from 600 to 800 pounds?
- What is the opportunity cost of increasing the annual output of potatoes from 200 to 400 pounds?
- Can you explain why the answers to parts c and d are not the same? What does this imply about the slope of the production possibility frontier?

## Solution

- 16. a.** The accompanying diagram shows the production possibility frontier for Atlantis.



- b.** No, Atlantis cannot produce 500 pounds of fish and 800 pounds of potatoes. If it produces 500 pounds of fish, the most potatoes it can produce is 600 pounds. This point would lie outside the production possibility frontier, at point G on the diagram.
- c.** The opportunity cost of increasing output from 600 to 800 pounds of potatoes is 200 pounds of fish. If Atlantis increases output from 600 to 800 pounds of potatoes, it has to cut fish production from 500 pounds to 300 pounds, that is, by 200 pounds.
- d.** The opportunity cost of increasing output from 200 to 400 pounds of potatoes is 50 pounds of fish. If Atlantis increases output from 200 to 400 pounds of potatoes, it has to cut fish production from 650 pounds to 600 pounds, that is, by 50 pounds.
- e.** The answers to parts c and d imply that the more potatoes Atlantis produces, the higher the opportunity cost becomes. For instance, as you grow more and more potatoes, you have to use less and less suitable land to do so. As a result, you have to divert increasingly more resources away from fishing as you grow more potatoes, meaning that you can produce increasingly less fish. This implies, of course, that the production possibility frontier becomes steeper the farther you move along it to the right; that is, the production possibility frontier is bowed out. (Mathematicians call this shape *concave*.)



# Supply and Demand

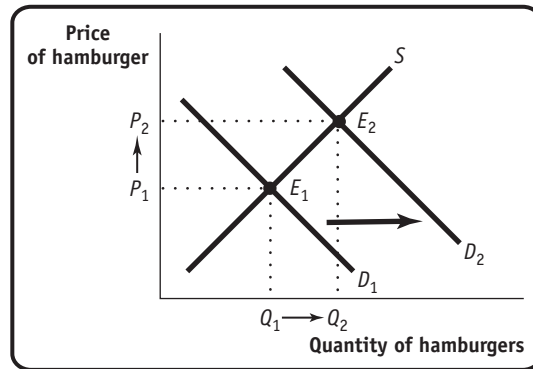
1. A survey indicated that chocolate is the most popular flavor of ice cream in America. For each of the following, indicate the possible effects on demand, supply, or both as well as equilibrium price and quantity of chocolate ice cream.
  - a. A severe drought in the Midwest causes dairy farmers to reduce the number of milk-producing cattle in their herds by a third. These dairy farmers supply cream that is used to manufacture chocolate ice cream.
  - b. A new report by the American Medical Association reveals that chocolate does, in fact, have significant health benefits.
  - c. The discovery of cheaper synthetic vanilla flavoring lowers the price of vanilla ice cream.
  - d. New technology for mixing and freezing ice cream lowers manufacturers' costs of producing chocolate ice cream.

## Solution

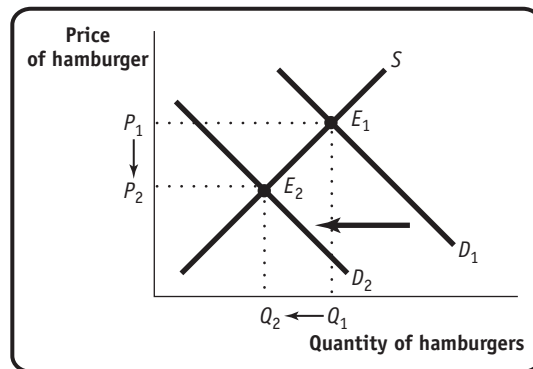
1.
  - a. By reducing their herds, dairy farmers reduce the supply of cream, a leftward shift of the supply curve for cream. As a result, the market price of cream rises, raising the cost of producing a unit of chocolate ice cream. This results in a leftward shift of the supply curve for chocolate ice cream as ice cream producers reduce the quantity of chocolate ice cream supplied at any given price. Ultimately, this leads to a rise in the equilibrium price and a fall in the equilibrium quantity of chocolate ice cream.
  - b. Consumers will now demand more chocolate ice cream at any given price, represented by a rightward shift of the demand curve. As a result, both equilibrium price and quantity rise.
  - c. The price of a substitute (vanilla ice cream) has fallen, leading consumers to substitute it for chocolate ice cream. The demand for chocolate ice cream decreases, represented by a leftward shift of the demand curve. Both equilibrium price and quantity fall.
  - d. Because the cost of producing ice cream falls, manufacturers are willing to supply more units of chocolate ice cream at any given price. This is represented by a rightward shift of the supply curve and results in a fall in the equilibrium price and a rise in the equilibrium quantity of chocolate ice cream.
2. In a supply and demand diagram, draw the shift of the demand curve for hamburgers in your hometown due to the following events. In each case, show the effect on equilibrium price and quantity.
  - a. The price of tacos increases.
  - b. All hamburger sellers raise the price of their french fries.
  - c. Income falls in town. Assume that hamburgers are a normal good for most people.
  - d. Income falls in town. Assume that hamburgers are an inferior good for most people.
  - e. Hot dog stands cut the price of hot dogs.

## Solution

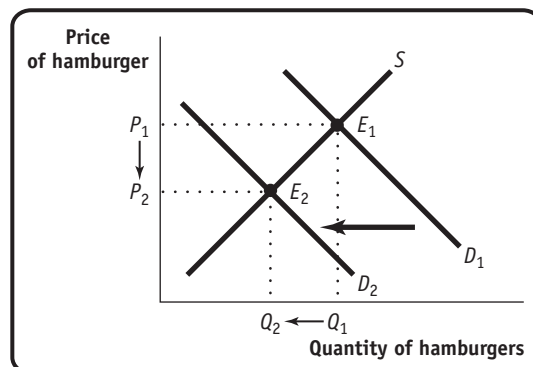
2. a. A rise in the price of a substitute (tacos) causes the demand for hamburgers to increase. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$  and results in a rise in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



- b. A rise in the price of a complement (french fries) causes the demand for hamburgers to decrease. This represents a leftward shift of the demand curve from  $D_1$  to  $D_2$  and results in a fall in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .

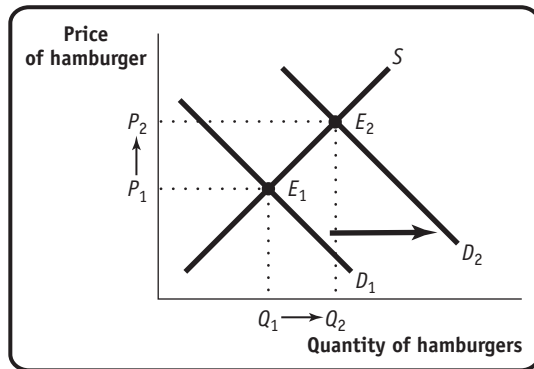


- c. A fall in income causes the demand for a normal good (hamburgers) to decrease. This represents a leftward shift of the demand curve from  $D_1$  to  $D_2$  and results in a fall in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .

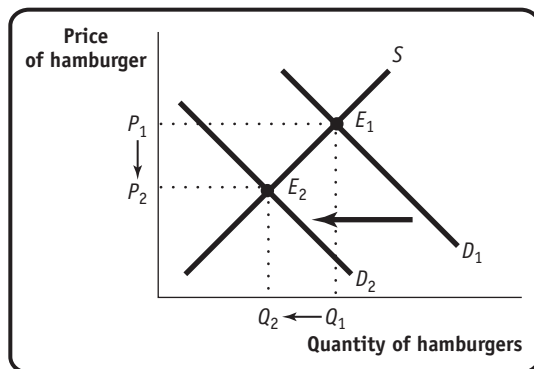




- d. A fall in income causes the demand for an inferior good (hamburgers) to increase. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$  and results in a rise in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



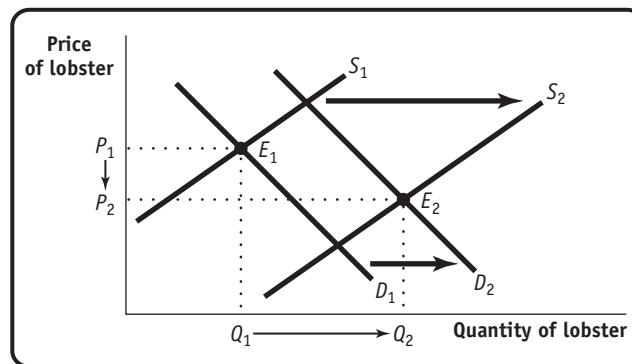
- e. A fall in the price of a substitute (hot dogs) causes demand for hamburgers to decrease. This is represented by a leftward shift of the demand curve from  $D_1$  to  $D_2$  and results in a fall in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



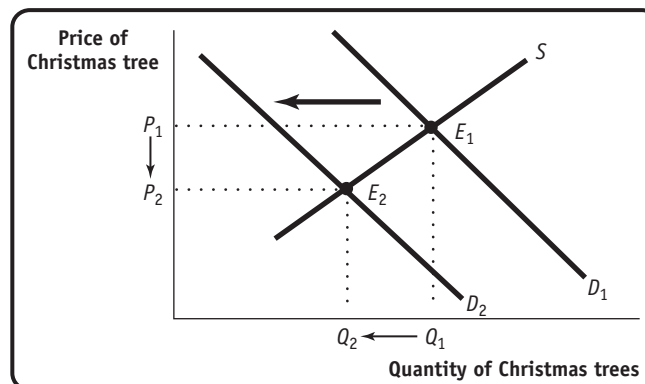
3. The market for many goods changes in predictable ways according to the time of year, in response to events such as holidays, vacation times, seasonal changes in production, and so on. Using supply and demand, explain the change in price in each of the following cases. Note that supply and demand may shift simultaneously.
- Lobster prices usually fall during the summer peak lobster harvest season, despite the fact that people like to eat lobster during the summer more than at any other time of year.
  - The price of a Christmas tree is lower after Christmas than before but fewer trees are sold.
  - The price of a round-trip ticket to Paris on Air France falls by more than \$200 after the end of school vacation in September. This happens despite the fact that generally worsening weather increases the cost of operating flights to Paris, and Air France therefore reduces the number of flights to Paris at any given price.

## Solution

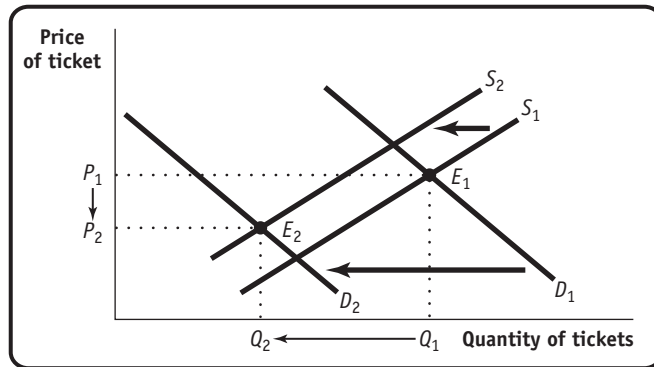
3. a. There is a rightward shift of the demand curve from  $D_1$  to  $D_2$  during the summer because consumers prefer to eat more lobster during the summer than at other times of the year. Other things equal, this leads to a rise in the price of lobster. Simultaneously, lobster fishermen produce more lobster during the summer peak harvest time, when it is cheaper to harvest lobster, representing a rightward shift of the supply curve of lobster from  $S_1$  to  $S_2$ . Other things equal, this leads to a fall in the price of lobster. Given the simultaneous rightward shifts of both the demand and supply curves, the equilibrium changes from  $E_1$  to  $E_2$ . The fall in price indicates that the rightward shift of the supply curve exceeds the rightward shift of the demand curve.



- b. There is a leftward shift of the demand curve for Christmas trees after Christmas from  $D_1$  to  $D_2$ , as fewer consumers want Christmas trees at any given price. The supply curve does not shift; the reduction in the quantity of trees supplied is a movement along the supply curve. This leads to a fall in the equilibrium price and quantity, as the equilibrium changes from  $E_1$  to  $E_2$ .



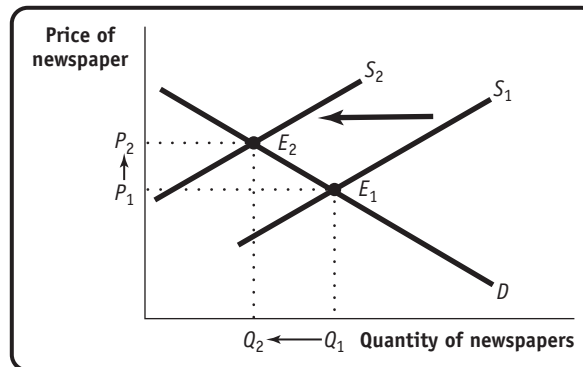
- c. There is a leftward shift of the demand curve for tickets to Paris in September, after the end of school vacation, from  $D_1$  to  $D_2$ . Other things equal, this leads to a fall in the price of tickets. At the same time, as the cost of operating flights increases, Air France decreases the number of flights, shifting the supply curve leftward from  $S_1$  to  $S_2$ . Other things equal, this leads to a rise in price. Given the simultaneous leftward shifts of both the demand and supply curves, the equilibrium changes from  $E_1$  to  $E_2$ . The fall in price indicates that the leftward shift of the demand curve exceeds the leftward shift of the supply curve.



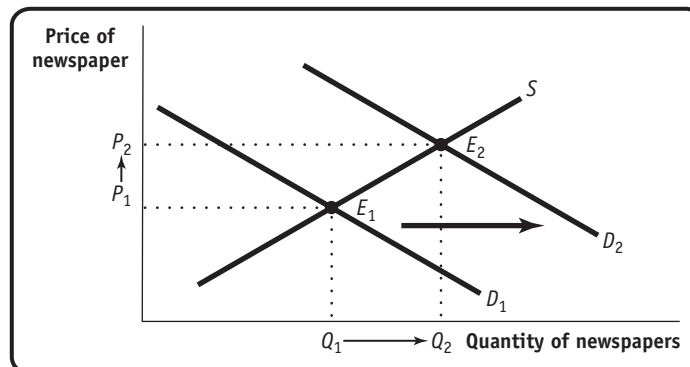
4. Show in a diagram the effect on the demand curve, the supply curve, the equilibrium price, and the equilibrium quantity of each of the following events.
- The market for newspapers in your town
    - The salaries of journalists go up.
    - There is a big news event in your town, which is reported in the newspapers.
  - The market for St. Louis Rams cotton T-shirts
    - The Rams win the Super Bowl.
    - The price of cotton increases.
  - The market for bagels
    - People realize how fattening bagels are.
    - People have less time to make themselves a cooked breakfast.
  - The market for the Krugman and Wells economics textbook
    - Your professor makes it required reading for all of his or her students.
    - Printing costs for textbooks are lowered by the use of synthetic paper.

## Solution

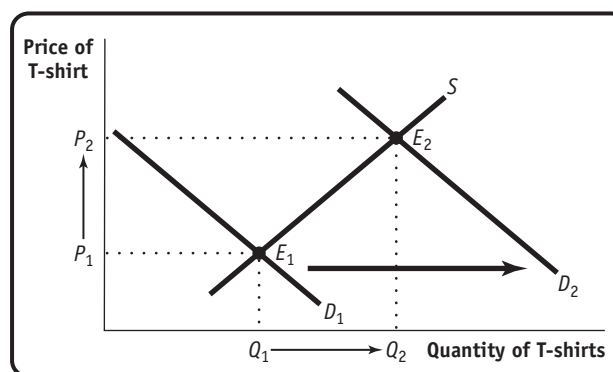
4. a. **Case 1:** Journalists are an input in the production of newspapers; an increase in their salaries will cause newspaper publishers to reduce the quantity supplied at any given price. This represents a leftward shift of the supply curve from  $S_1$  to  $S_2$  and results in a rise in the equilibrium price and a fall in the equilibrium quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



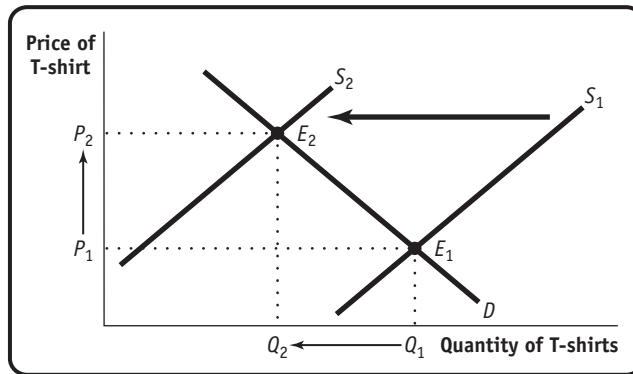
- Case 2:** Townspeople will wish to purchase more newspapers at any given price. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$  and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



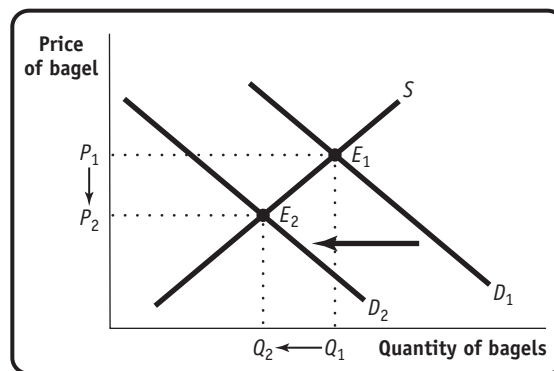
- b. **Case 1:** Fans will demand more St. Louis Rams memorabilia at any given price. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$  and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



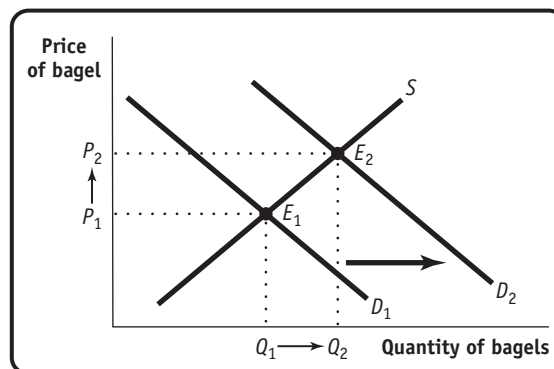
**Case 2:** Cotton is an input into T-shirts; an increase in its price will cause T-shirt manufacturers to reduce the quantity supplied at any given price, representing a leftward shift of the supply curve from  $S_1$  to  $S_2$ . This leads to a rise in the equilibrium price and a fall in the equilibrium quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



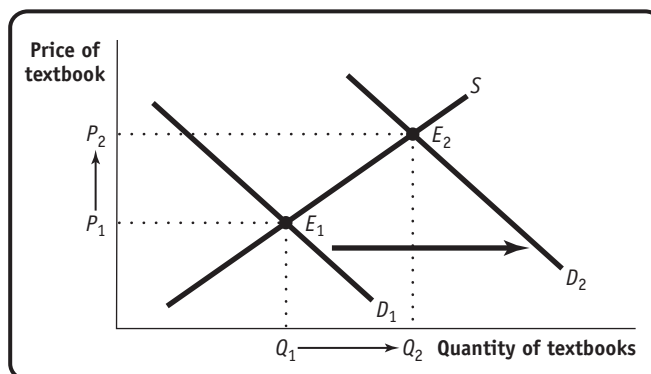
**c. Case 1:** Consumers will demand fewer bagels at any given price. This represents a leftward shift of the demand curve from  $D_1$  to  $D_2$  and leads to a fall in both the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



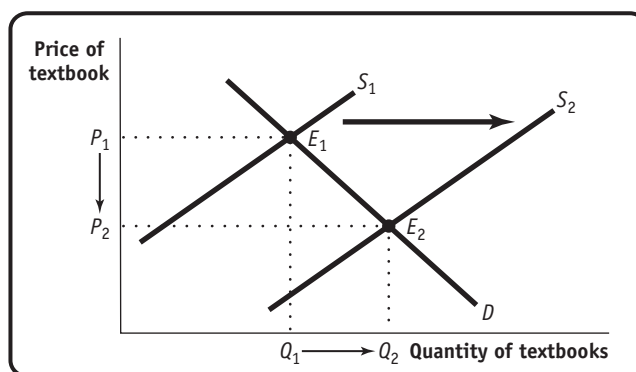
**Case 2:** Consumers will demand more bagels (a substitute for cooked breakfasts) at any given price. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$  and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



- d. **Case 1:** A greater quantity of textbooks will be demanded at any given price, representing a rightward shift of the demand curve from  $D_1$  to  $D_2$ . Equilibrium price and quantity will rise as the equilibrium changes from  $E_1$  to  $E_2$ .



- Case 2:** The textbook publisher will offer more textbooks for sale at any given price, representing a rightward shift of the supply curve from  $S_1$  to  $S_2$ . Equilibrium price will fall and equilibrium quantity will rise as the equilibrium changes from  $E_1$  to  $E_2$ .



5. Let's assume that each person in the United States consumes an average of 37 gallons of soft drinks (nondiet) at an average price of \$2 per gallon and that the U.S. population is 294 million. At a price of \$1.50 per gallon, each individual consumer would demand 50 gallons of soft drinks. From this information about the individual demand schedule, calculate the market demand schedule for soft drinks for the prices of \$1.50 and \$2 per gallon.

### Solution

5. The quantity demanded by an individual consumer at a price of \$2 was 37 gallons, and there were 294 million consumers. Multiplying the quantity demanded at that price by each individual consumer gives us the market quantity demanded at that price:  $294 \text{ million} \times 37 \text{ gallons} = 10.9 \text{ billion gallons}$ . Similarly, the market quantity demanded at a price of \$1.50 would be  $294 \text{ million} \times 50 \text{ gallons} = 14.7 \text{ billion gallons}$ .

6. Suppose that the supply schedule of Maine lobsters is as follows:

Price of lobster (per pound)	Quantity of lobster supplied (pounds)
\$25	800
20	700
15	600
10	500
5	400

Suppose that Maine lobsters can be sold only in the United States. The U.S. demand schedule for Maine lobsters is as follows:

Price of lobster (per pound)	Quantity of lobster demanded (pounds)
\$25	200
20	400
15	600
10	800
5	1,000

- a. Draw the demand curve and the supply curve for Maine lobsters. What are the equilibrium price and quantity of lobsters?

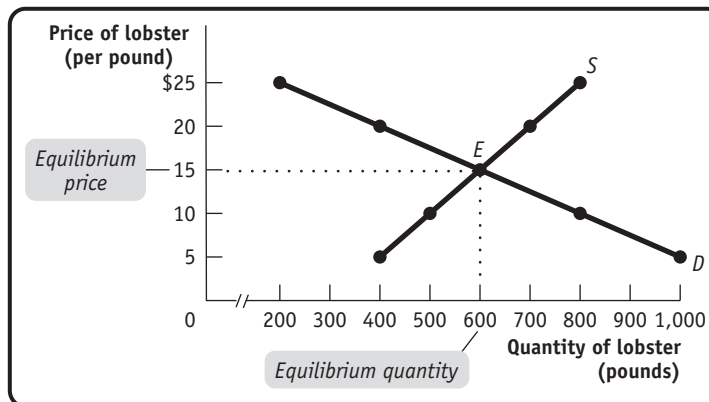
Now suppose that Maine lobsters can be sold in France. The French demand schedule for Maine lobsters is as follows:

Price of lobster (per pound)	Quantity of lobster demanded (pounds)
\$25	100
20	300
15	500
10	700
5	900

- b. What is the demand schedule for Maine lobsters now that French consumers can also buy them? Draw a supply and demand diagram that illustrates the new equilibrium price and quantity of lobsters. What will happen to the price at which fishermen can sell lobster? What will happen to the price paid by U.S. consumers? What will happen to the quantity consumed by U.S. consumers?

## Solution

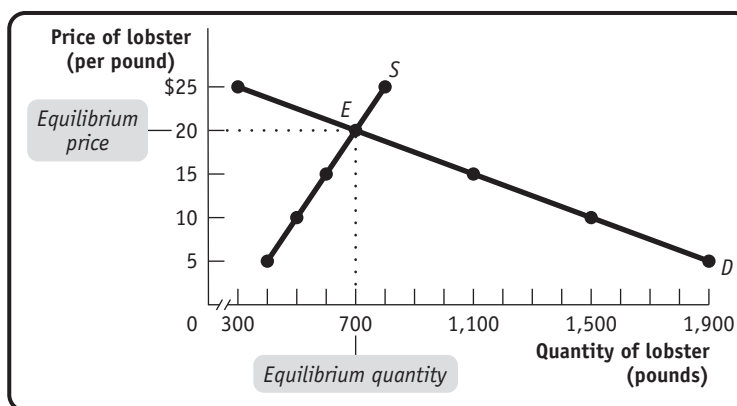
6. a. The equilibrium price of lobster is \$15 per pound and the equilibrium quantity is 600 pounds, point *E* in the accompanying diagram.



- b. The new demand schedule is obtained by adding together, at any given price, the quantity demanded by American consumers and the quantity demanded by French consumers, as shown in the accompanying table.

Price of lobster (per pound)	Quantity of lobster demanded (U.S. pounds plus French pounds)
\$25	300
20	700
15	1,100
10	1,500
5	1,900

The new equilibrium price of lobster is \$20 per pound and the new equilibrium quantity is 700 pounds, point *E* in the accompanying diagram. The opportunity to sell to French consumers makes Maine fishermen better off: they sell more lobster and at a higher price than before. U.S. consumers, however, are made worse off: they must pay a higher price for lobster (\$20 versus \$15 per pound) and, as a result, consume less lobster (400 versus 600 pounds).

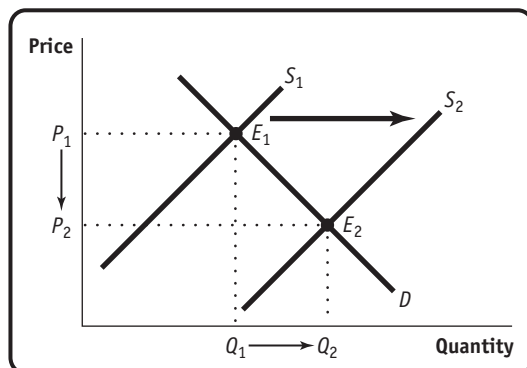




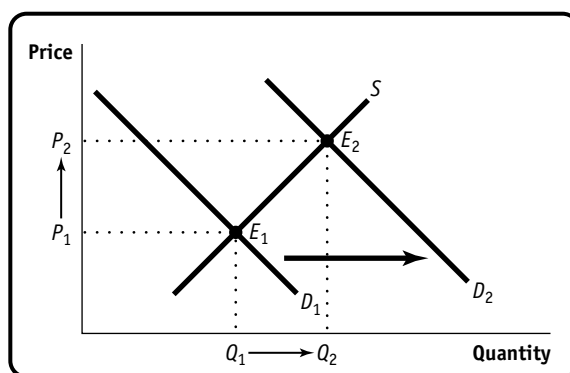
7. Find the flaws in reasoning in the following statements, paying particular attention to the distinction between shifts of and movements along the supply and demand curves. Draw a diagram to illustrate what actually happens in each situation.
- “A technological innovation that lowers the cost of producing a good might seem at first to result in a reduction in the price of the good to consumers. But a fall in price will increase demand for the good, and higher demand will send the price up again. It is not certain, therefore, that an innovation will really reduce price in the end.”
  - “A study shows that eating a clove of garlic a day can help prevent heart disease, causing many consumers to demand more garlic. This increase in demand results in a rise in the price of garlic. Consumers, seeing that the price of garlic has gone up, reduce their demand for garlic. This causes the demand for garlic to decrease and the price of garlic to fall. Therefore, the ultimate effect of the study on the price of garlic is uncertain.”

## Solution

7. a. This statement confuses a shift of a curve with a movement along a curve. A technological innovation lowers the cost of producing the good, leading producers to offer more of the good at any given price. This is represented by a rightward shift of the supply curve from  $S_1$  to  $S_2$ . As a result, the equilibrium price falls and the equilibrium quantity rises, as shown by the change from  $E_1$  to  $E_2$ . The statement “but a fall in price will increase demand for the good, and higher demand will send the price up again” is wrong for the following reasons. A fall in price does increase the quantity demanded and leads to an increase in the equilibrium quantity as one moves down along the demand curve. But it does not lead to an increase in demand—a rightward shift of the demand curve—and therefore does not cause the price to go up again.



- b. This statement also confuses a shift of a curve with a movement along a curve. The health report generates an increase in demand—a rightward shift of the demand curve from  $D_1$  to  $D_2$ . This leads to a higher equilibrium price and quantity as we move up along the supply curve, and the equilibrium changes from  $E_1$  to  $E_2$ . The following statements are wrong: “Consumers, seeing that the price of garlic has gone up, reduce their demand for garlic. This causes the demand for garlic to decrease and the price of garlic to fall.” They are wrong because they imply that the rise in the equilibrium price causes the demand for garlic to decrease—a leftward shift of the demand curve. But a rise in the equilibrium price via a movement along the supply curve does not cause the demand curve to shift leftward.



8. The following table shows a demand schedule for a normal good.

Price	Quantity demanded
\$23	70
21	90
19	110
17	130

- a. Do you think that the increase in quantity demanded (say, from 90 to 110 in the table) when price decreases (from \$21 to \$19) is due to a rise in consumers' income? Explain clearly (and briefly) why or why not.
- b. Now suppose that the good is an inferior good. Would the demand schedule still be valid for an inferior good?
- c. Lastly, assume you do not know whether the good is normal or inferior. Devise an experiment that would allow you to determine which one it was. Explain.

## Solution

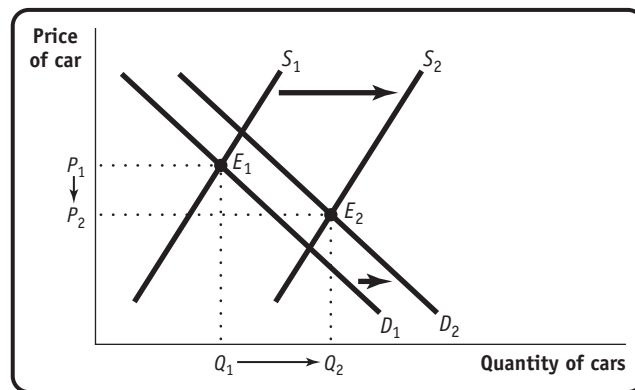
8. a. The increase in quantity demanded from 90 to 110 when the price declines from \$21 to \$19 is not due to a rise in consumers' income. Rather, it represents a movement along the demand curve as the price falls. In contrast, a rise in consumers' income causes the demand curve to shift rightward for a normal good; as a result, the quantity demanded will increase at any given price.
- b. This demand schedule is valid for an inferior good because inferior goods obey the law of demand: a rise in the price leads to a fall in the quantity demanded, other things equal.
- c. You can determine whether a good is normal or inferior only by examining what happens to the demand after consumers' income changes. A rise in income leads to an increase in demand for a normal good and a decrease in demand for an inferior good. A fall in income leads to a decrease in demand for a normal good and an increase in demand for an inferior good. So a suitable experiment would

be to raise consumers' income: if the quantity demanded at any given price rises, the good is normal; if the quantity demanded at any given price falls, the good is inferior. If you experiment by reducing consumers' income, the results are reversed for the two types of goods.

9. In recent years, the number of car producers in China has increased rapidly. In fact, China now has more car brands than the United States. In addition, car sales have climbed every year and automakers have increased their output at even faster rates, causing fierce competition and a decline in prices. At the same time, Chinese consumers' incomes have risen. Assume that cars are a normal good. Draw a diagram of the supply and demand curves for cars in China to explain what has happened in the Chinese car market.

## Solution

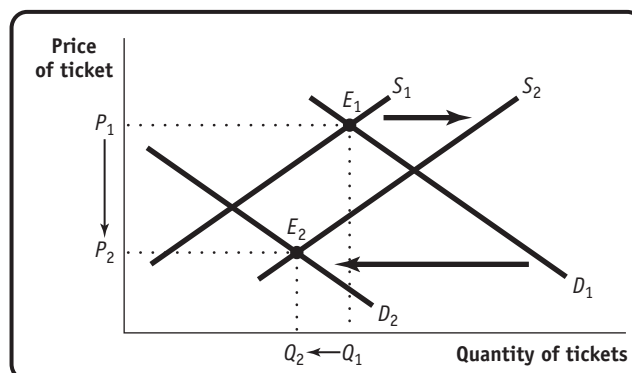
9. As more automakers enter the Chinese market, the supply curve shifts to the right, from  $S_1$  to  $S_2$ . And as Chinese consumers' incomes rise, the demand curve for cars shifts to the right, from  $D_1$  to  $D_2$ , because cars are a normal good. As a result, the equilibrium moves from its initial position at  $E_1$  to the new equilibrium at  $E_2$ , and the quantity of cars bought and sold increases from  $Q_1$  to  $Q_2$ . This accounts for the rapid increase in sales. Since the question mentions a decline in prices, the rightward shift of the supply curve must have been greater than the rightward shift of the demand curve.



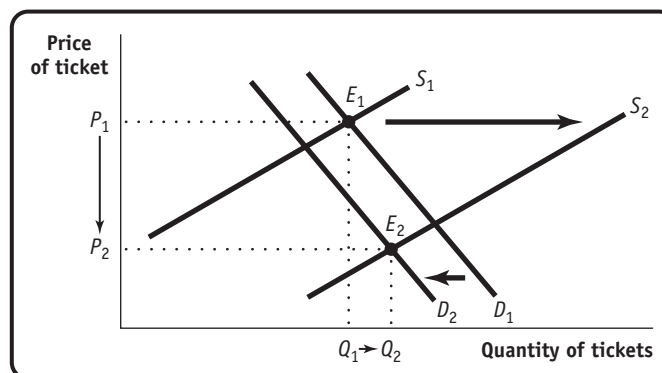
10. Aaron Hank is a star hitter for the Bay City baseball team. He is close to breaking the major league record for home runs hit during one season, and it is widely anticipated that in the next game he will break that record. As a result, tickets for the team's next game have been a hot commodity. But today it is announced that, due to a knee injury, he will not in fact play in the team's next game. Assume that season ticket-holders are able to resell their tickets if they wish. Use supply and demand diagrams to explain your answers to parts a and b.
- Show the case in which this announcement results in a lower equilibrium price and a lower equilibrium quantity than before the announcement.
  - Show the case in which this announcement results in a lower equilibrium price and a higher equilibrium quantity than before the announcement.
  - What accounts for whether case a or case b occurs?
  - Suppose that a scalper had secretly learned before the announcement that Aaron Hank would not play in the next game. What actions do you think he would take?

## Solution

10. a. Fewer fans want to attend the next game after the announcement is made. As a result, the demand curve will shift leftward from  $D_1$  to  $D_2$ , as fewer tickets are demanded at any given price; other things equal, this results in a fall in both equilibrium price and quantity. In addition, the supply curve will shift rightward from  $S_1$  to  $S_2$ , as more season ticket-holders are willing to sell tickets at any given price. Other things equal, this results in a fall in equilibrium price and a rise in equilibrium quantity. In this case, the leftward shift of the demand curve exceeds the rightward shift of the supply curve; as a result, equilibrium quantity falls, shown by the change of the equilibrium from  $E_1$  to  $E_2$ .



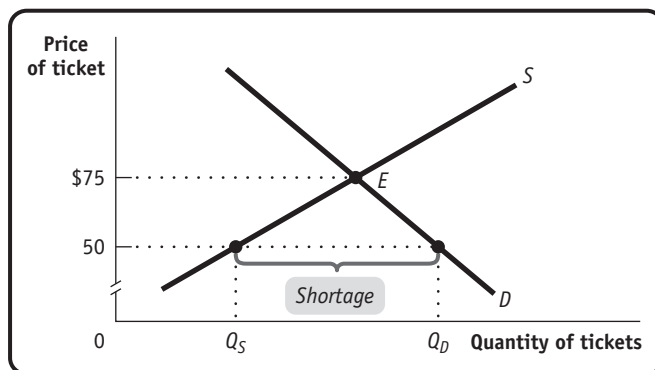
- b. The supply and demand curves shift in the same manner as in part a, but in this case the rightward shift of the supply curve exceeds the leftward shift of the demand curve. Consequently, equilibrium quantity rises, shown by the change of the equilibrium from  $E_1$  to  $E_2$ .



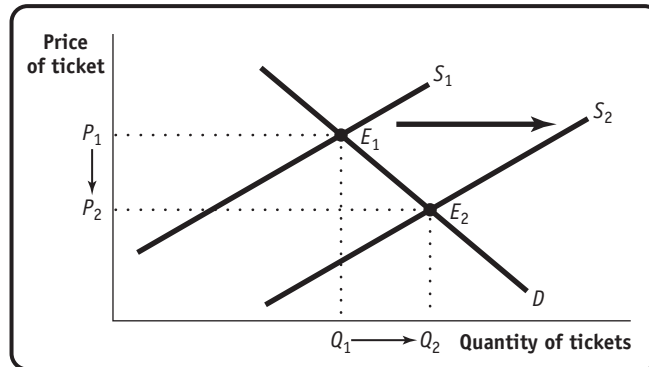
- c. Case a (equilibrium quantity falls) occurs because the decrease in demand exceeds the increase in supply. Case b (equilibrium quantity rises) occurs because the increase in supply exceeds the decrease in demand.
- d. A scalper who learns about the announcement secretly should take actions—such as lowering price somewhat—that ensure that he will sell all of his tickets before the announcement is made. He will do this because he knows a ticket will command a much lower price after the announcement. An expectation that the price will be lower in the future causes supply to increase today.

- 11.** Fans of rock and rock stars often bemoan the high price of concert tickets. One superstar has argued that it isn't worth hundreds, even thousands, of dollars to hear him and his band play. Let's assume this star sold out arenas around the country at an average ticket price of \$75.
- How would you evaluate the argument that ticket prices are too high?
  - Suppose that due to this star's protests, ticket prices were lowered to \$50. In what sense is this price too low? Draw a diagram using supply and demand curves to support your argument.
  - Suppose the rock superstar really wanted to bring down ticket prices. Since he and his band control the supply of their services, what do you recommend they do? Explain using a supply and demand diagram.
  - Suppose the band's next album was a total dud. Do you think they would still have to worry about ticket prices being too high? Why or why not? Draw a supply and demand diagram to support your argument.
  - Suppose the group announced their next tour was going to be their last. What effect would this likely have on the demand for and price of tickets? Illustrate with a supply and demand diagram.

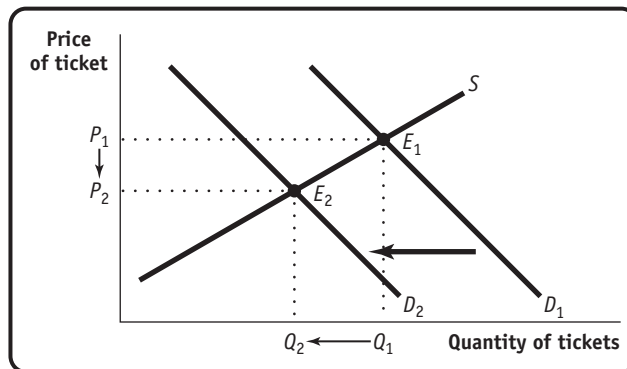
- 11.** **a.** If markets are competitive, the ticket price is simply the equilibrium price: the price at which quantity supplied is equal to quantity demanded. No one is "made" to pay \$75 to go to a concert: a potential concert-goer will pay \$75 if going to the concert seems worth that amount and will choose to do something else if it isn't.
- b.** At \$50 each, the quantity of tickets demanded exceeds the quantity of tickets supplied. There is a shortage of tickets at this price, shown by the difference between the quantity demanded at this price,  $Q_D$ , and the quantity supplied at this price,  $Q_S$ .



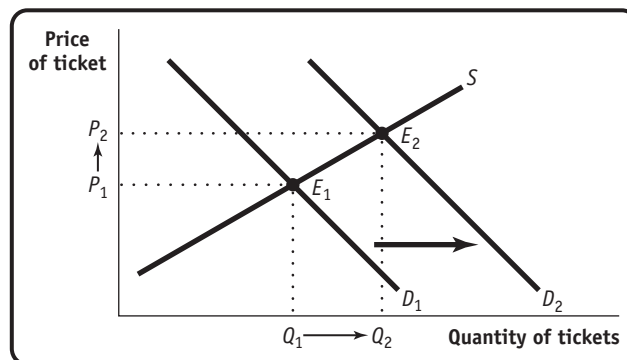
- c. The band can lower the average price of a ticket by increasing supply: give more concerts. This is shown as a rightward shift of the supply curve from  $S_1$  to  $S_2$ , resulting in a lower equilibrium price and a higher equilibrium quantity, shown by the change of the equilibrium from  $E_1$  to  $E_2$ .



- d. If the band's CD is a total dud, the demand for concert tickets is likely to decrease. This represents a leftward shift of the demand curve from  $D_1$  to  $D_2$ , resulting in a lower equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ . This is likely to eliminate the worry that ticket prices are "too high."



- e. The announcement that this is the group's last tour causes the demand for tickets to increase. This is represented by a rightward shift of the demand curve from  $D_1$  to  $D_2$ , resulting in an increase in both the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



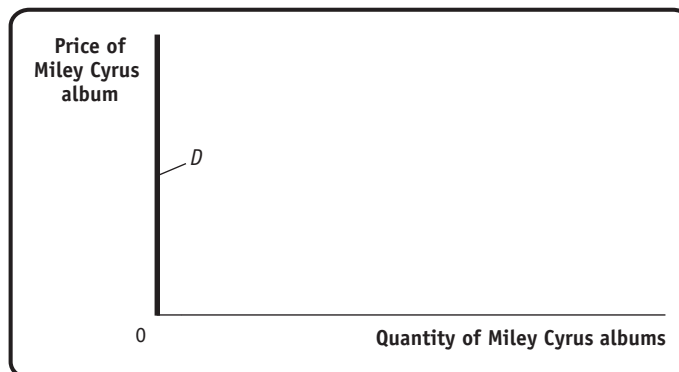
- 12.** After several years of decline, the market for handmade acoustic guitars is making a comeback. These guitars are usually made in small workshops employing relatively few highly skilled luthiers. Assess the impact on the equilibrium price and quantity of handmade acoustic guitars as a result of each of the following events. In your answers indicate which curve(s) shift(s) and in which direction.
- Environmentalists succeed in having the use of Brazilian rosewood banned in the United States, forcing luthiers to seek out alternative, more costly woods.
  - A foreign producer reengineers the guitar-making process and floods the market with identical guitars.
  - Music featuring handmade acoustic guitars makes a comeback as audiences tire of heavy metal and alternative rock music.
  - The country goes into a deep recession and the income of the average American falls sharply.

- 12.** **a.** The cost of producing handmade acoustic guitars rises as more costly woods are used to construct them. This reduces supply, as luthiers offer fewer guitars at any given price. This is represented by a leftward shift of the supply curve and results in a rise in the equilibrium price and a fall in the equilibrium quantity.
- b.** This represents a rightward shift of the supply curve, resulting in a fall in the equilibrium price and a rise in the equilibrium quantity.
- c.** As more people demand music played on acoustic guitars, the demand for these guitars by musicians increases as well. (Acoustic guitars are an input into the production of this music.) This represents a rightward shift of the demand curve, leading to a higher equilibrium price and quantity.
- d.** If average American income falls sharply, then the demand for handmade acoustic guitars will decrease sharply as well because they are a normal good. This is represented by a leftward shift of the demand curve, leading to a lower equilibrium price and quantity.

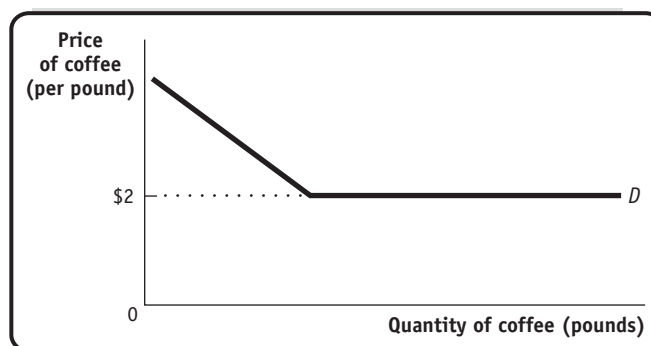
- 13.** *Demand twisters:* Sketch and explain the demand relationship in each of the following statements.
- I would never buy a Miley Cyrus album! You couldn't even give me one for nothing.
  - I generally buy a bit more coffee as the price falls. But once the price falls to \$2 per pound, I'll buy out the entire stock of the supermarket.
  - I spend more on orange juice even as the price rises. (Does this mean that I must be violating the law of demand?)
  - Due to a tuition rise, most students at a college find themselves with less disposable income. Almost all of them eat more frequently at the school cafeteria and less often at restaurants, even though prices at the cafeteria have risen, too. (This one requires that you draw both the demand and the supply curves for school cafeteria meals.)

## Solution

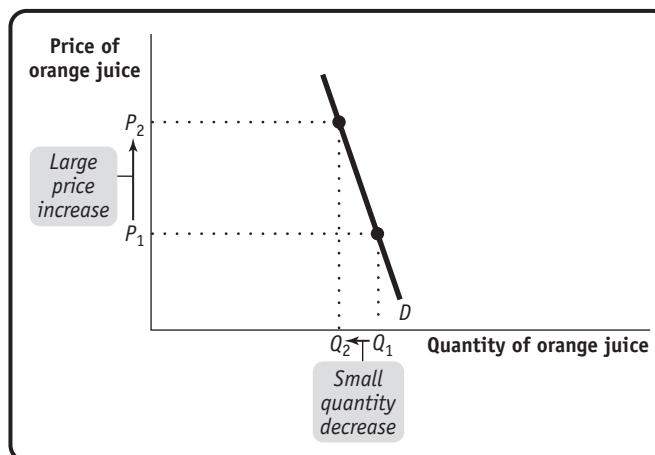
13. a. In this case, the quantity demanded is zero regardless of the price. So this person's demand curve for Miley Cyrus albums is a vertical line at the quantity of zero—that is, a vertical line that lies on top of the vertical axis.



- b. The person here has the typical downward-sloping demand curve for coffee until it reaches the price of \$2 per pound, at which point it becomes horizontal, showing that he or she would buy a very large quantity at that price.

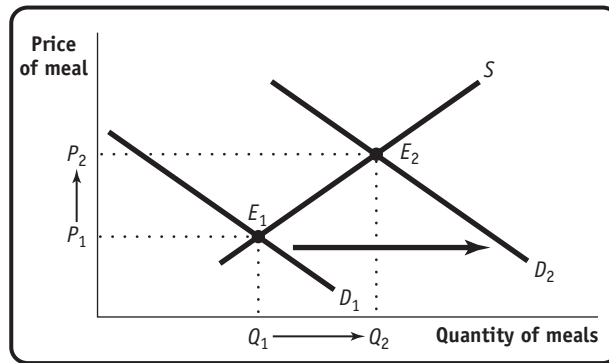


- c. This person does not necessarily violate the law of demand: the quantity of orange juice demanded may in fact fall as price goes up. The likely explanation is the following: spending is price times the quantity demanded. Although price goes up, the total amount of money this person spends on orange juice rises because he or she does not reduce the quantity demanded enough to offset the increased cost per unit. This person will have a steep demand curve as shown in the diagram: quantity demanded falls as price rises, but the fall in quantity demanded is proportionately less than the rise in price.



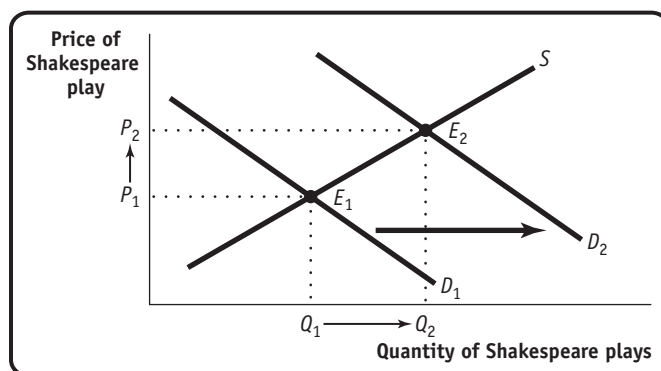


- d. Since students' income has fallen, but the demand for cafeteria meals has increased, cafeteria meals must be an inferior good. The rightward shift of the demand curve, from  $D_1$  to  $D_2$ , results in an increase in the equilibrium price and quantity of cafeteria meals, as the equilibrium changes from  $E_1$  to  $E_2$ .

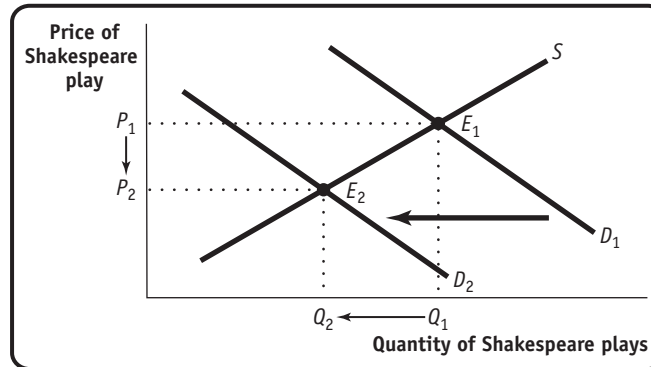


14. Will Shakespeare is a struggling playwright in sixteenth-century London. As the price he receives for writing a play increases, he is willing to write more plays. For the following situations, use a diagram to illustrate how each event affects the equilibrium price and quantity in the market for Shakespeare's plays.
- The playwright Christopher Marlowe, Shakespeare's chief rival, is killed in a bar brawl.
  - The bubonic plague, a deadly infectious disease, breaks out in London.
  - To celebrate the defeat of the Spanish Armada, Queen Elizabeth declares several weeks of festivities, which involves commissioning new plays.

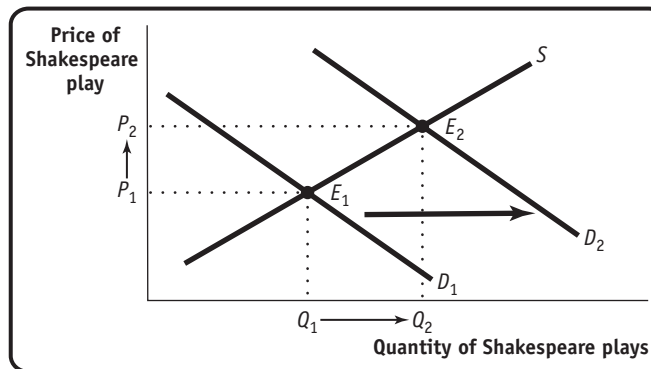
14. a. The death of Marlowe means that the supply of a substitute good (Marlowe's plays) has decreased. As a result, the demand for Shakespeare's plays will increase, inducing a rightward shift of the demand curve in the market for Shakespeare's plays from  $D_1$  to  $D_2$ . As a result, equilibrium price and quantity will rise as the equilibrium changes from  $E_1$  to  $E_2$ .



- b. After the outbreak of the plague, fewer Londoners will wish to see Shakespeare's plays to avoid contracting the illness, inducing a leftward shift of the demand curve from  $D_1$  to  $D_2$ . Equilibrium price and quantity will fall as the equilibrium changes from  $E_1$  to  $E_2$ .



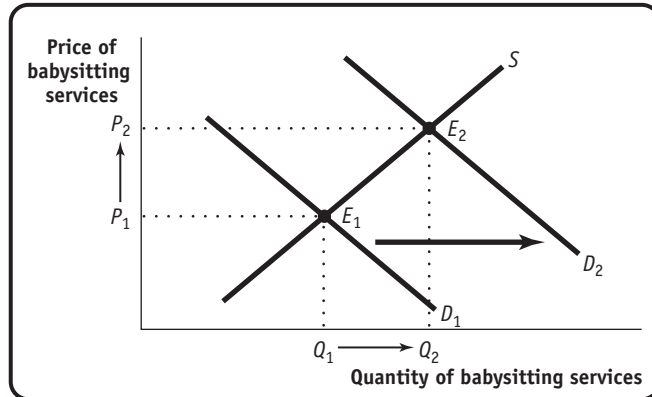
- c. Queen Elizabeth's commissions result in a greater quantity of Shakespeare's plays demanded at any given price. This represents a rightward shift of the demand curve from  $D_1$  to  $D_2$ , resulting in a higher equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



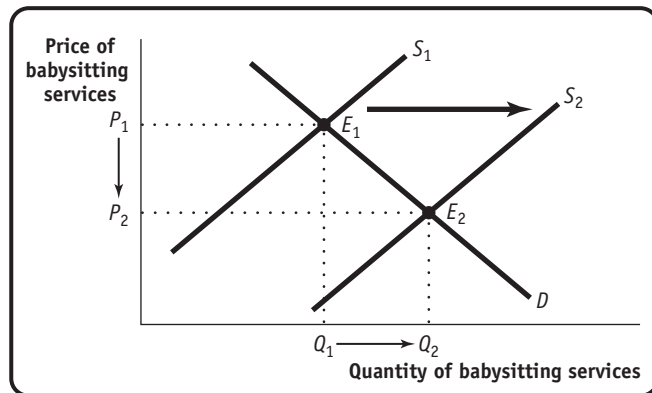
15. This year, the small town of Middling experiences a sudden doubling of the birth rate. After three years, the birth rate returns to normal. Use a diagram to illustrate the effect of these events on the following.
- The market for an hour of babysitting services in Middling this year
  - The market for an hour of babysitting services 14 years into the future, after the birth rate has returned to normal, by which time children born today are old enough to work as babysitters
  - The market for an hour of babysitting services 30 years into the future, when children born today are likely to be having children of their own

## Solution

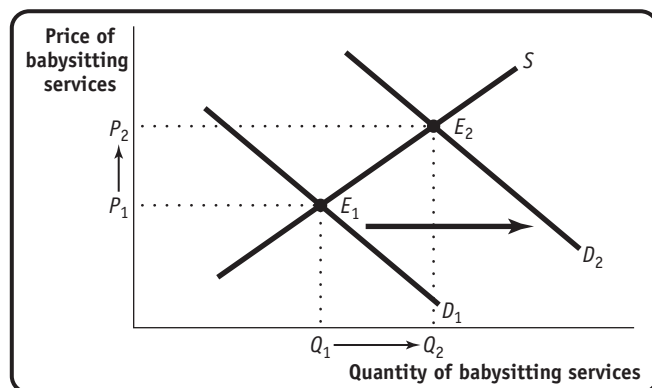
15. a. There are more babies today, so the demand for an hour of babysitting services has increased. This produces a rightward shift of the demand curve for babysitting services from  $D_1$  to  $D_2$ , resulting in a rise in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



- b. The children born today will cause an increase in the supply of babysitters available 14 years from now, when there will be a rightward shift of the supply curve for babysitting services from  $S_1$  to  $S_2$ . This will result in a lower equilibrium price and a higher equilibrium quantity as the equilibrium changes from  $E_1$  to  $E_2$ .

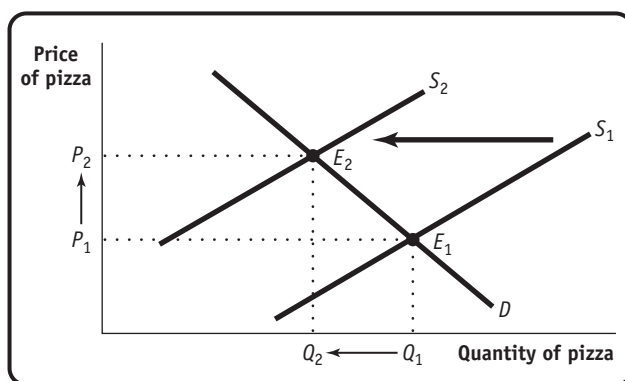


- c. It is likely that there will be an increase in the number of babies born 30 years from now. Therefore, there will be an increase in the demand for babysitting services, shifting the demand curve rightward from  $D_1$  to  $D_2$ . This will result in a higher equilibrium quantity and price as the equilibrium changes from  $E_1$  to  $E_2$ .

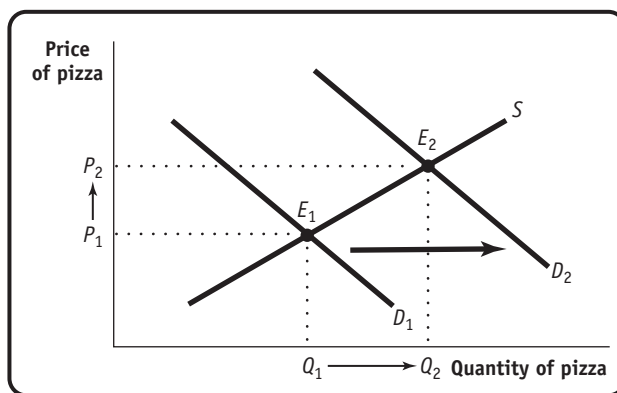


- 16.** Use a diagram to illustrate how each of the following events affects the equilibrium price and quantity of pizza.
- The price of mozzarella cheese rises.
  - The health hazards of hamburgers are widely publicized.
  - The price of tomato sauce falls.
  - The incomes of consumers rise, and pizza is an inferior good.
  - Consumers expect the price of pizza to fall next week.

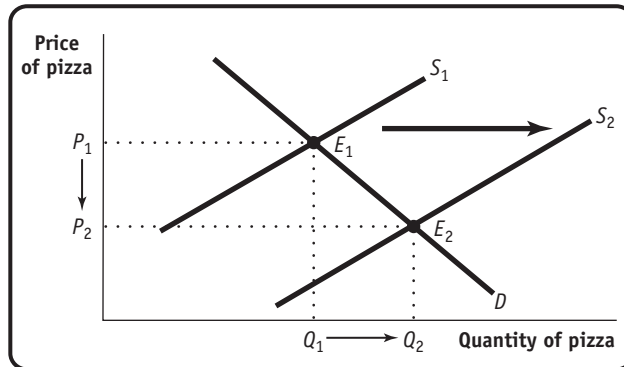
- 16. a.** Mozzarella is an input in the production of pizza. Since the cost of an input has risen, pizza producers will reduce the quantity supplied at any given price, a leftward shift of the supply curve from  $S_1$  to  $S_2$ . As a result, the equilibrium price of pizza will rise and the equilibrium quantity will fall as the equilibrium changes from  $E_1$  to  $E_2$ .



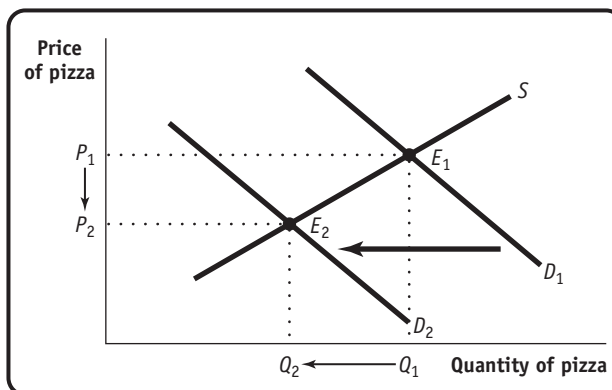
- b.** Consumers will substitute pizza in place of hamburgers, resulting in an increased demand for pizza at any given price. This generates a rightward shift of the demand curve from  $D_1$  to  $D_2$ , leading to a rise in the equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



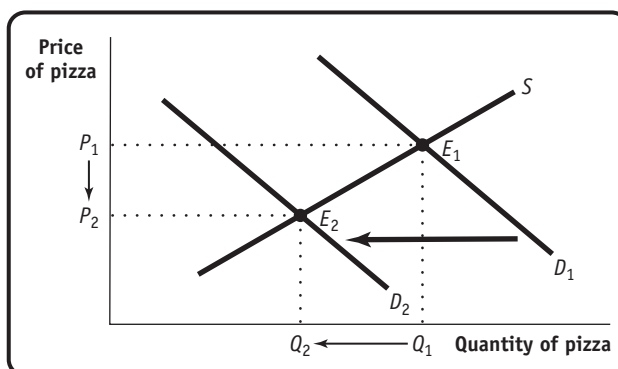
- c. Tomato sauce is an input in the production of pizza. Since the cost of an input has fallen, pizza producers will increase the quantity supplied at any given price, a rightward shift of the supply curve from  $S_1$  to  $S_2$ . As a result, the equilibrium price of pizza will fall and the equilibrium quantity will rise as the equilibrium changes from  $E_1$  to  $E_2$ .



- d. The demand for an inferior good decreases when the incomes of consumers rise. So a rise in consumer incomes produces a leftward shift of the demand curve from  $D_1$  to  $D_2$ , resulting in a lower equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



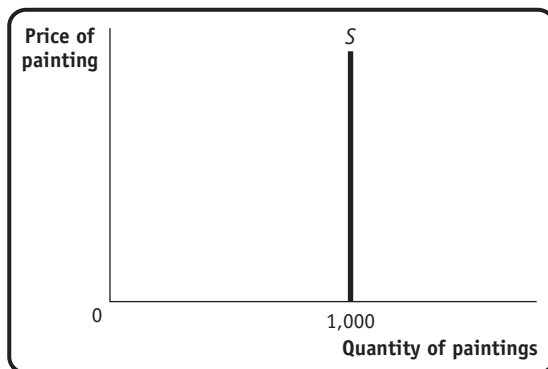
- e. Consumers will delay their purchases of pizza today in anticipation of consuming more pizza next week. As a result, the demand curve shifts leftward from  $D_1$  to  $D_2$ , resulting in a lower equilibrium price and quantity as the equilibrium changes from  $E_1$  to  $E_2$ .



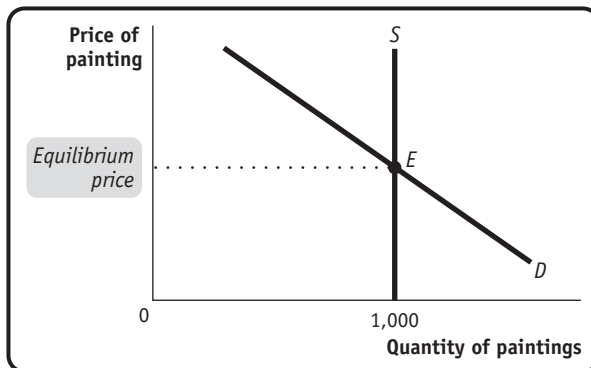
- 17.** Although he was a prolific artist, Pablo Picasso painted only 1,000 canvases during his “Blue Period.” Picasso is now dead, and all of his Blue Period works are currently on display in museums and private galleries throughout Europe and the United States.
- Draw a supply curve for Picasso Blue Period works. Why is this supply curve different from ones you have seen?
  - Given the supply curve from part a, the price of a Picasso Blue Period work will be entirely dependent on what factor(s)? Draw a diagram showing how the equilibrium price of such a work is determined.
  - Suppose rich art collectors decide that it is essential to acquire Picasso Blue Period art for their collections. Show the impact of this on the market for these paintings.

### Solution

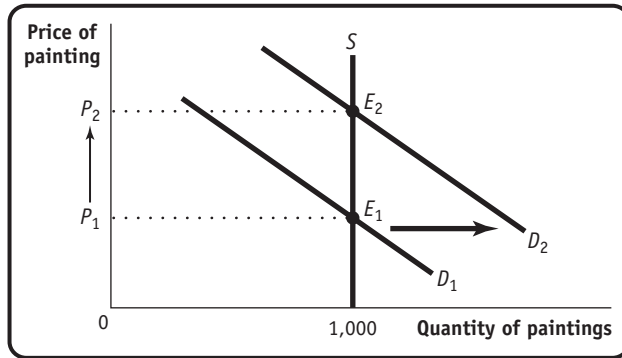
- 17. a.** There are no more Picasso Blue Period works available. Hence the supply curve is a vertical line at the quantity 1,000.



- b.** Since supply is fixed, the price of a Picasso Blue Period work is entirely determined by demand. Any change in demand is fully reflected in a change in price.



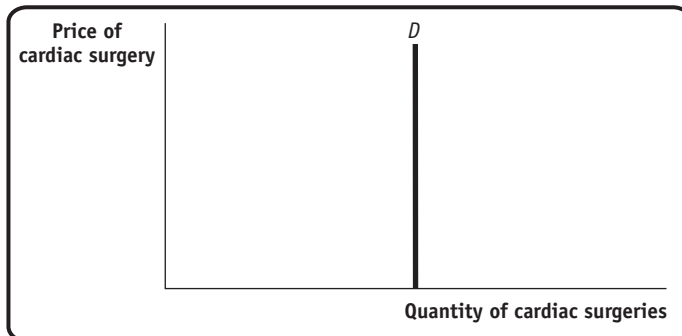
- c. This results in a rightward shift of the demand curve for these works from  $D_1$  to  $D_2$ , and the equilibrium changes from  $E_1$  to  $E_2$ . But since no more works are available, this increase in demand simply results in an increase in the equilibrium price.



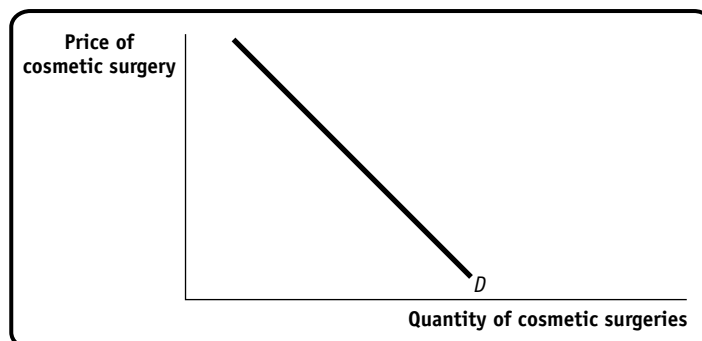
18. Draw the appropriate curve in each of the following cases. Is it like or unlike the curves you have seen so far? Explain.
- The demand for cardiac bypass surgery, given that the government pays the full cost for any patient
  - The demand for elective cosmetic plastic surgery, given that the patient pays the full cost
  - The supply of reproductions of Rembrandt paintings

**Solution**

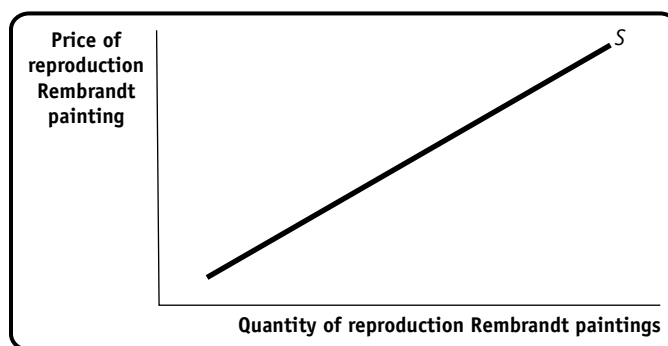
18. a. Since the government pays the full cost of cardiac bypass surgery, the price paid by the patient is always zero. Consequently, the demand for surgery is constant, regardless of the price actually paid by the government. The quantity demanded is constant at the quantity that would be demanded by patients if the government, not the patient, pays for surgery. That is, it is a vertical line at the quantity that patients would demand if the price of surgery to them were zero.



- b. In this case, the patient must pay the cost of the surgery, so the quantity demanded is affected by price, and the demand curve has its usual downward-sloping shape.



- c. The supply of Rembrandt reproductions is not fixed because they can be created by existing artists. So the supply curve of these reproductions has the familiar upward-sloping shape.



19. The accompanying table gives the annual U.S. demand and supply schedules for pickup trucks.

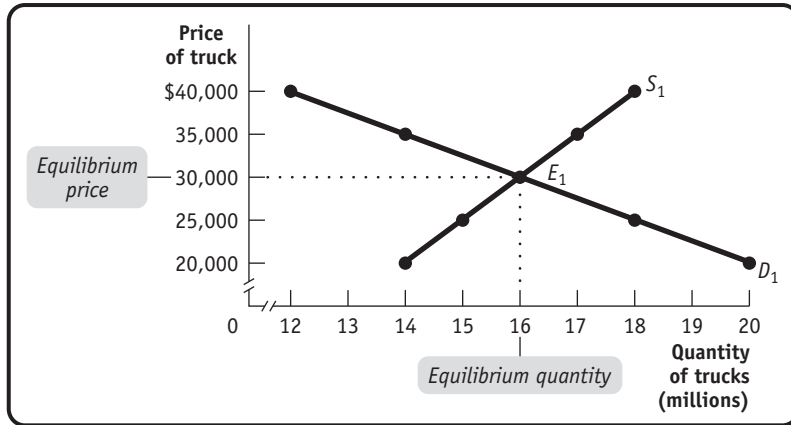
Price of truck	Quantity of trucks demanded (millions)	Quantity of trucks supplied (millions)
\$20,000	20	14
25,000	18	15
30,000	16	16
35,000	14	17
40,000	12	18

- Plot the demand and supply curves using these schedules. Indicate the equilibrium price and quantity on your diagram.
- Suppose the tires used on pickup trucks are found to be defective. What would you expect to happen in the market for pickup trucks? Show this on your diagram.
- Suppose that the U.S. Department of Transportation imposes costly regulations on manufacturers that cause them to reduce supply by one-third at any given price. Calculate and plot the new supply schedule and indicate the new equilibrium price and quantity on your diagram.



**Solution**

19. a. The supply curve is  $S_1$  and the demand curve is  $D_1$ . The equilibrium in the market for pickup trucks is indicated by point  $E_1$ , with an equilibrium price of \$30,000 and an equilibrium quantity of 16 million trucks bought and sold.

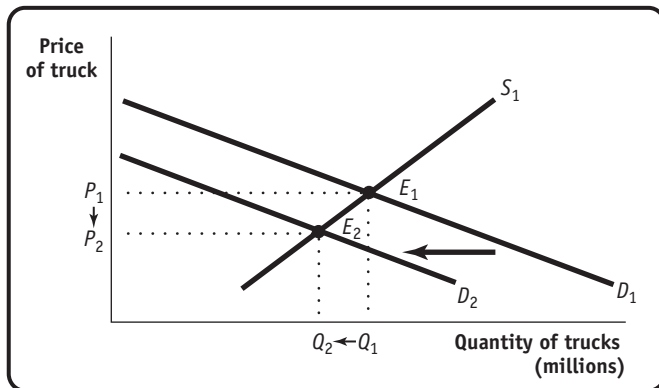


**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



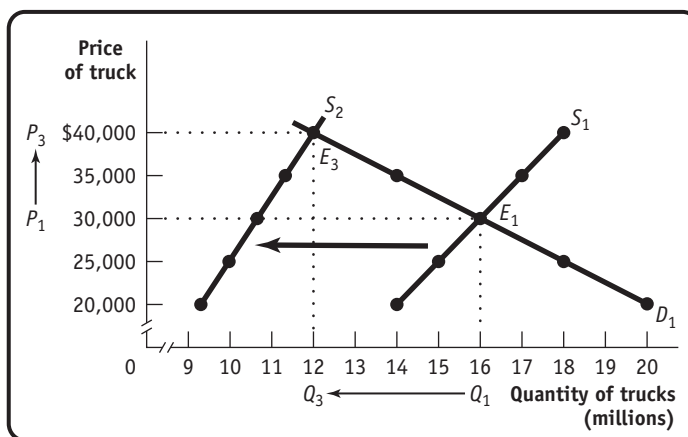
- b. The announcement of a defect is likely to decrease the demand for pickup trucks. This is represented by a leftward shift of the demand curve, as shown by the shift from  $D_1$  to  $D_2$ , and causes the equilibrium price and quantity to fall as the equilibrium changes from  $E_1$  to  $E_2$ .



- c. The new supply schedule is as follows.

Price of truck	Quantity of trucks supplied (millions)
\$20,000	9.3
25,000	10.0
30,000	10.7
35,000	11.3
40,000	12.0

This one-third decrease in the quantity supplied at any given price is shown as a leftward shift of the supply curve from  $S_1$  to  $S_2$ . It results in a new, higher equilibrium price, \$40,000 per truck, and a lower equilibrium quantity, 12 million trucks, as shown by the change of the equilibrium from  $E_1$  to  $E_3$ .



# Consumer and Producer Surplus

1. Determine the amount of consumer surplus generated in each of the following situations.
  - a. Leon goes to the clothing store to buy a new T-shirt, for which he is willing to pay up to \$10. He picks out one he likes with a price tag of exactly \$10. When he is paying for it, he learns that the T-shirt has been discounted by 50%.
  - b. Alberto goes to the music store hoping to find a used copy of *Nirvana's Nevermind* for up to \$30. The store has one copy of the record selling for \$30, which he purchases.
  - c. After soccer practice, Stacey is willing to pay \$2 for a bottle of mineral water. The 7-Eleven sells mineral water for \$2.25 per bottle, so she declines to purchase it.

## Solution

1.
  - a. Leon's consumer surplus is \$5. This is the difference between how much he is willing to pay (\$10) and how much he does pay (\$5).
  - b. Since Alberto's willingness to pay is \$30 and the price of the record is \$30, he gets zero consumer surplus.
  - c. No trade takes place because Stacey's willingness to pay is less than the price. So no consumer surplus is created.
2. Determine the amount of producer surplus generated in each of the following situations.
  - a. Gordon lists his old Lionel electric trains on eBay. He sets a minimum acceptable price, known as his *reserve price*, of \$75. After five days of bidding, the final high bid is exactly \$75. He accepts the bid.
  - b. So-Hee advertises her car for sale in the used-car section of the student newspaper for \$2,000, but she is willing to sell the car for any price higher than \$1,500. The best offer she gets is \$1,200, which she declines.
  - c. Sanjay likes his job so much that he would be willing to do it for free. However, his annual salary is \$80,000.

## Solution

2.
  - a. Gordon will receive no producer surplus since the price received for the trains is equal to his cost.
  - b. No trade takes place because So-Hee's cost is \$1,500, which is higher than the price of \$1,200 she is offered. So no producer surplus is created.
  - c. Sanjay's cost is zero. The price he is paid for his time is \$80,000, so his producer surplus is \$80,000.
3. There are six potential consumers of computer games, each willing to buy only one game. Consumer 1 is willing to pay \$40 for a computer game, consumer 2 is willing to pay \$35, consumer 3 is willing to pay \$30, consumer 4 is willing to pay \$25, consumer 5 is willing to pay \$20, and consumer 6 is willing to pay \$15.
  - a. Suppose the market price is \$29. What is the total consumer surplus?
  - b. The market price decreases to \$19. What is the total consumer surplus now?
  - c. When the price fell from \$29 to \$19, how much did each consumer's individual consumer surplus change? How does total consumer surplus change?

## Solution

- 3. a.** Consumer 1 buys a game since her willingness to pay is greater than the price. She gains  $\$40 - \$29 = \$11$ .
- Consumer 2 buys a game since his willingness to pay is greater than the price. He gains  $\$35 - \$29 = \$6$ .
- Consumer 3 buys a game since her willingness to pay is greater than the price. She gains  $\$30 - \$29 = \$1$ .
- The total consumer surplus is  $\$11 + \$6 + \$1 = \$18$ .
- b.** Consumer 1 buys a game since her willingness to pay is greater than the price. She gains  $\$40 - \$19 = \$21$ .
- Consumer 2 buys a game since his willingness to pay is greater than the price. He gains  $\$35 - \$19 = \$16$ .
- Consumer 3 buys a game since her willingness to pay is greater than the price. She gains  $\$30 - \$19 = \$11$ .
- Consumer 4 buys a game since his willingness to pay is greater than the price. He gains  $\$25 - \$19 = \$6$ .
- Consumer 5 buys a game since her willingness to pay is greater than the price. She gains  $\$20 - \$19 = \$1$ .
- The total consumer surplus is  $\$21 + \$16 + \$11 + \$6 + \$1 = \$55$ .
- c.** Total consumer surplus increases by  $\$55 - \$18 = \$37$  as a result of the price decrease. For consumers 1, 2, and 3 (the consumers who would also have bought games at the higher price), individual consumer surplus increases by \$10 each, the amount of the price reduction. This accounts for \$30 of the increase in consumer surplus. But consumers 4 and 5 now also get consumer surplus, since the lower price leads them to buy computer games also. Consumer 4 gets \$6 of consumer surplus, and consumer 5 gets \$1, accounting for the remaining \$7 of additional consumer surplus.
- 4. a.** In an auction, potential buyers compete for a good by submitting bids. Adam Galinsky, a social psychologist at Northwestern University, compared eBay auctions in which the same good was sold. He found that, on average, the higher the number of bidders, the higher the sales price. For example, in two auctions of identical iPods, the one with the higher number of bidders brought a higher selling price. According to Galinsky, this explains why smart sellers on eBay set absurdly low opening prices (the lowest price that the seller will accept), such as 1 cent for a new iPod. Use the concepts of consumer and producer surplus to explain Galinsky's reasoning.
- b.** You are considering selling your vintage 1969 convertible Volkswagen Beetle. If the car is in good condition, it is worth a lot; if it is in poor condition, it is useful only as scrap. Assume that your car is in excellent condition but that it costs a potential buyer \$500 for an inspection to learn the car's condition. Use what you learned in part a to explain whether or not you should pay for an inspection and share the results with all interested buyers.

## Solution

4. a. The higher the sales price, the greater the producer surplus received by a seller. So Galinsky's observation that a larger number of bidders results in a higher sales price means that a seller will want to take actions that increase the number of bidders for her good. The way to do this is to set a lower opening price. When the opening price is low, the seller is allowing more of the total surplus to be available to the winning bidder at the beginning of the auction. A potential buyer is more likely to bid if the opening price is low because he believes he can get a large share of the total surplus (that is, a large amount of consumer surplus) if he wins. If no one else bids, the bidder will indeed get that large amount of consumer surplus. But a low opening price also attracts other bidders, which, on average, increases the selling price and delivers more of the total surplus to the seller.
- b. If each potential bidder for your car has to pay the \$500 inspection cost or take the chance of paying for a car that is nearly worthless, then very few people will bid for your car. And as shown in part a, with fewer bidders it is likely that you will receive less for your car than if you had a larger number of bidders. Many more people, though, will bid for your car if they are able to find out, for free, that it is in excellent condition. So it would be smart of you to increase the number of potential bidders by paying for the inspection report yourself and sharing it freely.
5. Assume that due to an increase in demand, the average domestic airline fare increased from \$319.85 in the fourth quarter of 2013 to \$328.12 in the first quarter of 2014, an increase of \$8.27. The number of passenger tickets sold in the fourth quarter of 2013 was 151.4 million. Over the same period, the airlines' costs remained roughly the same: the price of jet fuel averaged around \$2 per gallon in both quarters and airline pilots' salaries remained roughly the same, averaging \$117,060 per year in 2013).

Can you determine precisely by how much producer surplus has increased as a result of the \$8.27 increase in the average fare? If you cannot be precise, can you determine whether it will be less than, or more than, a specific amount?

## Solution

5. Without knowing the exact supply curve, you cannot be specific about the increase in producer surplus. If the quantity of tickets supplied had not changed, producer surplus would have increased by  $\$8.27 \times 151.4 \text{ million} = \$1.252 \text{ billion}$ . But since supply curves normally slope upward and because the price has increased, producer surplus will have increased by more than \$1.252 billion.

6. The accompanying table shows the supply and demand schedules for used copies of the third edition of this textbook. The supply schedule is derived from offers at Amazon.com. The demand schedule is hypothetical.

Price of book	Quantity of books demanded	Quantity of books supplied
\$55	50	0
60	35	1
65	25	3
70	17	3
75	14	6
80	12	9
85	10	10
90	8	18
95	6	22
100	4	31
105	2	37
110	0	42

- a. Calculate consumer and producer surplus at the equilibrium in this market.
- b. Now the fourth edition of this textbook becomes available. As a result, the willingness to pay of each potential buyer for a second-hand copy of the third edition falls by \$20. In a table, show the new demand schedule and again calculate consumer and producer surplus at the new equilibrium.

## Solution

6. a. The equilibrium price is \$85, and 10 copies are bought and sold. Starting with the buyers with the highest willingness to pay, the first two buyers' willingness to pay is \$105, and so they each receive consumer surplus of  $\$105 - \$85 = \$20$ . The next two buyers' willingness to pay is \$100, and so they each receive consumer surplus of  $\$100 - \$85 = \$15$ . The next two buyers' willingness to pay is \$95, and so they each receive consumer surplus of  $\$95 - \$85 = \$10$ . The next two buyers' willingness to pay is \$90, and so they each receive consumer surplus of  $\$90 - \$85 = \$5$ . The next two buyers' willingness to pay is \$85, and so they each receive consumer surplus of  $\$85 - \$85 = \$0$ . All remaining potential buyers receive no consumer surplus since their willingness to pay is below the market price. Total consumer surplus is therefore  $2 \times \$20 + 2 \times \$15 + 2 \times \$10 + 2 \times \$5 = \$100$ .

Starting with the sellers with the lowest cost, the first seller's cost is \$60, and so she receives producer surplus of  $\$85 - \$60 = \$25$ . The next two sellers' cost is \$65, and so they each receive producer surplus of  $\$85 - \$65 = \$20$ . The next three sellers' cost is \$75, and so they each receive producer surplus of  $\$85 - \$75 = \$10$ . The next three sellers' cost is \$80, and so they each receive producer surplus of  $\$85 - \$80 = \$5$ . The next seller's cost is \$85, and so she receives producer surplus of  $\$85 - \$85 = \$0$ . All remaining potential sellers receive no producer surplus since their cost is above the market price. Total producer surplus is therefore  $1 \times \$25 + 2 \times \$20 + 3 \times \$10 + 3 \times \$5 = \$110$ .

- b. The new demand schedule is shown in the accompanying table.

Price of book	Quantity of books demanded	Quantity of books supplied
\$55	14	0
60	12	1
65	10	3
70	8	3
75	6	6
80	4	9
85	2	10

The equilibrium price is \$75, and 6 copies are bought and sold. Starting with the buyers with the highest willingness to pay, the first two buyers' willingness to pay is \$85, and so they each receive consumer surplus of  $\$85 - \$75 = \$10$ . The next two buyers' willingness to pay is \$80, and so they each receive consumer surplus of  $\$80 - \$75 = \$5$ . The next two buyers' willingness to pay is \$75, and so they each receive consumer surplus of  $\$75 - \$75 = \$0$ . All remaining potential buyers receive no consumer surplus since their willingness to pay is below the market price. So total consumer surplus is  $2 \times \$10 + 2 \times \$5 = \$30$ .

Starting with the sellers with the lowest cost, the first seller's cost is \$60, and so she receives producer surplus of  $\$75 - \$60 = \$15$ . The next two sellers' cost is \$65, and so they each receive producer surplus of  $\$75 - \$65 = \$10$ . The next three sellers' cost is \$75, and so they each receive producer surplus of  $\$75 - \$75 = \$0$ . All remaining potential sellers receive no producer surplus since their cost is above the market price. Total producer surplus is therefore  $1 \times \$15 + 2 \times \$10 = \$35$ .

7. On Thursday nights, a local restaurant has a pasta special. Ari likes the restaurant's pasta, and his willingness to pay for each serving is shown in the accompanying table.

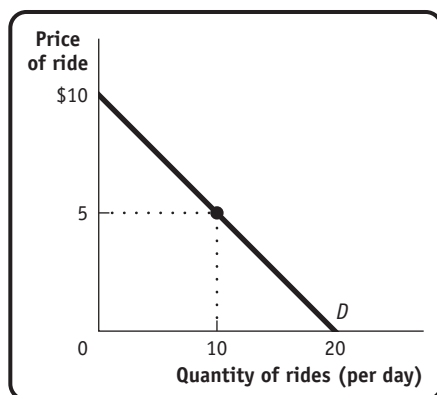
Quantity of pasta (servings)	Willingness to pay for pasta (per serving)
1	\$10
2	8
3	6
4	4
5	2
6	0

- a. If the price of a serving of pasta is \$4, how many servings will Ari buy? How much consumer surplus does he receive?
- b. The following week, Ari is back at the restaurant again, but now the price of a serving of pasta is \$6. By how much does his consumer surplus decrease compared to the previous week?

- c. One week later, he goes to the restaurant again. He discovers that the restaurant is offering an “all-you-can-eat” special for \$25. How much pasta will Ari eat, and how much consumer surplus does he receive now?
- d. Suppose you own the restaurant and Ari is a typical customer. What is the highest price you can charge for the “all-you-can-eat” special and still attract customers?

## Solution

7.
  - a. Ari will buy four servings of pasta. His consumer surplus is equal to \$12, that is:  $(\$10 - \$4) + (\$8 - \$4) + (\$6 - \$4) + (\$4 - \$4) = \$12$ .
  - b. Ari will buy three servings of pasta. His consumer surplus is  $(\$10 - \$6) + (\$8 - \$6) + (\$6 - \$6) = \$6$ , so his consumer surplus falls by \$6, from \$12 to \$6.
  - c. If there is an “all-you-can-eat” special, the price Ari pays per serving is zero. Therefore, he will eat six servings of pasta. The total amount he is willing to pay for those six servings is \$30, the sum of the amounts he is willing to pay for each individual serving. Since he actually pays \$25, his consumer surplus is \$5.
  - d. When there is an “all-you-can-eat” special, Ari will consume six servings, which, if free, would give him consumer surplus of \$30. Therefore, the most he is willing to pay for an “all-you-can-eat” special is \$30. If Ari is a typical customer, this is the highest price you can charge for the special.
8. You are the manager of Fun World, a small amusement park. The accompanying diagram shows the demand curve of a typical customer at Fun World.

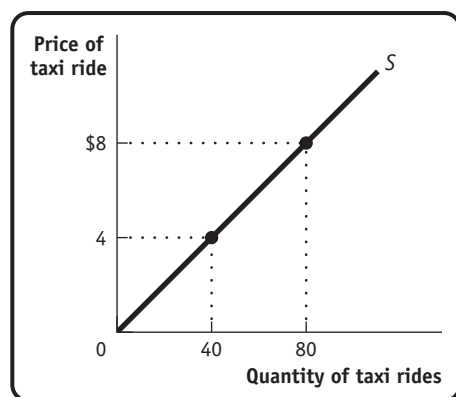


- a. Suppose that the price of each ride is \$5. At that price, how much consumer surplus does an individual consumer get? (Recall that the area of a right triangle is  $\frac{1}{2} \times$  the height of the triangle  $\times$  the base of the triangle.)
- b. Suppose that Fun World considers charging an admission fee, even though it maintains the price of each ride at \$5. What is the maximum admission fee it could charge? (Assume that all potential customers have enough money to pay the fee.)
- c. Suppose that Fun World lowered the price of each ride to zero. How much consumer surplus does an individual consumer get? What is the maximum admission fee Fun World could charge?



## Solution

8. a. From the demand curve, you can see that with a price per ride of \$5, the customer takes 10 rides. At this point her consumer surplus is  $\frac{1}{2} \times (\$10 - \$5) \times 10 = \$25$ .
- b. Since a consumer obtains consumer surplus of \$25 from going to Fun World when each ride costs \$5, that is the most that she would be willing to pay to go there. And it is therefore the maximum admission fee that Fun World could charge. (Charging consumers both an entrance fee and a price for each unit of a good bought is called a *two-part tariff*.)
- c. If Fun World charged nothing for each ride, a typical consumer would consume 20 rides, and this would give her a consumer surplus of  $\frac{1}{2} \times \$10 \times 20 = \$100$ . This is the maximum admission fee that Fun World can charge with a price per ride of zero.
9. The accompanying diagram illustrates a taxi driver's individual supply curve (assume that each taxi ride is the same distance).



- a. Suppose the city sets the price of taxi rides at \$4 per ride, and at \$4 the taxi driver is able to sell as many taxi rides as he desires. What is this taxi driver's producer surplus? (Recall that the area of a right triangle is  $\frac{1}{2} \times$  the height of the triangle  $\times$  the base of the triangle.)
- b. Suppose that the city keeps the price of a taxi ride set at \$4, but it decides to charge taxi drivers a "licensing fee." What is the maximum licensing fee the city could extract from this taxi driver?
- c. Suppose that the city allowed the price of taxi rides to increase to \$8 per ride. Again assume that, at this price, the taxi driver sells as many rides as he is willing to offer. How much producer surplus does an individual taxi driver now get? What is the maximum licensing fee the city could charge this taxi driver?

## Solution

9. a. At a price of \$4, the taxi driver supplies 40 rides. His producer surplus is therefore  $\frac{1}{2} \times \$4 \times 40 = \$80$ .
- b. Since the taxi driver's producer surplus is \$80, this is the most he is willing to pay to supply 40 rides at \$4. So it is the most the city can charge him as a licensing fee.
- c. At a price of \$8, the taxi driver supplies 80 rides, making his producer surplus  $\frac{1}{2} \times \$8 \times 80 = \$320$ . So \$320 is the most the city can charge as a licensing fee when the price per ride is \$8.

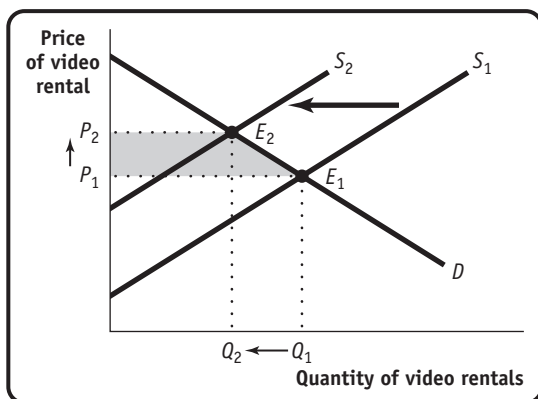
- 10.** In 2010, a New York district judge ruled in a copyright infringement lawsuit against the popular file-sharing website LimeWire and in favor of the 13 major record companies that had brought the lawsuit. The record companies, including Sony, Virgin, and Warner Brothers, had alleged that the file-sharing service encourages users to make illegal copies of copyrighted material. Allowing Internet users to obtain music for free limits the record companies' right to dispose of the music as they choose; in particular, it limits their right to give access to their music only to those who have paid for it. In other words, it limits the record companies' property rights.
- If everyone obtained music and video content for free from websites such as LimeWire, instead of paying the record companies, what would the record companies' producer surplus be from music sales? What are the implications for record companies' incentive to produce music content in the future?
  - If the record companies had lost the lawsuit and music could be freely downloaded from the Internet, what do you think would happen to mutually beneficial transactions (the producing and buying of music) in the future?

### Solution

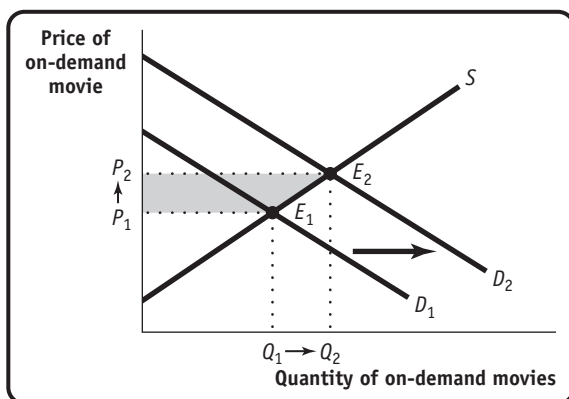
- 10.**
- If everyone obtained music and video content for free, record companies' producer surplus from producing music and videos would be zero. They would have no incentive to produce this content and so would not produce it in the future.
  - As a result of the limited property rights, many otherwise mutually beneficial transactions would not occur.
- 11.** Hollywood screenwriters negotiate a new agreement with movie producers stipulating that they will receive 10% of the revenue from every video rental of a movie they authored. They have no such agreement for movies shown on on-demand television.
- When the new writers' agreement comes into effect, what will happen in the market for video rentals—that is, will supply or demand shift, and how? As a result, how will consumer surplus in the market for video rentals change? Illustrate with a diagram. Do you think the writers' agreement will be popular with consumers who rent videos?
  - Consumers consider video rentals and on-demand movies substitutable to some extent. When the new writers' agreement comes into effect, what will happen in the market for on-demand movies—that is, will supply or demand shift, and how? As a result, how will producer surplus in the market for on-demand movies change? Illustrate with a diagram. Do you think the writers' agreement will be popular with cable television companies that show on-demand movies?

## Solution

11. a. The payment to writers will increase the cost of providing video rentals. In the accompanying diagram, the supply curve shifts leftward from  $S_1$  to  $S_2$ , the equilibrium price of video rentals rises from  $P_1$  to  $P_2$ , and the quantity of video rentals bought and sold falls from  $Q_1$  to  $Q_2$ . As a result, consumer surplus will decrease by the shaded amount. The writers' agreement will not be popular with consumers.



- b. The higher price of video rentals will make on-demand movies more popular. They are substitute goods, and the demand for them will increase when the price of video rentals rises. In the accompanying diagram, the demand curve shifts rightward from  $D_1$  to  $D_2$ , the equilibrium price rises from  $P_1$  to  $P_2$ , and the equilibrium quantity rises from  $Q_1$  to  $Q_2$ . Producer surplus will increase by the shaded amount. This change will be popular with the cable television companies that show on-demand movies.



## WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via





# Price Controls and Quotas: Meddling with Markets

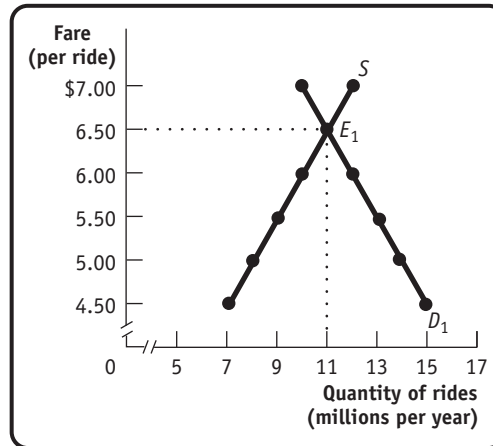
1. In order to ingratiate himself with voters, the mayor of Gotham City decides to lower the price of taxi rides. Assume, for simplicity, that all taxi rides are the same distance and therefore cost the same. The accompanying table shows the demand and supply schedules for taxi rides.

Fare (per ride)	Quantity of rides (millions per year)	
	Quantity demanded	Quantity supplied
\$7.00	10	12
6.50	11	11
6.00	12	10
5.50	13	9
5.00	14	8
4.50	15	7

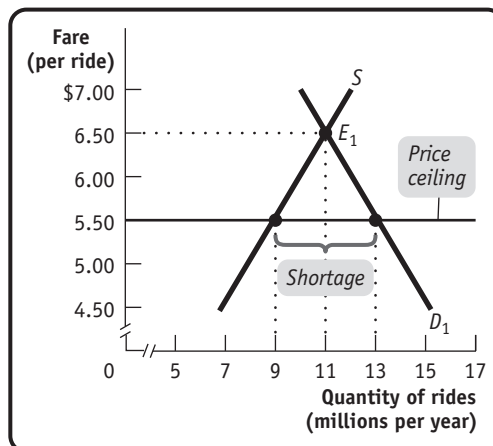
- Assume that there are no restrictions on the number of taxi rides that can be supplied (there is no medallion system). Find the equilibrium price and quantity.
- Suppose that the mayor sets a price ceiling at \$5.50. How large is the shortage of rides? Illustrate with a diagram. Who loses and who benefits from this policy?
- Suppose that the stock market crashes and, as a result, people in Gotham City are poorer. This reduces the quantity of taxi rides demanded by 6 million rides per year at any given price. What effect will the mayor's new policy have now? Illustrate with a diagram.
- Suppose that the stock market rises and the demand for taxi rides returns to normal (that is, returns to the demand schedule given in the table). The mayor now decides to ingratiate himself with taxi drivers. He announces a policy in which operating licenses are given to existing taxi drivers; the number of licenses is restricted such that only 10 million rides per year can be given. Illustrate the effect of this policy on the market, and indicate the resulting price and quantity transacted. What is the quota rent per ride?

## Solution

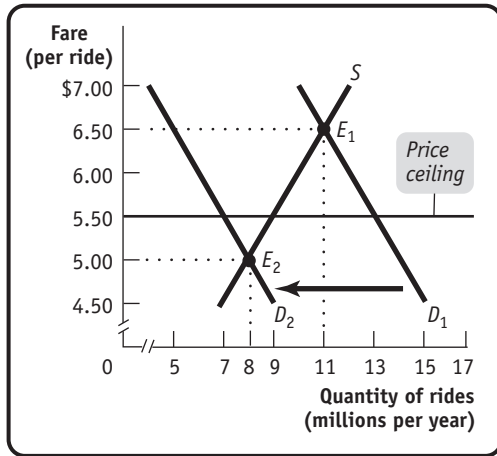
1. a. The equilibrium in the market for taxi rides is shown by  $E_1$  in the accompanying diagram. The equilibrium price is \$6.50; at that price, the quantity demanded equals the quantity supplied—11 million taxi rides per year. The demand and supply curves ( $D_1$  and  $S$ ) illustrate this initial situation.



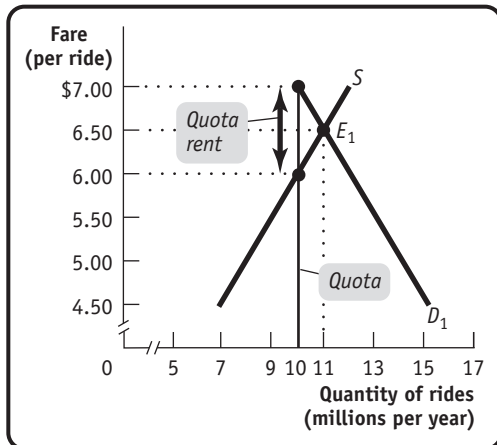
- b. With a price ceiling of \$5.50, the quantity supplied is 9 million taxi rides and the quantity demanded is 13 million. So the shortage is 13 million – 9 million = 4 million. Taxi drivers clearly lose out: there are fewer taxi rides supplied than before, and at a lower price. The impact on consumers is unclear: fewer people now manage to get rides, but those who do, get them at a lower price.



- c. The new demand curve is  $D_2$ . Now the price ceiling has no effect: the equilibrium is point  $E_2$  and the market price settles at \$5, which is below the mandated price ceiling of \$5.50. There will be 8 million taxi rides demanded and supplied, at a price of \$5 each.



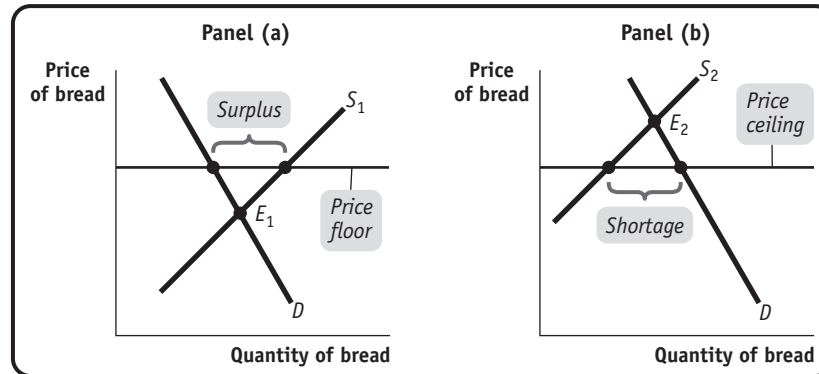
- d. The accompanying diagram illustrates the effect of the quota of 10 million taxi rides. The quantity of taxi rides is now 10 million, at a price of \$7. The quota rent per ride is \$1.



2. In the late eighteenth century, the price of bread in New York City was controlled, set at a predetermined price above the market price.
- Draw a diagram showing the effect of the policy. Did the policy act as a price ceiling or a price floor?
  - What kinds of inefficiencies were likely to have arisen when the controlled price of bread was above the market price? Explain in detail.
- One year during this period, a poor wheat harvest caused a leftward shift in the supply of bread and therefore an increase in its market price. New York bakers found that the controlled price of bread in New York was below the market price.
- Draw a diagram showing the effect of the price control on the market for bread during this one-year period. Did the policy act as a price ceiling or a price floor?
  - What kinds of inefficiencies do you think occurred during this period? Explain in detail.

## Solution

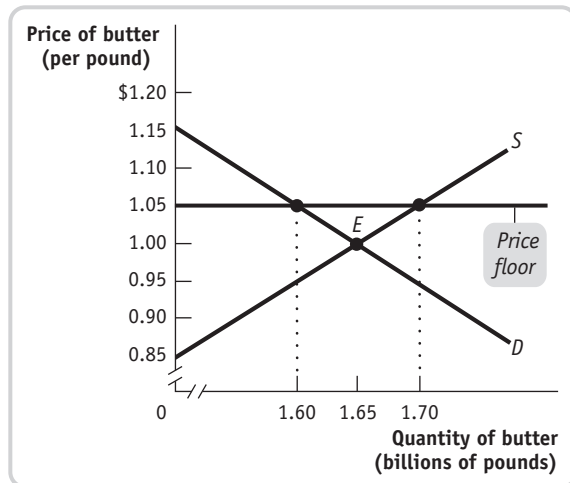
2. a. Panel (a) of the accompanying diagram illustrates the effect of this policy. Since the price is set *above* the market equilibrium price, this policy acts as a price floor: it raises the price artificially above the equilibrium. As a result, too much bread is produced: there is a surplus.



- b. As with all price floors above the equilibrium price, there are several associated inefficiencies. First, there is deadweight loss from inefficiently low quantity. Some transactions that would have occurred at the unregulated market price no longer occur. Second, there is inefficient allocation of sales among bakers. Some bakers who are willing to sell at a lower price don't get to operate, while bakers who will only operate by selling at a higher price do get to operate. Third, there are wasted resources from surplus production of bread that must be given or thrown away. Fourth, there is inefficiently high quality as bakers produce bread of higher quality than consumers want. Consumers would instead prefer a lower price.
- c. Panel (b) illustrates the effect of the fixed price if the market equilibrium is above that price. The set price now acts like a price ceiling, preventing the price from rising to the equilibrium. There is a shortage, as occurs with every price ceiling below the equilibrium price.
- d. As with all price ceilings below the equilibrium price, there are several associated inefficiencies. First, there is deadweight loss from inefficiently low quantity. There is a persistent shortage of bread, and some transactions that would have occurred at the equilibrium price no longer occur. Second, there is inefficient allocation to consumers, as some who want bread very much are not able to find any, while those who value bread less are able to purchase some. Third, there are wasted resources as consumers expend resources to find bread. Fourth, there is inefficiently low quality of bread that is offered for sale.



3. The U.S. Department of Agriculture (USDA) administers the price floor for butter, which the 2008 Farm Bill set at \$1.05 per pound. At that price, according to data from the USDA, the quantity of butter supplied in 2010 was 1.7 billion pounds, and the quantity demanded was 1.6 billion pounds. To support the price of butter at the price floor, the USDA therefore had to buy up 100 million pounds of butter. The accompanying diagram shows supply and demand curves illustrating the market for butter.



- In the absence of a price floor, how much consumer surplus is created? How much producer surplus? What is the total surplus?
- With the price floor at \$1.05 per pound of butter, consumers buy 1.6 billion pounds of butter. How much consumer surplus is created now?
- With the price floor at \$1.05 per pound of butter, producers sell 1.7 billion pounds of butter (some to consumers and some to the USDA). How much producer surplus is created now?
- How much money does the USDA spend on buying up surplus butter?
- Taxes must be collected to pay for the purchases of surplus butter by the USDA. As a result, total surplus (producer plus consumer) is reduced by the amount the USDA spent on buying surplus butter. Using your answers for parts b–d, what is the total surplus when there is a price floor? How does this compare to the total surplus without a price floor from part a?

## Solution

- In the absence of a price floor, consumer surplus is the area below the demand curve but above the equilibrium price of \$1.00: it is  $((\$1.15 - \$1.00) \times 1.65 \text{ billion})/2 = \$123.75 \text{ million}$ . Producer surplus is the area above the supply curve but below the equilibrium price of \$1.00: it is  $((\$1.00 - \$0.85) \times 1.65 \text{ billion})/2 = \$123.75 \text{ million}$ . Total surplus therefore is  $\$123.75 \text{ million} + \$123.75 \text{ million} = \$247.5 \text{ million}$ .
  - With the price floor at \$1.05 per pound, consumer surplus is the area below the demand curve but above the price of \$1.05: it is  $((\$1.15 - \$1.05) \times 1.6 \text{ billion})/2 = \$80 \text{ million}$ .
  - With the price floor at \$1.05 per pound, producer surplus is the area above the supply curve but below the price of \$1.05: it is  $((\$1.05 - \$0.85) \times 1.7 \text{ billion})/2 = \$170 \text{ million}$ .
  - The USDA buys 100 million pounds of butter at a price of \$1.05 per pound, for a total of  $\$1.05 \times 100 \text{ million} = \$105 \text{ million}$ .

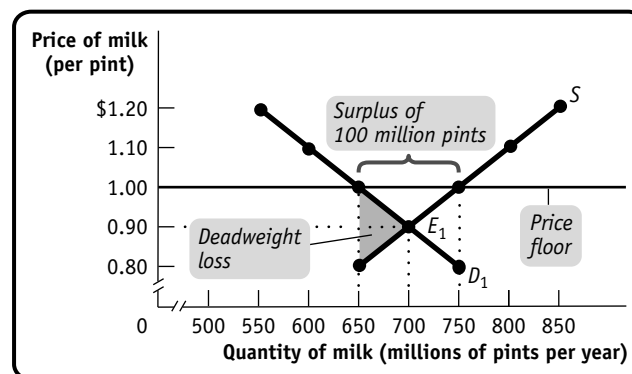
- e. Total surplus when there is a price floor is consumer surplus plus producer surplus minus the money spent by the USDA. It is \$80 million + \$170 million – \$105 million = \$145 million. This is less than the \$247.5 million total surplus without any price support.
4. The accompanying table shows hypothetical demand and supply schedules for milk per year. The U.S. government decides that the incomes of dairy farmers should be maintained at a level that allows the traditional family dairy farm to survive. So it implements a price floor of \$1 per pint by buying surplus milk until the market price is \$1 per pint.

Price of milk (per pint)	Quantity of milk (millions of pints per year)	
	Quantity demanded	Quantity supplied
\$1.20	550	850
1.10	600	800
1.00	650	750
0.90	700	700
0.80	750	650

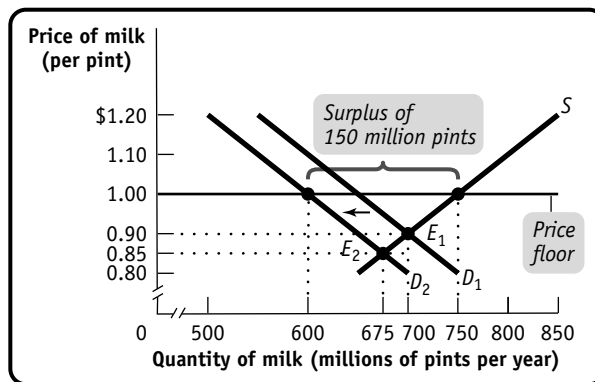
- a. In a diagram, show the deadweight loss from the inefficiently low quantity bought and sold.
- b. How much surplus milk will be produced as a result of this policy?
- c. What will be the cost to the government of this policy?
- d. Since milk is an important source of protein and calcium, the government decides to provide the surplus milk it purchases to elementary schools at a price of only \$0.60 per pint. Assume that schools will buy any amount of milk available at this low price. But parents now reduce their purchases of milk at any price by 50 million pints per year because they know their children are getting milk at school. How much will the dairy program now cost the government?
- e. Explain how inefficiencies in the form of inefficient allocation to sellers and wasted resources arise from this policy.

## Solution

4. a. The deadweight loss is shown in the accompanying diagram by the shaded triangle.
- b. With demand of  $D_1$  and supply of  $S$ , the equilibrium would be at point  $E_1$  in the accompanying diagram. However, with a price floor at \$1, the quantity supplied is 750 million pints and the quantity demanded is 650 million pints. So the policy causes a surplus of milk of 100 million pints per year.



- c. In order to sustain this price floor (to prevent black market sales of surplus milk below the price floor), the government has to buy up the surplus of milk. Buying 100 million pints of milk at a price of \$1 each costs the government \$100 million.
- d. As a result of sales of cheap milk to schools, the quantity demanded falls by 50 million pints per year at any price: the demand curve shifts leftward to the new demand curve  $D_2$ . Without the price floor, the equilibrium would now be at point  $E_2$ . However, with the price floor at \$1, there is now a surplus of 150 million pints. In order to sustain the price floor of \$1, the government must buy up 150 million pints at \$1 each; that is, it must spend \$150 million. It does, however, sell those 150 million pints to schools at \$0.60 each (and from those sales makes  $\$0.60 \times 150 \text{ million} = \$90 \text{ million}$ ), so that the policy costs the government  $\$150 \text{ million} - \$90 \text{ million} = \$60 \text{ million}$ .



- e. Some milk producers are inefficient: if the price was allowed to reach equilibrium, they would find it too costly to produce. In their absence, milk would be produced only by the most efficient producers. Furthermore, resources are being wasted: although no milk is poured away outright, the government spends significant amounts of money on purchases of milk. This is money that might be used more effectively for purposes other than providing cheap milk to schoolchildren, such as improving the quality of public schools.
5. As noted in the text, European governments tend to make greater use of price controls than does the U.S. government. For example, the French government sets minimum starting yearly wages for new hires who have completed *le bac*, certification roughly equivalent to a high school diploma. The demand schedule for new hires with *le bac* and the supply schedule for similarly credentialed new job seekers are given in the accompanying table. The price here—given in euros, the currency used in France—is the same as the yearly wage.

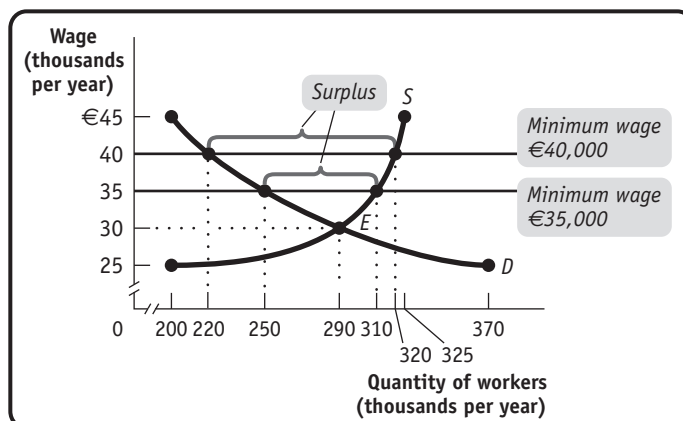
Wage (per year)	Quantity demanded (new job offers per year)	Quantity supplied (new job seekers per year)
€45,000	200,000	325,000
40,000	220,000	320,000
35,000	250,000	310,000
30,000	290,000	290,000
25,000	370,000	200,000

- a. In the absence of government interference, what are the equilibrium wage and number of graduates hired per year? Illustrate with a diagram. Will there be anyone seeking a job at the equilibrium wage who is unable to find one—that is, will there be anyone who is involuntarily unemployed?

- b. Suppose the French government sets a minimum yearly wage of €35,000. Is there any involuntary unemployment at this wage? If so, how much? Illustrate with a diagram. What if the minimum wage is set at €40,000? Also illustrate with a diagram.
- c. Given your answer to part b and the information in the table, what do you think is the relationship between the level of involuntary unemployment and the level of the minimum wage? Who benefits from such a policy? Who loses? What is the missed opportunity here?

## Solution

5. a. The equilibrium wage is €30,000, and 290,000 workers are hired. There is full employment: nobody is involuntarily unemployed. The equilibrium is at point E.

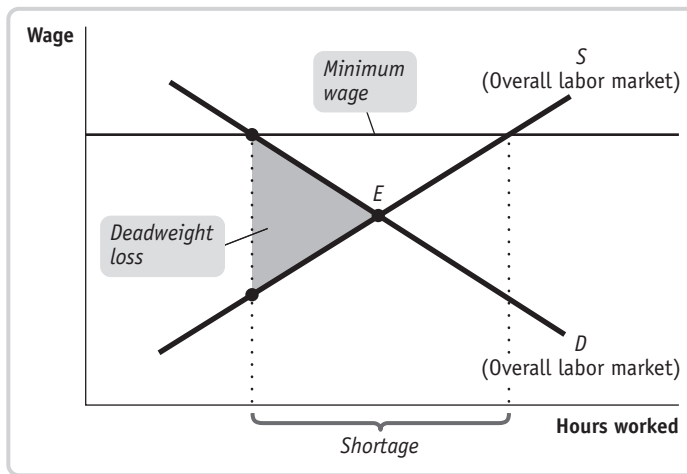


- b. With a minimum wage of €35,000, there is a surplus of workers of 60,000 (the quantity supplied is 310,000 and the quantity demanded is 250,000). That is, there are 60,000 workers who are involuntarily unemployed. At a minimum wage of €40,000, there is a surplus of workers of 100,000: this is the number of involuntarily unemployed workers.
- c. The higher the minimum wage, the larger the amount of involuntary unemployment. The people who benefit from this policy are those workers who succeed in getting hired: they now enjoy a higher wage. Those workers who do not get hired, however, lose: if the market was allowed to reach equilibrium, more workers would be employed. Employers also lose: fewer employers can now afford to hire workers, and they need to pay higher wages. The missed opportunity is that there are workers who want to work even at a wage lower than the minimum wage and firms that would willingly hire them at a lower wage; but because the wage is not allowed to fall below the minimum wage, these hires are not made.
6. In many European countries high minimum wages have led to high levels of unemployment and underemployment, and two a two-tier labor system. In the formal labor market, workers have good jobs that pay at least the minimum wage. In the informal, or black market for labor, workers have poor jobs and receive less than the minimum wage.
- a Draw a demand and supply diagram showing the effect of the imposition of a minimum wage on the overall market for labor, with wage on the vertical axis and hours of labor on the horizontal axis. Your supply curve should represent the hours of labor offered by workers according to the wage, and the demand curve represents the hours of labor demanded by employers according to the wage. On your diagram show the deadweight loss from the imposition of a minimum wage. What type of shortage is created? Illustrate on your diagram the size of the shortage.

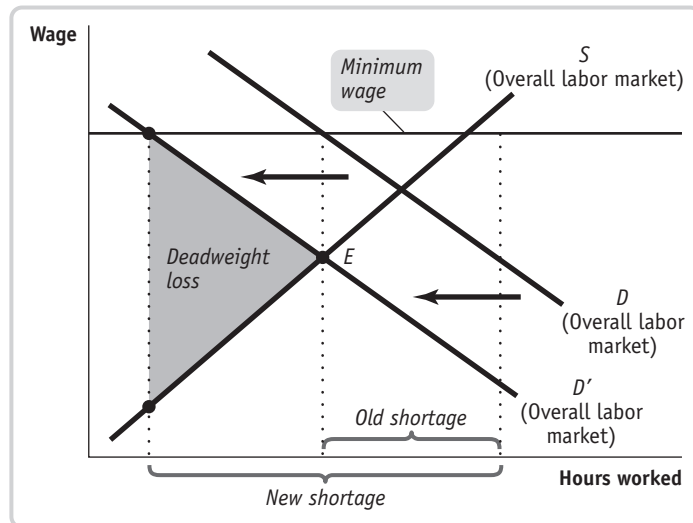
- b. Assume that the imposition of the high minimum wage causes a contraction in the economy so that employers in the formal sector cut their production and their demand for workers. Illustrate the effect of this on the overall market for labor. What happens to the size of the deadweight loss? The shortage? Illustrate with a diagram.
- c. Assume that the workers who cannot get a job paying at least the minimum wage move into the informal labor market where there is no minimum wage. What happens to the size of the informal market for labor as a result of the economic contraction? What happens to the equilibrium wage in the informal labor market? Illustrate with a supply and demand diagram for the informal market.

**Solution**

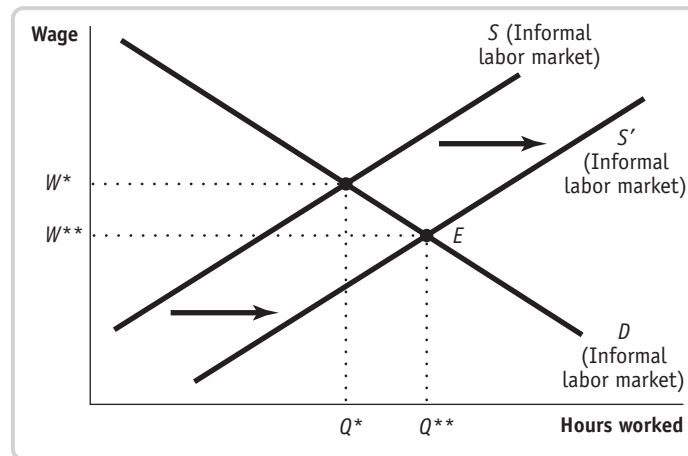
6. a. The shortage created is a shortage of jobs: at the minimum wage there are more job-seekers than there are jobs available.



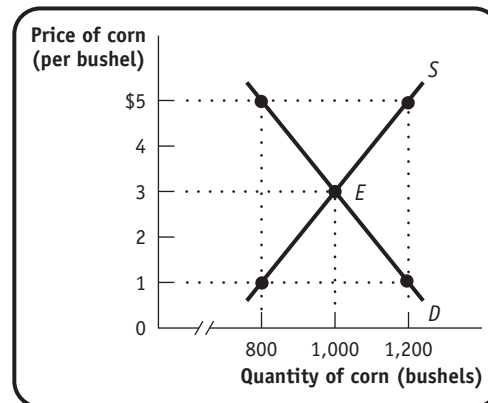
- b. The contraction in the economy causes the demand for labor to fall, shifting the demand curve leftwards from  $D$  to its new position at  $D'$ . Both the deadweight loss and the shortage of jobs caused by the minimum wage increase as a result of the fall in the demand for labor.



- c. As a result of the economic contraction which reduces the demand for workers in the overall market, workers move to the informal labor market. This increases the supply of labor in the informal labor market. The supply curve for labor shifts rightwards from  $S$  to its new position at  $S'$ . The equilibrium wage in the informal labor market falls from  $w^*$  to  $w^{**}$  and the quantity of hours transacted increases from  $Q^*$  to  $Q^{**}$ , as the informal labor market expands.



7. For the last 80 years the U.S. government has used price supports to provide income assistance to American farmers. To implement these price supports, at times the government has used price floors, which it maintains by buying up the surplus farm products. At other times, it has used target prices, a policy by which the government gives the farmer an amount equal to the difference between the market price and the target price for each unit sold. Consider the market for corn depicted in the accompanying diagram.



- If the government sets a price floor of \$5 per bushel, how many bushels of corn are produced? How many are purchased by consumers? By the government? How much does the program cost the government? How much revenue do corn farmers receive?
- Suppose the government sets a target price of \$5 per bushel for any quantity supplied up to 1,000 bushels. How many bushels of corn are purchased by consumers and at what price? By the government? How much does the program cost the government? How much revenue do corn farmers receive?
- Which of these programs (in parts a and b) costs corn consumers more? Which program costs the government more? Explain.
- Is one of these policies less inefficient than the other? Explain.

## Solution

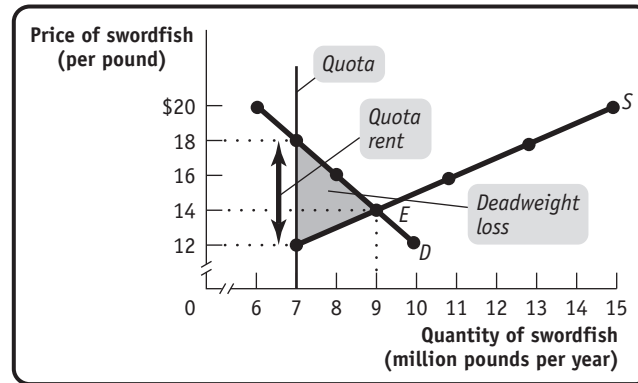
7. a. With a price floor of \$5, the quantity of corn supplied is 1,200 bushels. The quantity demanded is only 800 bushels: there is a surplus of 400 bushels. The government therefore has to buy up the surplus of 400 bushels, at a price of \$5 each: the program costs the government  $400 \times \$5 = \$2,000$ . Corn farmers sell 1,200 bushels (800 to consumers and 400 to the government) and therefore make  $1,200 \times \$5 = \$6,000$  in revenue.
- b. If the government sets a target price of \$5, the market reaches equilibrium at a price of \$3 and a quantity of 1,000 bushels. There is no surplus (or shortage). The government does not buy any corn under this policy. For each bushel sold, the government pays farmers \$2 (to make up the difference between the market price of \$3 and the target price of \$5), so the government pays a total of  $1,000 \times \$2 = \$2,000$ . Corn farmers sell 1,000 bushels and make \$5 for each bushel (\$3 come from consumers and \$2 from the government), for a total of \$5,000 of revenue.
- c. The price-floor policy is more expensive for consumers: they pay \$5 per bushel (compared to the \$3 under the target-price policy). Both policies are equally expensive for the government.
- d. The target-price policy avoids the inefficiency of wasted resources: surplus corn bought by the government and either given or thrown away. It is less inefficient than the price-floor policy.
8. The waters off the North Atlantic coast were once teeming with fish. But due to overfishing by the commercial fishing industry, the stocks of fish became seriously depleted. In 1991, the National Marine Fishery Service of the U.S. government implemented a quota to allow fish stocks to recover. The quota limited the amount of swordfish caught per year by all U.S.-licensed fishing boats to 7 million pounds. As soon as the U.S. fishing fleet had met the quota limit, the swordfish catch was closed down for the rest of the year. The accompanying table gives the hypothetical demand and supply schedules for swordfish caught in the United States per year.

Price of swordfish (per pound)	Quantity of swordfish (millions of pounds per year)	
	Quantity demanded	Quantity supplied
\$20	6	15
18	7	13
16	8	11
14	9	9
12	10	7

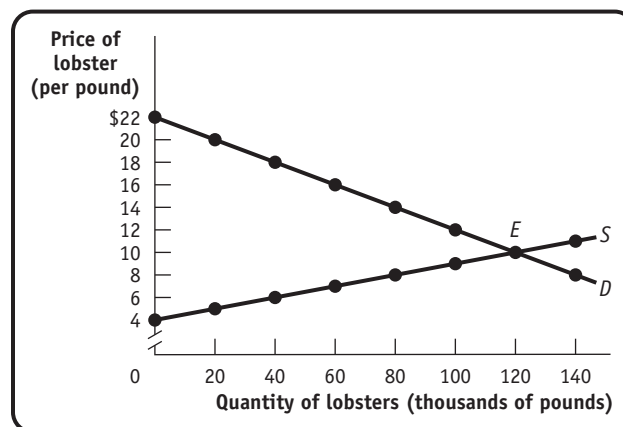
- a. Use a diagram to show the effect of the quota on the market for swordfish in 1991. In your diagram, illustrate the deadweight loss from inefficiently low quantity.
- b. How do you think fishermen will change how they fish in response to this policy?

## Solution

8. a. The quantity sold is 7 million pounds, at a price of \$18 per pound. On each pound of fish caught, each fisherman earns quota rent of \$6, as shown in the accompanying diagram. The shaded triangle shows the deadweight loss.



- b. Because each pound of swordfish gives a fisherman \$6 quota rent, each fisherman will attempt to fish as much as possible as soon as the swordfish catch opens. You should therefore see fishermen scramble to fish right at the beginning of the season, and you should see the catch being closed down very soon thereafter. (Which is exactly what happens.)
9. In Maine, you must have a license to harvest lobster commercially; these licenses are issued yearly. The state of Maine is concerned about the dwindling supplies of lobsters found off its coast. The state fishery department has decided to place a yearly quota of 80,000 pounds of lobsters harvested in all Maine waters. It has also decided to give licenses this year only to those fishermen who had licenses last year. The accompanying diagram shows the demand and supply curves for Maine lobsters.

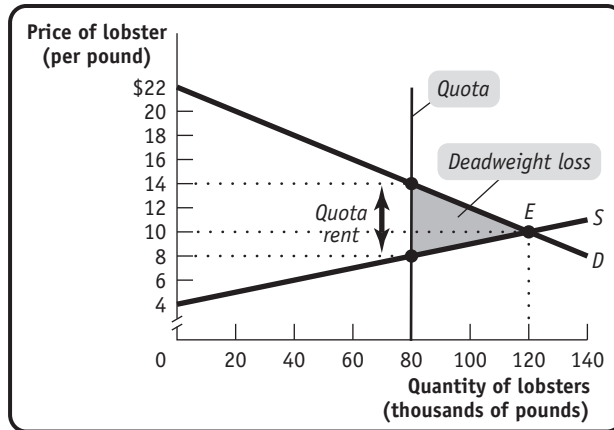


- In the absence of government restrictions, what are the equilibrium price and quantity?
- What is the *demand price* at which consumers wish to purchase 80,000 pounds of lobsters?
- What is the *supply price* at which suppliers are willing to supply 80,000 pounds of lobsters?
- What is the *quota rent* per pound of lobster when 80,000 pounds are sold? Illustrate the quota rent and the deadweight loss on the diagram.
- Explain a transaction that benefits both buyer and seller but is prevented by the quota restriction.



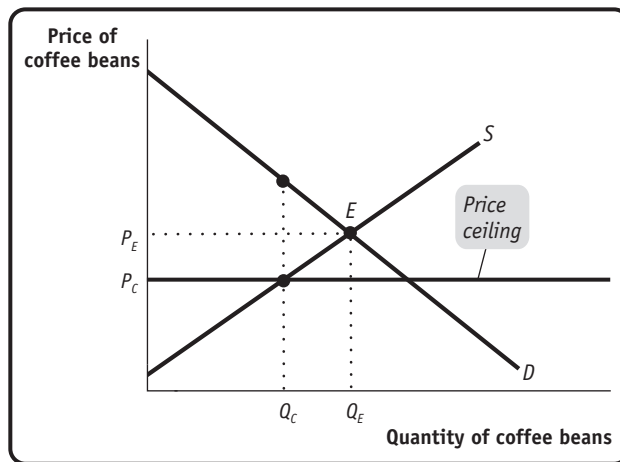
**Solution**

9. a. Without government restrictions, the equilibrium in the market for lobsters is at point *E*. The equilibrium price for lobsters is \$10 per pound. At that price, the quantity demanded and the quantity supplied are 120,000 pounds of lobsters.



- b. The demand price of 80,000 pounds of lobsters is \$14.  
 c. The supply price of 80,000 pounds of lobsters is \$8.  
 d. The quota rent per pound of lobster is  $\$14 - \$8 = \$6$ .  
 e. Under the quota policy, the producer and consumer of the 80,001st pound of lobster could both be better off: the producer would be willing to sell for just a little more than \$8, and the consumer would be willing to buy for just a little less than \$14. The quota, however, prevents this trade.

10. The Venezuelan government has imposed a price ceiling on the retail price of roasted coffee beans. The accompanying diagram shows the market for coffee beans. In the absence of price controls, the equilibrium is at point *E*, with an equilibrium price of  $P_E$  and an equilibrium quantity bought and sold of  $Q_E$ .

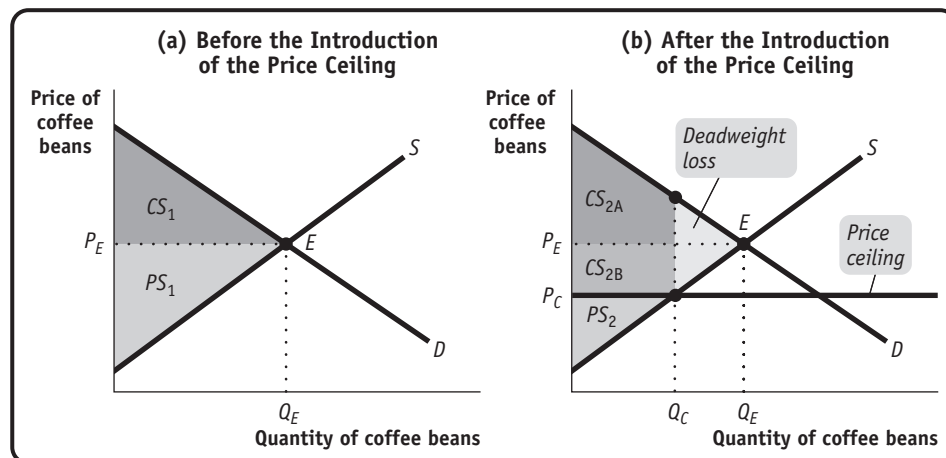


- a. Show the consumer and producer surplus before the introduction of the price ceiling. After the introduction of the price ceiling, the price falls to  $P_C$  and the quantity bought and sold falls to  $Q_C$ .  
 b. Show the consumer surplus after the introduction of the price ceiling (assuming that the consumers with the highest willingness to pay get to buy the available coffee beans; that is, assuming that there is no inefficient allocation to consumers).

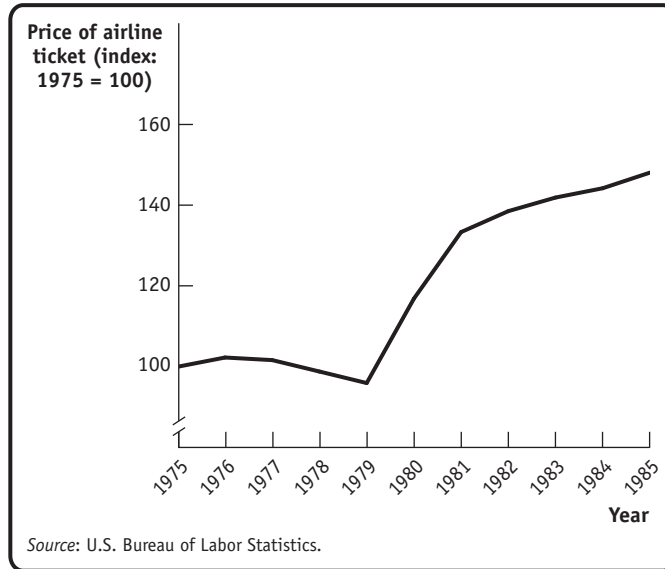
- c. Show the producer surplus after the introduction of the price ceiling (assuming that the producers with the lowest cost get to sell their coffee beans; that is, assuming that there is no inefficient allocation of sales among producers).
- d. Using the diagram, show how much of what was producer surplus before the introduction of the price ceiling has been transferred to consumers as a result of the price ceiling.
- e. Using the diagram, show how much of what was total surplus before the introduction of the price ceiling has been lost. That is, how great is the deadweight loss?

## Solution

10. a. Consumer surplus is the area labeled  $CS_1$  and producer surplus is the area labeled  $PS_1$  in panel (a) of the accompanying diagram.
- b. Consumer surplus after the introduction of the price ceiling is made up of the sum of the two areas labeled  $CS_{2A}$  and  $CS_{2B}$  in panel (b).
- c. Producer surplus after the introduction of the price ceiling is the area labeled  $PS_2$  in panel (b).
- d. The amount of surplus transferred from producers to consumers as a result of the introduction of the price ceiling is the area labeled  $CS_{2B}$  in panel (b).
- e. The amount of total surplus lost as a result of the introduction of the price ceiling, the deadweight loss, is the area labeled deadweight loss in panel (b).



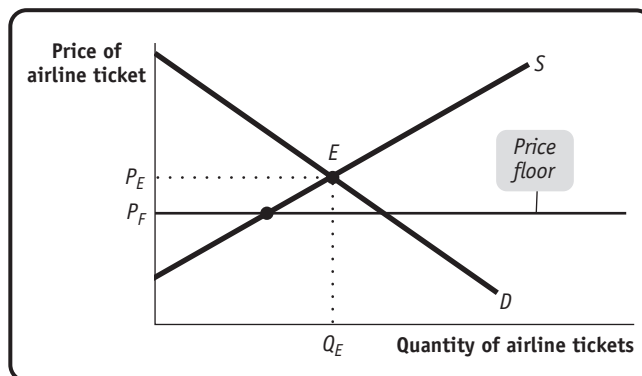
11. The accompanying diagram shows data from the U.S. Bureau of Labor Statistics on the average price of an airline ticket in the United States from 1975 until 1985, adjusted to eliminate the effect of *inflation* (the general increase in the prices of all goods over time). In 1978, the United States Airline Deregulation Act removed the price floor on airline fares, and it also allowed the airlines greater flexibility to offer new routes.



- Looking at the data on airline ticket prices in the diagram, do you think the price floor that existed before 1978 was binding or nonbinding? That is, do you think it was set above or below the equilibrium price? Draw a supply and demand diagram, showing where the price floor that existed before 1978 was in relation to the equilibrium price.
- Most economists agree that the average airline ticket price per mile traveled actually *fell* as a result of the Airline Deregulation Act. How might you reconcile that view with what you see in the diagram?

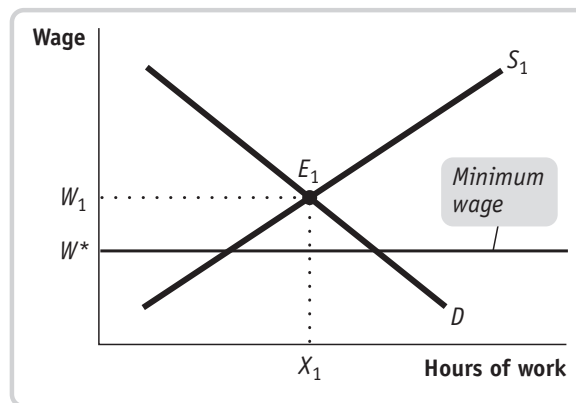
## Solution

11. a. When a binding price floor—one that is set above the equilibrium price—is removed, you should expect the price of the good to fall. From looking at the data in the figure, you should think that the pre-1978 price floor was ineffective, since the price of an airline ticket actually rose after 1978. In the accompanying diagram, the price floor,  $P_F$ , is nonbinding: it is set below the equilibrium price,  $P_E$ . In that case, removing the price floor would not lead to a decrease in price.

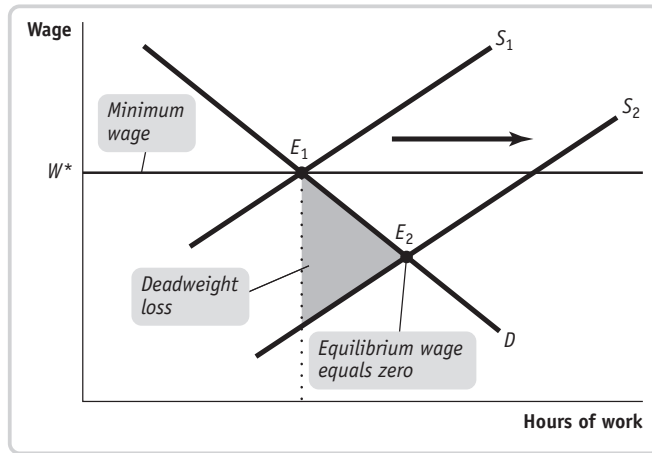


- b. Many things that determine the price of an average airline ticket changed in 1978; the removal of the price floor on airline tickets was just one of them. What also changed was that airlines now could—and did—offer longer-range flights. So although the average ticket price increased, so did the distance of the average airline flight. As a result, the cost *per mile traveled* actually fell—leading most economists to claim that the Airline Deregulation Act resulted in lower airfares. Remember that when you want to analyze the effect of one change, you have to hold *other things equal*. And in this case, many other things changed at the same time.
12. Many college students attempt to land internships before graduation to burnish their resumes, gain experience in a chosen field, or try out possible careers. The hope shared by all of these prospective interns is that they will find internships that pay more than typical summer jobs, such as waiting tables or flipping burgers.
- a. With wage measured on the vertical axis and number of hours of work on the horizontal axis, draw a supply and demand diagram for the market for interns in which the minimum wage is non-binding at the market equilibrium.
- b. Assume that a market downturn reduces the demand for interns by employers. However, many students are willing and eager to work in unpaid internships. As a result, the new market equilibrium wage is equal to zero. Draw another supply and demand diagram to illustrate this new market equilibrium.

12. a. Here the market-clearing wage,  $W_1$ , is non-binding because it is above the minimum wage. In this case the minimum wage has no effect on the market for interns: the number of hours transacted in the market equilibrium,  $X_1$ , is the same as if there had been no minimum wage.



- b. The economic downturn will result in an increase in the supply of interns. The supply curve will shift outward to its new position at  $S_2$  and result in a new equilibrium wage of zero. The minimum wage is now binding and, as a result, there is a deadweight loss.



13. Suppose it is decided that rent control in New York City will be abolished and that market rents will now prevail. Assume that all rental units are identical and so are offered at the same rent. To address the plight of residents who may be unable to pay the market rent, an income supplement will be paid to all low-income households equal to the difference between the old controlled rent and the new market rent.
- Use a diagram to show the effect on the rental market of the elimination of rent control. What will happen to the quality and quantity of rental housing supplied?
  - Use a second diagram to show the additional effect of the income-supplement policy on the market. What effect does it have on the market rent and quantity of rental housing supplied in comparison to your answers to part a?
  - Are tenants better or worse off as a result of these policies? Are landlords better or worse off? Is society as a whole better or worse off?
  - From a political standpoint, why do you think cities have been more likely to resort to rent control rather than a policy of income supplements to help low-income people pay for housing?

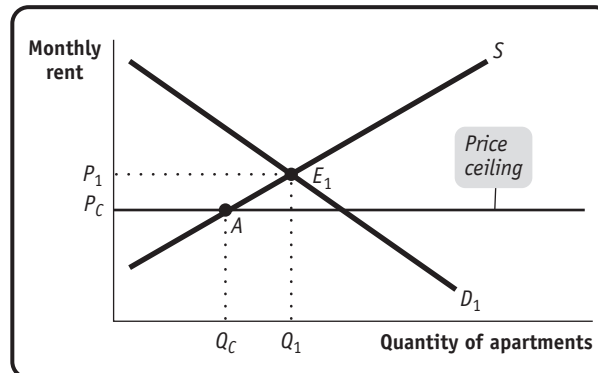
**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via

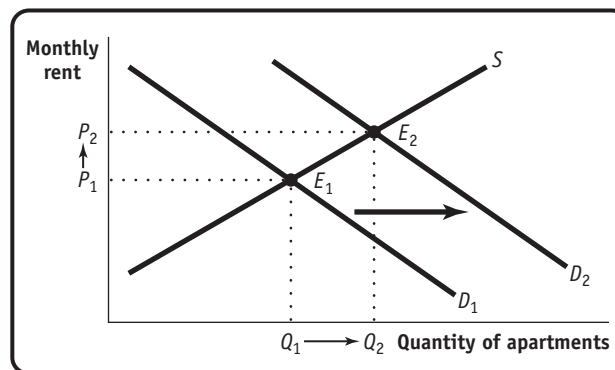


## Solution

- 13. a.** With a price ceiling at  $P_C$ , the quantity bought and sold is  $Q_C$ , indicated by point A. The ceiling at  $P_C$  is eliminated and the rent returns to the market equilibrium  $E_1$ , with an equilibrium rent of  $P_1$ . The quantity supplied increases from  $Q_C$  to the equilibrium quantity  $Q_1$ . At the same time, you should expect the quality of rental housing to improve. As you learned in this chapter, one of the inefficiencies caused by price ceilings is inefficiently low quality. As the rent returns to the equilibrium rent, landlords again have the incentive to invest in the quality of their apartments in order to attract renters.



- b.** The income-supplement policy causes a rightward shift of the demand curve from  $D_1$  to  $D_2$ . This results in an increase in the equilibrium rent, from  $P_1$  to  $P_2$ , and an increase in the equilibrium quantity, from  $Q_1$  to  $Q_2$ , as the equilibrium changes from  $E_1$  to  $E_2$ .



- c.** Landlords are clearly better off as a result of these two policies: more landlords rent out apartments, and at a higher monthly rent. It is not clear whether tenants are better or worse off. Some tenants who previously could not get apartments can now do so, but at a higher rent. In particular, those tenants who do not receive the income supplement and who used to rent cheap apartments under the price ceiling are now worse off. Society as a whole is better off because the deadweight loss caused by a price ceiling has been eliminated: there are now no missed gains from trade.
- d.** It is likely that tenants who currently live in rent-controlled housing are better organized than people who cannot currently find rental housing. And more organized groups can generally exert greater influence over city policy.

# Elasticity

- 1.** Do you think the price elasticity of demand for Ford sport-utility vehicles (SUVs) will increase, decrease, or remain the same when each of the following events occurs? Explain your answer.
- Other car manufacturers, such as General Motors, decide to make and sell SUVs.
  - SUVs produced in foreign countries are banned from the American market.
  - Due to ad campaigns, Americans believe that SUVs are much safer than ordinary passenger cars.
  - The time period over which you measure the elasticity lengthens. During that longer time, new models such as four-wheel-drive cargo vans appear.

## Solution

- 1.**
- The price elasticity of demand for Ford SUVs will increase because more substitutes are available.
  - The price elasticity of demand for Ford SUVs will decrease because fewer substitutes are available.
  - The price elasticity of demand for Ford SUVs will decrease because other cars are viewed as less of a substitute.
  - The price elasticity of demand for Ford SUVs will increase over time because more substitutes (such as four-wheel-drive cargo vans) become available.
- 2.** In the United States, 2013 was a bad year for growing wheat. And as wheat supply decreased, the price of wheat rose dramatically, leading to a lower quantity demanded (a movement along the demand curve). The accompanying table describes what happened to prices and the quantity of wheat demanded.

	2012	2013
Quantity demanded (bushels)	2.2 billion	2.0 billion
Average price (per bushel)	\$3.42	\$4.26

- Using the midpoint method, calculate the price elasticity of demand for winter wheat.
- What is the total revenue for U.S. wheat farmers in 2012 and 2013?
- Did the bad harvest increase or decrease the total revenue of U.S. wheat farmers? How could you have predicted this from your answer to part a?

## Solution

- 2.**
- Using the midpoint method, the percent change in the quantity of U.S. winter wheat demanded is

$$\frac{2.0 \text{ billion} - 2.2 \text{ billion}}{2.1 \text{ billion}} \times 100 = \frac{-0.2 \text{ billion}}{2.1 \text{ billion}} \times 100 = -9.5\%$$

and the percent change in the price of U.S. winter wheat is

$$\frac{\$4.26 - \$3.42}{\$3.84} \times 100 = \frac{\$0.84}{\$3.84} \times 100 = 21.9\%$$

Dropping the minus sign, the price elasticity of demand is therefore

$$\frac{9.5\%}{21.9\%} = 0.43$$

so that demand is inelastic.

- b. The total revenue in 2012 is the price per bushel in 2012 times the quantity of bushels demanded in 2012. That is, total revenue in 2012 is  $\$3.42 \times 2.2$  billion = \$7.524 billion. Similarly, total revenue in 2013 is  $\$4.26 \times 2.0$  billion = \$8.52 billion.
- c. The rise in price from 2012 to 2013 increased U.S. wheat farmers' total revenue. This could have been predicted by knowing that demand is inelastic: in part a we calculated a price elasticity of demand of 0.43. The price effect of this price rise (which tends to increase total revenue) outweighed the quantity effect (which tends to decrease total revenue).

3. The accompanying table gives part of the supply schedule for personal computers in the United States.

Price of computer	Quantity of computers supplied
\$1,100	12,000
900	8,000

- a. Calculate the price elasticity of supply when the price increases from \$900 to \$1,100 using the midpoint method.
- b. Suppose firms produce 1,000 more computers at any given price due to improved technology. As price increases from \$900 to \$1,100, is the price elasticity of supply now greater than, less than, or the same as it was in part a?
- c. Suppose a longer time period under consideration means that the quantity supplied at any given price is 20% higher than the figures given in the table. As price increases from \$900 to \$1,100, is the price elasticity of supply now greater than, less than, or the same as it was in part a?

3. a. Using the midpoint method, the percent change in the quantity supplied is

$$\frac{12,000 - 8,000}{(8,000 + 12,000)/2} \times 100 = \frac{4,000}{10,000} \times 100 = 40\%$$

and the percent change in the price is

$$\frac{\$1,100 - \$900}{(\$900 + \$1,100)/2} \times 100 = \frac{\$200}{\$1,000} \times 100 = 20\%$$

The price elasticity of supply is therefore

$$\frac{40\%}{20\%} = 2$$

- b. The elasticity estimate would be lower. A price change from \$900 to \$1,100 is a 20% price change, just as calculated in part a. Previously, when the quantity supplied changed from 8,000 to 12,000, that was a 40% change in the quantity supplied. Now that the quantity supplied at each price is higher by 1,000, the same price change would imply a change in the quantity supplied from 9,000 to 13,000, which is a 36% change using the midpoint method. The new price elasticity of supply is  $36\%/20\% = 1.8$ , which is lower than in part a.



- c. The elasticity estimate would be unchanged. The price increase from \$900 to \$1,100 is a 20% increase, just as calculated in part a. But now that all quantities are 20% higher, the quantity supplied increases from 9,600 to 14,400. Using the midpoint method, this is an increase of

$$\frac{14,400 - 9,600}{(9,600 + 14,400)/2} \times 100 = \frac{4,800}{12,000} \times 100 = 40\%$$

so that the price elasticity of supply is

$$\frac{40\%}{20\%} = 2$$

Therefore the price elasticity of supply is the same as in part a.

4. The accompanying table lists the cross-price elasticities of demand for several goods, where the percent quantity change is measured for the first good of the pair, and the percent price change is measured for the second good.

Good	Cross-price elasticities of demand
Air-conditioning units and kilowatts of electricity	-0.34
Coke and Pepsi	+0.63
High-fuel-consuming sport-utility vehicles (SUVs) and gasoline	-0.28
McDonald's burgers and Burger King burgers	+0.82
Butter and margarine	+1.54

- Explain the sign of each of the cross-price elasticities. What does it imply about the relationship between the two goods in question?
- Compare the absolute values of the cross-price elasticities and explain their magnitudes. For example, why is the cross-price elasticity of McDonald's burgers and Burger King burgers less than the cross-price elasticity of butter and margarine?
- Use the information in the table to calculate how a 5% increase in the price of Pepsi affects the quantity of Coke demanded.
- Use the information in the table to calculate how a 10% decrease in the price of gasoline affects the quantity of SUVs demanded.

## Solution

4. a. A negative cross-price elasticity of demand implies that the two goods are complements. So air-conditioning units and kilowatts of electricity are complements, as are sport-utility vehicles and gasoline. A positive cross-price elasticity of demand implies that the two goods are substitutes. So Coke and Pepsi are substitutes, as are McDonald's and Burger King burgers as well as butter and margarine.
- b. The larger (and positive) the cross-price elasticity of demand is, the more closely the two goods are substitutes. Since the cross-price elasticity of butter and margarine is larger than the cross-price elasticity of McDonald's burgers and Burger King burgers, butter and margarine are closer substitutes than are McDonald's and Burger King burgers. Similarly, the greater (and negative) the cross-price elasticity of demand is, the more strongly the two goods are complements.
- c. A cross-price elasticity of 0.63 implies that a 1% increase in the price of Pepsi would increase the quantity of Coke demanded by 0.63%. So a 5% increase in the price of Pepsi would increase the quantity of Coke demanded by five times as much, that is, by  $5 \times 0.63\% = 3.15\%$ .

d. A cross-price elasticity of  $-0.28$  implies that a 1% fall in the price of gasoline would increase the quantity of SUVs demanded by 0.28%. So a 10% fall in the price of gasoline would increase the quantity of SUVs demanded by 10 times as much, that is, by  $10 \times 0.28\% = 2.8\%$ .

5. What can you conclude about the price elasticity of demand in each of the following statements?
- “The pizza delivery business in this town is very competitive. I’d lose half my customers if I raised the price by as little as 10%.”
  - “I owned both of the two Jerry Garcia autographed lithographs in existence. I sold one on eBay for a high price. But when I sold the second one, the price dropped by 80%.”
  - “My economics professor has chosen to use the Krugman/Wells textbook for this class. I have no choice but to buy this book.”
  - “I always spend a total of exactly \$10 per week on coffee.”

5. a. This statement says that a 10% increase in price reduces the quantity demanded by 50%. That is, the price elasticity of demand is

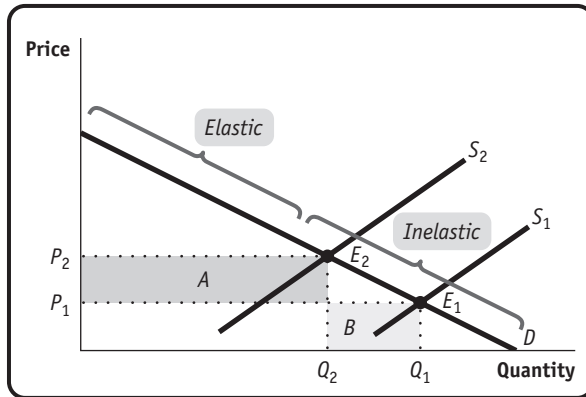
$$\frac{50\%}{10\%} = 5$$

So demand is elastic.

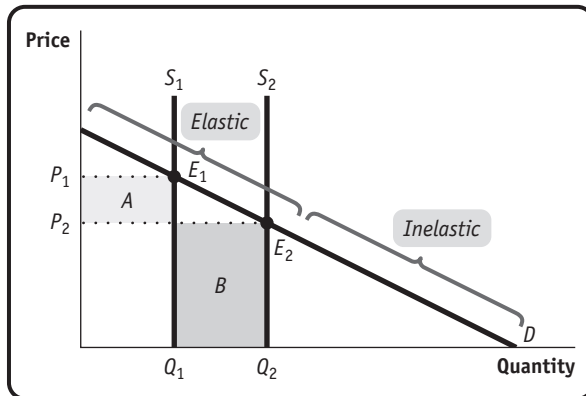
- The fact that it was necessary for price to drop by 80% in order to sell one more unit (an increase in quantity of 67%, using the midpoint method) indicates that the demand for Jerry Garcia autographed lithographs is inelastic.
  - There is no substitute available, so demand is inelastic. (Although, over time, as more used Krugman/Wells textbooks become available, the price elasticity of demand will increase.)
  - Demand is unit-elastic: no matter what the price of coffee is, the total revenue to the producer (which is my total expenditure on coffee) remains the same.
6. Take a linear demand curve like that shown in Figure 6-5, where the range of prices for which demand is elastic and inelastic is labeled. In each of the following scenarios, the supply curve shifts. Show along which portion of the demand curve (that is, the elastic or the inelastic portion) the supply curve must have shifted in order to generate the event described. In each case, show on the diagram the quantity effect and the price effect.
- Recent attempts by the Colombian army to stop the flow of illegal drugs into the United States have actually benefited drug dealers.
  - New construction increased the number of seats in the football stadium and resulted in greater total revenue from box-office ticket sales.
  - A fall in input prices has led to higher output of Porsches. But total revenue for the Porsche Company has declined as a result.

**Solution**

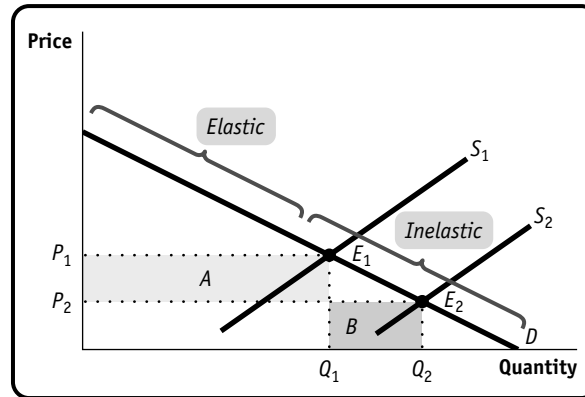
6. a. Attempts to stop the flow of drugs into the United States shift the supply curve leftward, raising the price of drugs and reducing the quantity demanded. If this benefits drug dealers, their total revenue must have increased. That is, we must be on the inelastic portion of the demand curve, where a rise in price results in an increase in revenue (the price effect outweighs the quantity effect). In the accompanying diagram, as supply shifts from  $S_1$  to  $S_2$ , revenue decreases by area  $B$  but increases by area  $A$ .



- b. An increase in the number of seats shifts the supply curve rightward, reducing the price of stadium seats and increasing the quantity demanded. If this increases total revenue, we must be on the elastic portion of the demand curve, where a fall in price results in an increase in total revenue from box-office sales (the quantity effect outweighs the price effect). In the accompanying diagram, as supply shifts from  $S_1$  to  $S_2$ , total revenue decreases by area  $A$  but increases by area  $B$ . (The supply curve is a vertical line because the supply of seats is perfectly inelastic: whatever the price, the supply of seats is just how many seats there are in the stadium.)



- c. Increasing production shifts the supply curve rightward, lowering the price of Porsches and increasing the quantity demanded. If this reduces total revenue, we must be on the inelastic portion of the demand curve, where a fall in price results in a fall in total revenue (the price effect outweighs the quantity effect). In the accompanying diagram, as supply shifts from  $S_1$  to  $S_2$ , total revenue decreases by area A but increases only by area B.



7. The accompanying table shows the price and yearly quantity sold of souvenir T-shirts in the town of Crystal Lake according to the average income of the tourists visiting.

Price of T-shirt	Quantity of T-shirts demanded when average tourist income is \$20,000	Quantity of T-shirts demanded when average tourist income is \$30,000
\$4	3,000	5,000
5	2,400	4,200
6	1,600	3,000
7	800	1,800

- a. Using the midpoint method, calculate the price elasticity of demand when the price of a T-shirt rises from \$5 to \$6 and the average tourist income is \$20,000. Also calculate it when the average tourist income is \$30,000.
- b. Using the midpoint method, calculate the income elasticity of demand when the price of a T-shirt is \$4 and the average tourist income increases from \$20,000 to \$30,000. Also calculate it when the price is \$7.

7. a. Suppose the average tourist income is \$20,000. Using the midpoint method, the percent change in the quantity demanded is

$$\frac{1,600 - 2,400}{(2,400 + 1,600)/2} \times 100 = \frac{-800}{2,000} \times 100 = -40\%$$

and the percent change in the price is

$$\frac{\$6 - \$5}{(\$5 + \$6)/2} \times 100 = \frac{\$1}{\$5.50} \times 100 = 18.2\%$$

Dropping the minus sign, the price elasticity of demand is therefore

$$\frac{40\%}{18.2\%} = 2.2$$

Now suppose the average tourist income is \$30,000. The percent change in the quantity demanded is

$$\frac{3,000 - 4,200}{(4,200 + 3,000)/2} \times 100 = \frac{-1,200}{3,600} \times 100 = -33.3\%$$

and the percent change in the price is, as before,

$$\frac{\$6 - \$5}{(\$5 + \$6)/2} \times 100 = \frac{\$1}{\$5.50} \times 100 = 18.2\%$$

Dropping the minus sign, the price elasticity of demand is therefore

$$\frac{33.3\%}{18.2\%} = 1.8$$

- b. Suppose the price of a T-shirt is \$4. Using the midpoint method, the percent change in the quantity demanded is

$$\frac{5,000 - 3,000}{(3,000 + 5,000)/2} \times 100 = \frac{2,000}{4,000} \times 100 = 50\%$$

and the percent change in income is

$$\frac{\$30,000 - \$20,000}{(\$20,000 + \$30,000)/2} \times 100 = \frac{\$10,000}{\$25,000} \times 100 = 40\%$$

The income elasticity of demand is therefore

$$\frac{50\%}{40\%} = 1.25$$

Now suppose the price is \$7. The percent change in the quantity demanded is

$$\frac{1,800 - 800}{(800 + 1,800)/2} \times 100 = \frac{1,000}{1,300} \times 100 = 76.9\%$$

and the percent change in income is, as before,

$$\frac{\$30,000 - \$20,000}{(\$20,000 + \$30,000)/2} \times 100 = \frac{\$10,000}{\$25,000} \times 100 = 40\%$$

The income elasticity of demand is therefore

$$\frac{76.9\%}{40\%} = 1.9$$

8. A recent study determined the following elasticities for Volkswagen Beetles:

$$\begin{aligned} \text{Price elasticity of demand} &= 2 \\ \text{Income elasticity of demand} &= 1.5 \end{aligned}$$

The supply of Beetles is elastic. Based on this information, are the following statements true or false? Explain your reasoning.

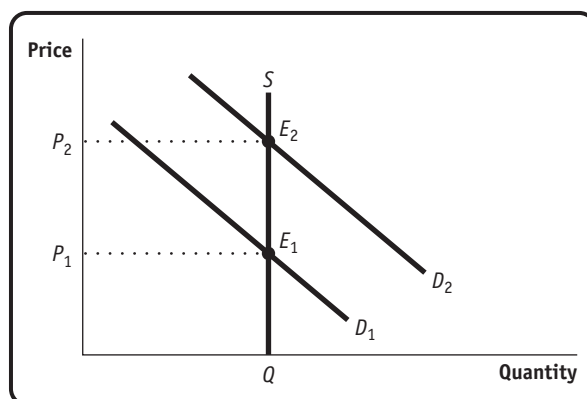
- a. A 10% increase in the price of a Beetle will reduce the quantity demanded by 20%.  
 b. An increase in consumer income will increase the price and quantity of Beetles sold.

## Solution

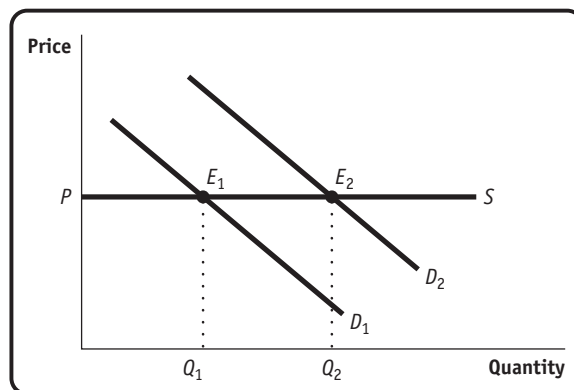
8. a. True. The price elasticity of demand for Beetles is 2. That is, a 1% increase in the price would reduce the quantity demanded by 2%. Therefore, a 10% increase in the price would reduce the quantity demanded by 20%.  
 b. The first part of the statement is true. The income elasticity of demand for Beetles is positive (they are a normal good). That is, an increase in income will increase the demand for Beetles. The demand curve shifts rightward, and the price and quantity of Beetles supplied both increase.

9. In each of the following cases, do you think the price elasticity of supply is (i) perfectly elastic; (ii) perfectly inelastic; (iii) elastic, but not perfectly elastic; or (iv) inelastic, but not perfectly inelastic? Explain using a diagram.
- An increase in demand this summer for luxury cruises leads to a huge jump in the sales price of a cabin on the *Queen Mary 2*.
  - The price of a kilowatt of electricity is the same during periods of high electricity demand as during periods of low electricity demand.
  - Fewer people want to fly during February than during any other month. The airlines cancel about 10% of their flights as ticket prices fall about 20% during this month.
  - Owners of vacation homes in Maine rent them out during the summer. Due to the soft economy this year, a 30% decline in the price of a vacation rental leads more than half of homeowners to occupy their vacation homes themselves during the summer.

9. a. Supply is perfectly inelastic: the quantity of cabins on the *Queen Mary 2* is fixed. As demand increases (a rightward shift in the demand curve), the price of a cabin on the *Queen Mary 2* increases, without an increase in the quantity supplied. See the accompanying diagram.



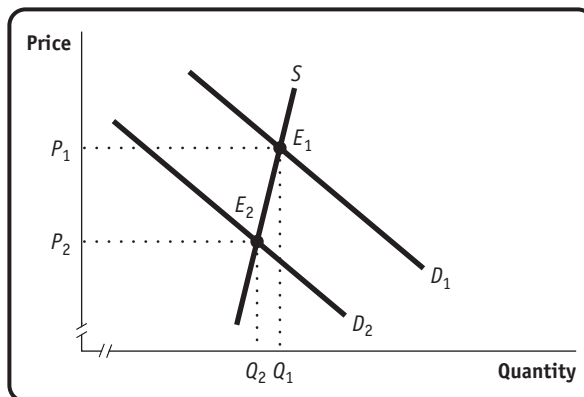
- b. Supply is perfectly elastic. As demand changes (for instance, as demand increases in times of high electricity demand), price does not change but the quantity supplied does change. See the accompanying diagram.



- c. Supply is inelastic. As price falls by 20%, the quantity supplied falls by 10%. This implies a price elasticity of supply of

$$\frac{10\%}{20\%} = 0.5$$

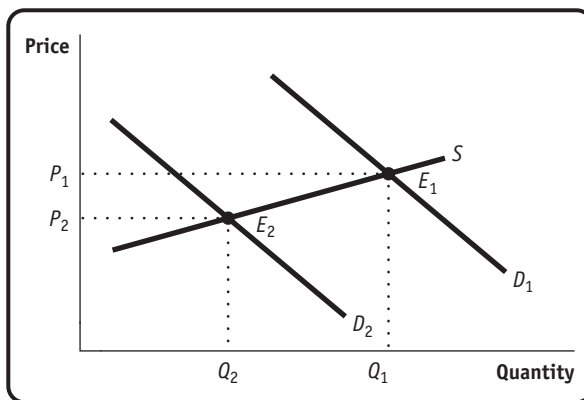
which is inelastic. See the accompanying diagram.



- d. Supply is elastic. As price falls by 30%, the quantity supplied falls by more than 50%. This implies a price elasticity of supply greater than

$$\frac{50\%}{30\%}$$

that is, a price elasticity of supply greater than 1.7. See the accompanying diagram.



10. Use an elasticity concept to explain each of the following observations.
- During economic booms, the number of new personal care businesses, such as gyms and tanning salons, is proportionately greater than the number of other new businesses, such as grocery stores.
  - Cement is the primary building material in Mexico. After new technology makes cement cheaper to produce, the supply curve for the Mexican cement industry becomes relatively flatter.
  - Some goods that were once considered luxuries, like a telephone, are now considered virtual necessities. As a result, the demand curve for telephone services has become steeper over time.
  - Consumers in a less developed country like Guatemala spend proportionately more of their income on equipment for producing things at home, like sewing machines, than consumers in a more developed country like Canada.

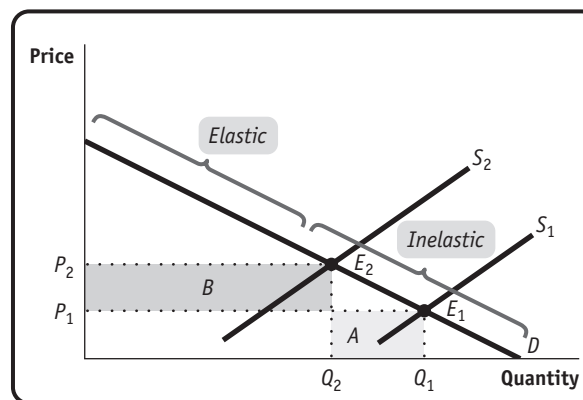
10. a. During times of economic boom, incomes rise. Whether, and by how much, demand responds to changes in income is determined by the income elasticity of demand. Since the demand for personal care services increases as income increases, personal care services are a normal good. If the demand for personal care

services is more responsive to changes in income than the demand for other products, the income elasticity of demand for personal care services is greater than the income elasticity of demand for other products. As a result of the proportionately greater increase in demand, you would see the quantity of personal care services supplied increase by proportionately more.

- b. New technology has made cement easier to produce. This implies that as the price of cement rises, many more firms are now willing to supply cement than before; that is, supply has become more elastic, leading to a relatively flatter supply curve.
- c. As telephones have become less and less of a luxury, the price elasticity of demand for telephones has fallen: telephones have become so much a necessity of daily life that it is now more difficult for consumers to substitute away from telephones. As demand for telephones has become less elastic (less responsive to changes in the price), the demand curve for telephones has become steeper.
- d. Incomes in Canada are higher than those in Guatemala. The statement therefore implies that as income rises, the demand for sewing machines increases by proportionately less than the change in income, making the income elasticity of demand inelastic. Maybe the demand for sewing machines even decreases as income rises, implying that sewing machines are an inferior good, with a negative income elasticity of demand.

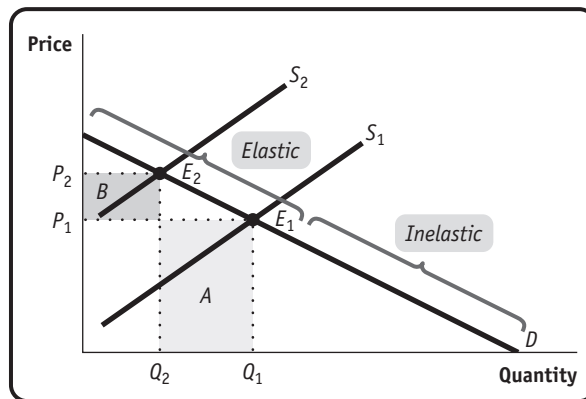
- 11.** Taiwan is a major world supplier of semiconductor chips. A recent earthquake severely damaged the production facilities of Taiwanese chip-producing companies, sharply reducing the amount of chips they could produce.
- a. Assume that the total revenue of a typical non-Taiwanese chip manufacturer rises due to these events. In terms of an elasticity, what must be true for this to happen? Illustrate the change in total revenue with a diagram, indicating the price effect and the quantity effect of the Taiwan earthquake on this company's total revenue.
  - b. Now assume that the total revenue of a typical non-Taiwanese chip manufacturer falls due to these events. In terms of an elasticity, what must be true for this to happen? Illustrate the change in total revenue with a diagram, indicating the price effect and the quantity effect of the Taiwan earthquake on this company's total revenue.

- 11. a.** The earthquake shifts the supply curve to the left, leading to a price increase. If the increase in price results in an increase in total revenue, then the price effect (which tends to increase total revenue) must outweigh the quantity effect (which tends to reduce total revenue). That is, demand must have been inelastic. In the accompanying diagram, as supply shifted leftward from  $S_1$  to  $S_2$ , the fall in total revenue due to the quantity effect (area A) is outweighed by the gain in total revenue due to the price effect (area B).





- b. If the increase in price results in a fall in total revenue, then the quantity effect (which tends to reduce total revenue) must outweigh the price effect (which tends to increase total revenue). That is, demand must have been elastic. In the accompanying diagram, as supply shifted leftward from  $S_1$  to  $S_2$ , total revenue falls by the amount of the quantity effect (area A) but rises by the amount of the price effect (area B). The quantity effect (area A) is larger than the price effect (area B), so total revenue declines.

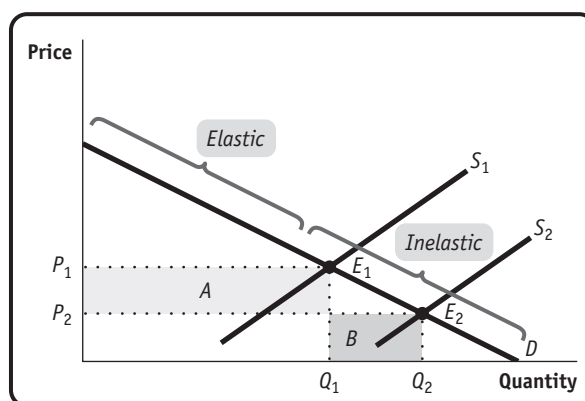


12. There is a debate about whether sterile hypodermic needles should be passed out free of charge in cities with high drug use. Proponents argue that doing so will reduce the incidence of diseases, such as HIV/AIDS, that are often spread by needle sharing among drug users. Opponents believe that doing so will encourage more drug use by reducing the risks of this behavior. As an economist asked to assess the policy, you must know the following: (i) how responsive the spread of diseases like HIV/AIDS is to the price of sterile needles and (ii) how responsive drug use is to the price of sterile needles. Assuming that you know these two things, use the concepts of price elasticity of demand for sterile needles and the cross-price elasticity between drugs and sterile needles to answer the following questions.
- In what circumstances do you believe this is a beneficial policy?
  - In what circumstances do you believe this is a bad policy?

- 12. a.** Handing out free needles lowers the price of needles to zero. First consider the demand for needles. The higher the price elasticity of demand for sterile needles, the greater the increase in the quantity of sterile needles demanded in response to a decrease in the price. And the greater the increase in the quantity of sterile needles demanded, the lower the spread of diseases like HIV/AIDS. Now consider the demand for drugs. Drugs and sterile needles are complements: as the price of sterile needles falls, the demand for drugs increases. This implies that the cross-price elasticity of demand between drugs and sterile needles is negative. The less negative (the closer to zero) the cross-price elasticity of demand between drugs and sterile needles, the less responsive is the demand for drugs to the price of sterile needles. So the policy would be beneficial if the price elasticity of demand for sterile needles is high (elastic) and the cross-price elasticity of demand between drugs and sterile needles is negative and low (close to zero, that is, weakly complementary).
- b.** Similar reasoning as in part a implies that the policy would be a bad idea if the price elasticity of demand for sterile needles is low (inelastic) and the cross-price elasticity of demand between drugs and sterile needles is high and negative (strongly complementary).

- 13.** Worldwide, the average coffee grower has increased the amount of acreage under cultivation over the past few years. The result has been that the average coffee plantation produces significantly more coffee than it did 10 to 20 years ago. Unfortunately for the growers, however, this has also been a period in which their total revenues have plunged. In terms of an elasticity, what must be true for these events to have occurred? Illustrate these events with a diagram, indicating the quantity effect and the price effect that gave rise to these events.

- 13.** An increase in the amount of acreage that is cultivated results in a rightward shift in the supply of coffee. This reduces the price of coffee and increases the quantity demanded. If total revenue from coffee sales have decreased, this means that the price effect (which tends to lower total revenue) must have outweighed the quantity effect (which tends to increase total revenue). This implies that demand must be inelastic. As shown in the accompanying diagram, the price effect results in a loss of total revenue equal to the size of area A. The quantity effect (the quantity demanded increases as a result of the price fall) results in an increase in total revenue equal to the size of area B. Area A exceeds area B, so total revenue falls.



- 14.** A recent report by the U.S. Centers for Disease Control and Prevention (CDC), published in the CDC's *Morbidity and Mortality Weekly Report*, studied the effect of an increase in the price of beer on the incidence of new cases of sexually transmitted disease in young adults. In particular, the researchers analyzed the responsiveness of gonorrhea cases to a tax-induced increase in the price of beer. The report concluded that "the . . . analysis suggested that a beer tax increase of \$0.20 per six-pack could reduce overall gonorrhea rates by 8.9%." Assume that a six-pack costs \$5.90 before the price increase. Use the midpoint method to determine the percent increase in the price of a six-pack, and then calculate the cross-price elasticity of demand between beer and incidence of gonorrhea. According to your estimate of this cross-price elasticity of demand, are beer and gonorrhea complements or substitutes?

- 14.** The percent increase in the price of beer is

$$\frac{\$0.20}{(\$5.90 + \$6.10)/2} \times 100 = \frac{\$0.20}{\$6.00} \times 100 = 3.3\%$$

Since the incidence of gonorrhea fell by 8.9%, the cross-price elasticity of demand is

$$\frac{-8.9\%}{3.3\%} = -2.7$$

Since the cross-price elasticity of demand is negative, beer and gonorrhea are complements.

15. The U.S. government is considering reducing the amount of carbon dioxide that firms are allowed to produce by issuing a limited number of tradable allowances for carbon dioxide (CO<sub>2</sub>) emissions. In an April 25, 2007, report, the U.S. Congressional Budget Office (CBO) argues that “most of the cost of meeting a cap on CO<sub>2</sub> emissions would be borne by consumers, who would face persistently higher prices for products such as electricity and gasoline . . . poorer households would bear a larger burden relative to their income than wealthier households would.” What assumption about one of the elasticities you learned about in this chapter has to be true for poorer households to be disproportionately affected?

**15.** For poorer households to be disproportionately affected by an increase in energy prices, it is necessary that those households spend a larger share of their income on energy products than wealthier households. In other words, as income rises, the quantity of energy products demanded has to increase less than proportionately. So the CBO must think that the income elasticity of demand for energy products, although positive, is less than 1: energy products are income-inelastic. In fact, this is just what the CBO report says: “lower-income households tend to spend a larger fraction of their income than wealthier households do and . . . energy products account for a bigger share of their spending.”

16. According to data from the U.S. Department of Energy, sales of the fuel-efficient Toyota Prius hybrid fell from 158,574 vehicles sold in 2008 to 139,682 in 2009. Over the same period, according to data from the U.S. Energy Information Administration, the average price of regular gasoline fell from \$3.27 to \$2.35 per gallon. Using the midpoint method, calculate the cross-price elasticity of demand between Toyota Prii (the official plural of “Prius” is “Prii”) and regular gasoline. According to your estimate of the cross-price elasticity, are the two goods complements or substitutes? Does your answer make sense?

- 16.** A fall in price of regular gasoline from \$3.27 to \$2.35 per gallon, using the midpoint method, is a percent change of

$$\frac{\$2.35 - \$3.27}{\$2.81} \times 100 = \frac{-\$0.92}{\$2.81} \times 100 = -32.7\%$$

And a fall in the quantity of Prii demanded from 158,574 to 139,682 vehicles, using the midpoint method, is a percent change of

$$\frac{139,682 - 158,574}{149,128} \times 100 = \frac{-18,892}{149,128} \times 100 = -12.7\%$$

So the cross-price elasticity of demand is

$$\frac{-12.7\%}{-32.7\%} = 0.4$$

Since the cross-price elasticity of demand between Toyota Prii and regular gasoline is positive, this estimate indicates that the two are substitutes. This answer might seem perplexing because cars and gasoline are generally complements: you need gasoline to run a (gasoline-powered) car like a Toyota Prius. The generally complementary relationship between gas and cars implies that the cross-price elasticity between them would be negative. But a Toyota Prius adds another dimension to the comparison: it is a fuel-efficient car, not a gas-guzzler. And fuel-efficient cars and gas-guzzlers are substitutes. So as gasoline prices rise, the demand for gas-guzzling cars falls and the demand for fuel-efficient cars (such as the Toyota Prius), which are substitutes, rises. So the substitute nature of gas-guzzlers and Toyota Prii implies a positive cross-price elasticity between gas and Toyota Prii. Which effect is stronger? Clearly the substitution effect is stronger because the data show a positive cross-price elasticity.

**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



- 17.** Nile.com, the online bookseller, wants to increase its total revenue. One strategy is to offer a 10% discount on every book it sells. Nile.com knows that its customers can be divided into two distinct groups according to their likely responses to the discount. The accompanying table shows how the two groups respond to the discount.

	Group A (sales per week)	Group B (sales per week)
Volume of sales before the 10% discount	1.55 million	1.50 million
Volume of sales after the 10% discount	1.65 million	1.70 million

- Using the midpoint method, calculate the price elasticities of demand for group A and group B.
- Explain how the discount will affect total revenue from each group.
- Suppose Nile.com knows which group each customer belongs to when he or she logs on and can choose whether or not to offer the 10% discount. If Nile.com wants to increase its total revenue, should discounts be offered to group A or to group B, to neither group, or to both groups?

- 17. a.** Using the midpoint method, the percent change in the quantity demanded by group A is

$$\frac{1.65 \text{ million} - 1.55 \text{ million}}{(1.55 \text{ million} + 1.65 \text{ million})/2} \times 100 = \frac{0.1 \text{ million}}{1.6 \text{ million}} \times 100 = 6.25\%$$

and since the change in price is 10%, the price elasticity of demand for group A is

$$\frac{6.25\%}{10\%} = 0.625$$

Using the midpoint method, the percent change in the quantity demanded by group B is

$$\frac{1.7 \text{ million} - 1.5 \text{ million}}{(1.5 \text{ million} + 1.7 \text{ million})/2} \times 100 = \frac{0.2 \text{ million}}{1.6 \text{ million}} \times 100 = 12.5\%$$

and since the change in price is 10%, the price elasticity of demand for group B is

$$\frac{12.5\%}{10\%} = 1.25$$

- For group A, since the price elasticity of demand is 0.625 (demand is inelastic), total revenue will decrease as a result of the discount. For group B, since the price elasticity of demand is 1.25 (demand is elastic), total revenue will increase as a result of the discount.
- If Nile.com wants to increase total revenue, it should definitely not offer the discount to group A and it should definitely offer the discount to group B.

# Taxes

1. The United States imposes an excise tax on the sale of domestic airline tickets. Let's assume that in 2013 the total excise tax was \$6.10 per airline ticket (consisting of the \$3.60 flight segment tax plus the \$2.50 September 11 fee). According to data from the Bureau of Transportation Statistics, in 2013, 643 million passengers traveled on domestic airline trips at an average price of \$380 per trip. The accompanying table shows the supply and demand schedules for airline trips. The quantity demanded at the average price of \$380 is actual data; the rest is hypothetical.

Price of trip	Quantity of trips demanded (millions)	Quantity of trips supplied (millions)
\$380.02	642	699
380.00	643	698
378.00	693	693
373.90	793	643
373.82	913	642

- a. What is the government tax revenue in 2013 from the excise tax?
- b. On January 1, 2014, the total excise tax increased to \$6.20 per ticket. What is the equilibrium quantity of tickets transacted now? What is the average ticket price now? What is the 2014 government tax revenue?
- c. Does this increase in the excise tax increase or decrease government tax revenue?

## Solution

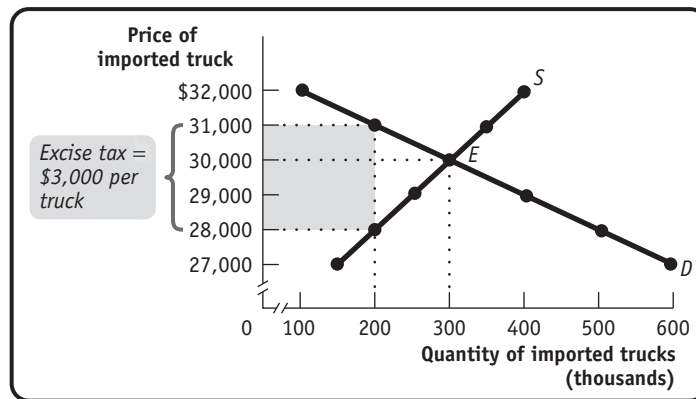
1.
  - a. Tax revenue is  $\$6.10 \text{ per trip} \times 643 \text{ million trips} = \$3,922.3 \text{ million}$ .
  - b. The equilibrium quantity now falls to 642 million, with the price rising to \$380.02. Tax revenue rises to  $\$6.20 \text{ per trip} \times 642 \text{ million trips} = \$3,980.40 \text{ million}$ .
  - c. The increase in the excise tax increases government tax revenue.
2. The U.S. government would like to help the American auto industry compete against foreign automakers that sell trucks in the United States. It can do this by imposing an excise tax on each foreign truck sold in the United States. The hypothetical pre-tax demand and supply schedules for imported trucks are given in the accompanying table.

Price of imported truck	Quantity of imported trucks (thousands)	
	Quantity demanded	Quantity supplied
\$32,000	100	400
31,000	200	350
30,000	300	300
29,000	400	250
28,000	500	200
27,000	600	150

- a. In the absence of government interference, what is the equilibrium price of an imported truck? The equilibrium quantity? Illustrate with a diagram.
- b. Assume that the government imposes an excise tax of \$3,000 per imported truck. Illustrate the effect of this excise tax in your diagram from part a. How many imported trucks are now purchased and at what price? How much does the foreign automaker receive per truck?
- c. Calculate the government revenue raised by the excise tax in part b. Illustrate it on your diagram.
- d. How does the excise tax on imported trucks benefit American automakers? Whom does it hurt? How does inefficiency arise from this government policy?

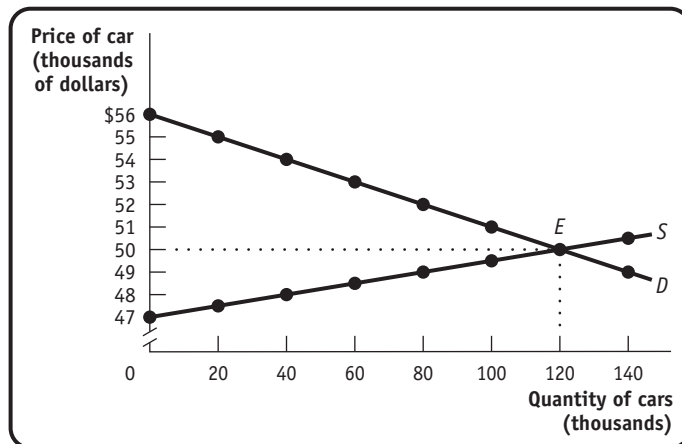
## Solution

2. a. The equilibrium price without government interference is \$30,000 and the equilibrium quantity is 300,000, as shown by point *E* in the accompanying diagram.



- b. The effect of the excise tax is illustrated in the diagram: a tax of \$3,000 per truck puts a wedge between the price paid by consumers, or the demand price (\$31,000), and the price received by producers, or the supply price (\$28,000). The quantity bought and sold is 200,000 trucks. The foreign automaker receives \$28,000 per truck (after tax).
- c. Since 200,000 trucks are sold, and the government earns a tax of \$3,000 on each truck, the total tax revenue is  $200,000 \times \$3,000 = \$600$  million. This is the shaded area in the diagram.
- d. The excise tax leads to a rise in the price of imported trucks. Since American trucks are substitutes for imported trucks, the effect of the tax is to increase the demand for American-made trucks, which leads to a higher price for them. As a result, buyers of both domestic and foreign trucks pay higher prices because of the tax on foreign trucks. Inefficiency arises because some mutually beneficial transactions no longer occur due to the higher prices for trucks caused by the tax.

3. In 1990, the United States began to levy a tax on sales of luxury cars. For simplicity, assume that the tax was an excise tax of \$6,000 per car. The accompanying figure shows hypothetical demand and supply curves for luxury cars.



- a. Under the tax, what is the price paid by consumers? What is the price received by producers? What is the government tax revenue from the excise tax?

Over time, the tax on luxury automobiles was slowly phased out (and completely eliminated in 2002). Suppose that the excise tax falls from \$6,000 per car to \$4,500 per car.

- b. After the reduction in the excise tax from \$6,000 to \$4,500 per car, what is the price paid by consumers? What is the price received by producers? What is tax revenue now?
- c. Compare the tax revenue created by the taxes in parts a and b. What accounts for the change in tax revenue from the reduction in the excise tax?

## Solution

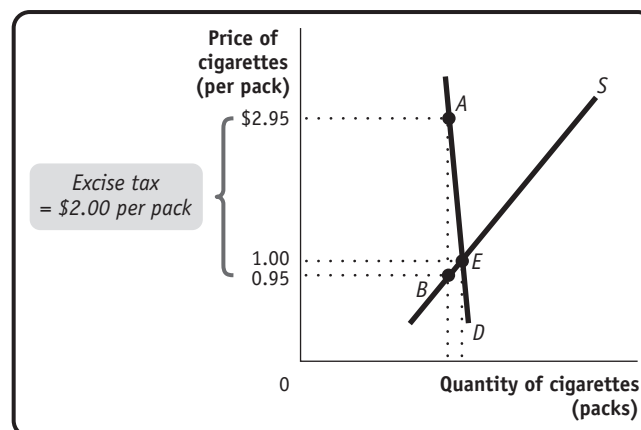
3. a. The price paid by consumers is \$54,000. The price received by producers is \$48,000. The government's tax revenue is \$6,000 per car  $\times$  40,000 cars = \$240 million.
- b. The price paid by consumers is now \$53,000. The price received by producers is \$48,500. The government's tax revenue is \$4,500 per car  $\times$  60,000 cars = \$270 million.
- c. The government tax revenue rose as a result of the reduction in the excise tax. This occurs because the supply of and the demand for luxury automobiles are both highly elastic: a fall in the price paid by consumers leads to a large increase in the quantity demanded, and a rise in the price received by producers leads to a large increase in the quantity supplied. As a result, reducing the tax leads to a large increase in the quantity of luxury automobiles bought and sold—so large, in fact, that the increase in the quantity bought and sold more than makes up for the decrease in the tax per car.
4. All states impose excise taxes on gasoline. According to data from the Federal Highway Administration, the state of California imposes an excise tax of \$0.40 per gallon of gasoline. In 2013, gasoline sales in California totaled 18.4 billion gallons. What was California's tax revenue from the gasoline excise tax? If California doubled the excise tax, would tax revenue double? Why or why not?

## Solution

4. Tax revenue is  $\$0.40$  per gallon  $\times$  18.4 billion gallons =  $\$7.36$  billion. Doubling the excise tax would reduce the amount of gasoline bought and sold, and tax revenue would less than double. The exception would be a case in which either demand or supply is perfectly inelastic; only in that special case would the quantity transacted not change as a result of the imposition of the excise tax, and tax revenue would—in this special case only—double as a result of a doubling in the excise tax rate.
5. In the United States, each state government can impose its own excise tax on the sale of cigarettes. Suppose that in the state of North Texarkana, the state government imposes a tax of  $\$2.00$  per pack sold within the state. In contrast, the neighboring state of South Texarkana imposes no excise tax on cigarettes. Assume that in both states the pre-tax price of a pack of cigarettes is  $\$1.00$ . Assume that the total cost to a resident of North Texarkana to smuggle a pack of cigarettes from South Texarkana is  $\$1.85$  per pack. (This includes the cost of time, gasoline, and so on.) Assume that the supply curve for cigarettes is neither perfectly elastic nor perfectly inelastic.
- Draw a diagram of the supply and demand curves for cigarettes in North Texarkana showing a situation in which it makes economic sense for a North Texarkanan to smuggle a pack of cigarettes from South Texarkana to North Texarkana. Explain your diagram.
  - Draw a corresponding diagram showing a situation in which it does not make economic sense for a North Texarkanan to smuggle a pack of cigarettes from South Texarkana to North Texarkana. Explain your diagram.
  - Suppose the demand for cigarettes in North Texarkana is perfectly inelastic. How high could the cost of smuggling a pack of cigarettes go until a North Texarkanan no longer found it profitable to smuggle?
  - Still assume that demand for cigarettes in North Texarkana is perfectly inelastic and that all smokers in North Texarkana are smuggling their cigarettes at a cost of  $\$1.85$  per pack, so no tax is paid. Is there any inefficiency in this situation? If so, how much per pack? Suppose chip-embedded cigarette packaging makes it impossible to smuggle cigarettes across the state border. Is there any inefficiency in this situation? If so, how much per pack?

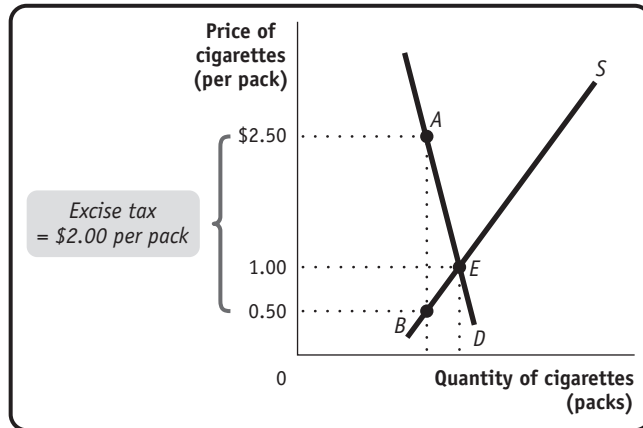
## Solution

5. a. In the accompanying figure, the demand for cigarettes in North Texarkana is relatively inelastic. So most of the  $\$2.00$  tax is borne by consumers, who pay an after-tax price of  $\$2.95$ . Since it would cost  $\$2.85$  to purchase and smuggle a pack from South Texarkana ( $\$1.00$  price per pack +  $\$1.85$  smuggling cost per pack), this diagram illustrates a situation in which a North Texarkanan would be better off smuggling rather than purchasing cigarettes in North Texarkana.

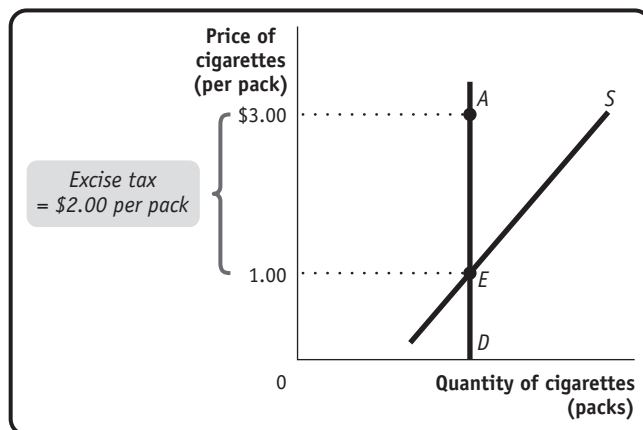




- b. In the accompanying diagram, the demand in North Texarkana is less inelastic. As a result, consumers pay an after-tax price of \$2.50. In this case, it does not make economic sense to smuggle.



- c. As shown in the accompanying diagram, if the demand for cigarettes in North Texarkana is perfectly inelastic, the demand curve is a vertical line and all of the tax is borne by consumers. In that case, the after-tax price paid by North Texarkanans is \$3.00. So the cost of smuggling could go as high as \$1.99, and North Texarkanans would still be better off smuggling; at a cost of \$2.00 to smuggle, they would be indifferent between smuggling and purchasing their cigarettes in their home state.



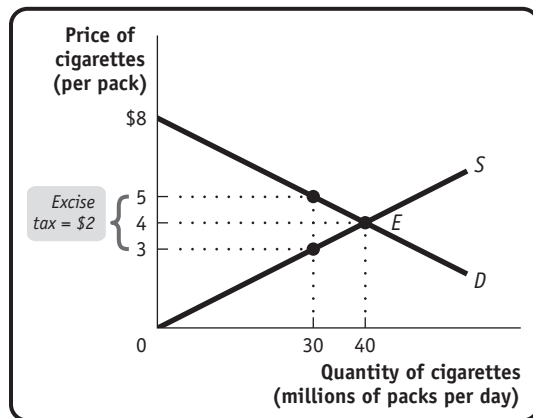
- d. Since demand is perfectly inelastic, the same number of cigarettes are transacted after the tax is imposed compared to before the tax is imposed. But there is still an inefficiency incurred in this situation despite the fact that no tax is paid and no transactions are discouraged: it is the \$1.85 that is spent to smuggle a pack of cigarettes. This is the value of resources spent to evade the tax that consumers would have preferred to spend on other goods and activities. If technology eliminates smuggling altogether, there is no inefficiency. Because demand is perfectly inelastic, no transactions are discouraged by the tax, and all of the surplus lost by consumers is captured by the government as tax revenue.

- 6.** In each of the following cases involving taxes, explain: (i) whether the incidence of the tax falls more heavily on consumers or producers, (ii) why government revenue raised from the tax is not a good indicator of the true cost of the tax, and (iii) how deadweight loss arises as a result of the tax.
- The government imposes an excise tax on the sale of all college textbooks. Before the tax was imposed, 1 million textbooks were sold every year at a price of \$50. After the tax is imposed, 600,000 books are sold yearly; students pay \$55 per book, \$30 of which publishers receive.
  - The government imposes an excise tax on the sale of all airline tickets. Before the tax was imposed, 3 million airline tickets were sold every year at a price of \$500. After the tax is imposed, 1.5 million tickets are sold yearly; travelers pay \$550 per ticket, \$450 of which the airlines receive.
  - The government imposes an excise tax on the sale of all toothbrushes. Before the tax, 2 million toothbrushes were sold every year at a price of \$1.50. After the tax is imposed, 800,000 toothbrushes are sold every year; consumers pay \$2 per toothbrush, \$1.25 of which producers receive.

## Solution

- 6. a.** After the imposition of the tax, consumers pay \$5 more per book than before; publishers receive \$20 less per book than before. Producers (publishers) bear more of the tax. The tax is  $\$55 - \$30 = \$25$  per book, and 600,000 books are bought and sold. So government revenue is \$15 million. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to the higher price, there are now 400,000 potential consumers who would have bought the books without the tax but no longer will buy them. Deadweight loss arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is accounted for by the 400,000 potential consumers and publishers who would have made transactions without the tax but do not once the tax is levied.
- b.** After the imposition of the tax, travelers pay \$50 more per ticket than before; airlines receive \$50 less than before. The tax is split evenly between consumers and producers. The tax is  $\$550 - \$450 = \$100$  per ticket, and 1.5 million tickets are bought and sold. So government revenue is \$150 million. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to 1.5 million travelers paying higher prices, there are now 1.5 million potential consumers who would have bought tickets without the tax but no longer buy tickets. Deadweight loss arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is represented by the 1.5 million tickets that would have been transacted at the pre-tax price but are not transacted once the tax is levied.
- c.** After the imposition of the tax, consumers pay \$0.50 more per toothbrush than before; producers receive \$0.25 less than before. The incidence of the tax falls mainly on consumers. The tax is  $\$2.00 - \$1.25 = \$0.75$  per toothbrush, and 800,000 toothbrushes are bought and sold. So government revenue is \$600,000. This, however, is a poor estimate of the cost of the tax, since it does not take into account the fact that, in addition to 800,000 toothbrushes now being more expensive, there are 1.2 million toothbrushes that would have been transacted without the tax but are no longer transacted. Inefficiency arises because consumers and producers lose surplus that is not captured as government revenue. That loss in surplus is represented by the 1.2 million toothbrushes that would have been transacted at the pre-tax price but are not transacted once the tax is levied.

7. The accompanying diagram shows the market for cigarettes. The current equilibrium price per pack is \$4, and every day 40 million packs of cigarettes are sold. In order to recover some of the health care costs associated with smoking, the government imposes a tax of \$2 per pack. This will raise the equilibrium price to \$5 per pack and reduce the equilibrium quantity to 30 million packs.



The economist working for the tobacco lobby claims that this tax will reduce consumer surplus for smokers by \$40 million per day, since 40 million packs now cost \$1 more per pack. The economist working for the lobby for sufferers of second-hand smoke argues that this is an enormous overestimate and that the reduction in consumer surplus will be only \$30 million per day, since after the imposition of the tax only 30 million packs of cigarettes will be bought and each of these packs will now cost \$1 more. They are both wrong. Why?

## Solution

7. The economist working for the tobacco lobby is overestimating the change in consumer surplus. She is assuming that there will be no change in the quantity demanded and that consumers will continue to smoke 40 million packs of cigarettes per day even when the price has risen by \$1 per pack. The economist working for the second-hand smoke lobby is underestimating the loss of consumer surplus. He calculates the loss of consumer surplus to be \$30 million: \$1 per pack times the number of packs per day that are still sold, 30 million. He fails to count the loss of consumer surplus to those who smoke less or none at all after the tax, accounted for by the fall in consumption from 40 million to 30 million packs per day.

We can calculate the loss in consumer surplus from the tax by comparing the total consumer surplus before the tax is levied to the total consumer surplus after. Recall that the area of a triangle is  $\frac{1}{2} \times$  the base of the triangle  $\times$  the height of the triangle. Before the tax the consumer surplus was  $\frac{1}{2} \times (\$8 - \$4) \times 40$  million = \$80 million. After the tax, the consumer surplus is  $\frac{1}{2} \times (\$8 - \$5) \times 30$  million = \$45 million. The reduction in consumer surplus is \$80 million - \$45 million = \$35 million.

8. Consider the original market for pizza in Collegetown, illustrated in the accompanying table. Collegetown officials decide to impose an excise tax on pizza of \$4 per pizza.

Price of pizza	Quantity of pizza demanded	Quantity of pizza supplied
\$10	0	6
9	1	5
8	2	4
7	3	3
6	4	2
5	5	1
4	6	0
3	7	0
2	8	0
1	9	0

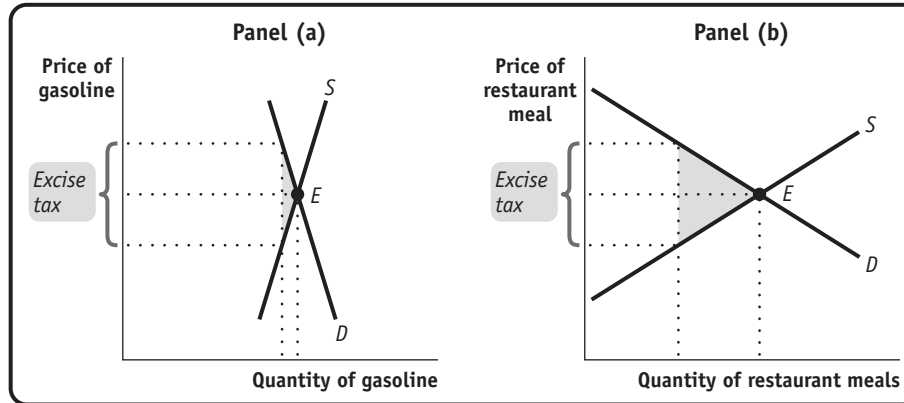
- What is the quantity of pizza bought and sold after the imposition of the tax? What is the price paid by consumers? What is the price received by producers?
- Calculate the consumer surplus and the producer surplus after the imposition of the tax. By how much has the imposition of the tax reduced consumer surplus? By how much has it reduced producer surplus?
- How much tax revenue does Collegetown earn from this tax?
- Calculate the deadweight loss from this tax.

## Solution

8. a. The tax drives a wedge between the price paid by consumers and the price received by producers. Consumers now pay \$9, and producers receive \$5. So after the imposition of the tax, the quantity bought and sold will be one pizza.
- b. Consumer surplus is now zero (the one consumer who still buys a pizza at \$9 has a willingness to pay of just \$9, so that the consumer surplus is  $\$9 - \$9 = \$0$ ). Compared to the situation before the imposition of the tax, where the equilibrium price was \$7, consumer surplus has fallen by \$3. Similarly, the producer of the one pizza has a cost of \$5, and this is the price he receives, so producer surplus is also zero. Compared to pre-tax producer surplus, it has fallen by \$3.
- c. Collegetown earns a tax of \$4 per pizza sold, which is a total tax revenue of \$4.
- d. Total surplus has been decreased by \$6. Of that \$6, the town earns \$4 in revenue, but \$2 of surplus is lost. That is the deadweight loss from this tax.
9. The state needs to raise money, and the governor has a choice of imposing an excise tax of the same amount on one of two previously untaxed goods: the state can tax sales of either restaurant meals or gasoline. Both the demand for and the supply of restaurant meals are more elastic than the demand for and the supply of gasoline. If the governor wants to minimize the deadweight loss caused by the tax, which good should be taxed? For each good, draw a diagram that illustrates the deadweight loss from taxation.

Solution

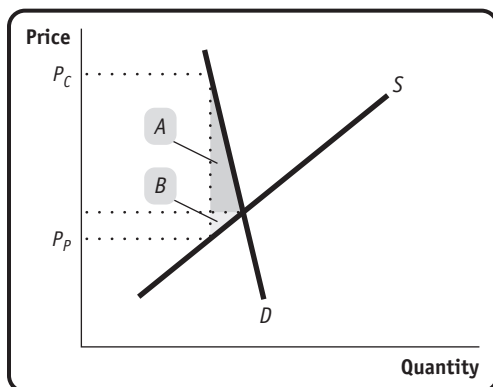
9. The tax should be imposed on sales of gasoline. Since both demand for and supply of gasoline are less elastic, changes in the price of gasoline will result in smaller reductions in the quantity demanded and quantity supplied. As a result, fewer transactions are discouraged by the tax—in other words, less total surplus (consumer and producer surplus) is lost. Panel (a) of the accompanying diagram illustrates a tax imposed on sales of gasoline, for which both demand and supply are less elastic; panel (b) illustrates a tax imposed on sales of restaurant meals, for which both demand and supply are more elastic. As you can see, deadweight loss, the shaded triangle, is larger in panel (b) than in panel (a).



10. Assume that the demand for gasoline is inelastic and supply is relatively elastic. The government imposes a sales tax on gasoline. The tax revenue is used to fund research into clean fuel alternatives to gasoline, which will improve the air we all breathe.
- Who bears more of the burden of this tax, consumers or producers? Show in a diagram who bears how much of the excess burden.
  - Is this tax based on the benefits principle or the ability-to-pay principle? Explain.

Solution

10. a. The accompanying diagram shows an inelastic (relatively steep) demand curve for gasoline. The tax, whether imposed on consumers or producers, drives a wedge between the price paid by consumers,  $P_C$ , and the price received by producers,  $P_P$ . The burden of the tax is illustrated by the gray and light gray areas A and B. Area A is the loss of consumer surplus—the burden of the tax that falls on consumers. Area B is the loss of producer surplus—the burden of the tax that falls on producers. Here, the burden is borne predominantly by consumers.



b. Consumers who drive cars that use more gasoline pay most of the tax. If this tax were based on the benefits principle, the tax revenue would have to benefit those who pay most of the tax. However, everyone benefits equally from research into cleaner fuel, because of the improvement in air quality, so the tax is not based on the benefits principle. If this tax were based on the ability-to-pay principle, more of the tax would have to be paid by those who have a greater ability to pay. This would be true if cars that consume more gasoline were driven largely by higher-income individuals. To some extent this may be true: higher-income individuals drive larger cars, SUVs, and so on, and to the extent to which this is true, the tax is based on the ability-to-pay principle. However, a significant number of lower-income individuals drive old, fuel-inefficient cars. To the extent to which this is true, the tax is not based on the ability-to-pay principle.

- 11.** Assess the following four tax policies in terms of the benefits principle versus the ability-to-pay principle.
- A tax on gasoline that finances maintenance of state roads
  - An 8% tax on imported goods valued in excess of \$800 per household brought in on passenger flights
  - Airline-flight landing fees that pay for air traffic control
  - A reduction in the amount of income tax paid based on the number of dependent children in the household

### Solution

- 11.**
- This tax is based on the benefits principle, since the people who use the state's roads will be the ones paying the gasoline tax.
  - This tax is based on the ability-to-pay principle, since the people paying the tax will presumably be individuals who buy expensive items abroad and then import them on passenger flights.
  - This tax is based on the benefits principle, since the airlines pay the landing fee and are also the beneficiary of air traffic control services.
  - This deduction is based on the ability-to-pay principle. People who have more dependent children in their household will have higher expenses and so are less able to pay a given amount of income taxes, other things equal.
- 12.** You are advising the government on how to pay for national defense. There are two proposals for a tax system to fund national defense. Under both proposals, the tax base is an individual's income. Under proposal A, all citizens pay exactly the same lump-sum tax, regardless of income. Under proposal B, individuals with higher incomes pay a greater proportion of their income in taxes.
- Is the tax in proposal A progressive, proportional, or regressive? What about the tax in proposal B?
  - Is the tax in proposal A based on the ability-to-pay principle or on the benefits principle? What about the tax in proposal B?
  - In terms of efficiency, which tax is better? Explain.

- 12.**
- The tax in proposal A is regressive: since everyone pays the same dollar amount in taxes, higher-income individuals pay a lower percentage of their income in taxes. The tax in proposal B is progressive: higher-income individuals pay a higher percentage of their income in taxes.
  - Every citizen benefits equally from national defense. The tax in proposal A is based on the benefits principle: since everyone benefits equally, everyone pays equally. The tax in proposal B is based on the ability-to-pay principle: higher-income individuals are able to pay more taxes, and under this proposal they do pay more taxes.
  - In terms of efficiency, the lump-sum tax is better. The lump-sum tax creates a marginal tax rate of zero: once the tax is paid, every additional dollar earned is no longer taxed. Since it does not depend on people's actions (how much income they choose to earn), it does not distort their incentives to earn income. The tax in proposal B has a higher marginal tax rate: each additional dollar of income earned is taxed. And the marginal tax rate is increasing: each additional dollar of income earned is taxed more than the previous dollar. This creates inefficiency, because it distorts the incentive to earn more income.
- 13.** Each of the following tax proposals has income as the tax base. In each case, calculate the marginal tax rate for each level of income. Then calculate the percentage of income paid in taxes for an individual with a pre-tax income of \$5,000 and for an individual with a pre-tax income of \$40,000. Classify the tax as being proportional, progressive, or regressive. (*Hint:* You can calculate the marginal tax rate as the percentage of an additional \$1 in income that is taxed away.)
- All income is taxed at 20%.
  - All income up to \$10,000 is tax-free. All income above \$10,000 is taxed at a constant rate of 20%.
  - All income between \$0 and \$10,000 is taxed at 10%. All income between \$10,000 and \$20,000 is taxed at 20%. All income higher than \$20,000 is taxed at 30%.
  - Each individual who earns more than \$10,000 pays a lump-sum tax of \$10,000. If the individual's income is less than \$10,000, that individual pays in taxes exactly what his or her income is.
  - Of the four tax policies, which is likely to cause the worst incentive problems? Explain.

- 13.**
- The marginal tax rate is 20% regardless of the taxpayer's income level: on each additional \$1 in income, individuals pay \$0.20 in taxes, which is 20%. An individual with a pre-tax income of \$5,000 would pay  $\$5,000 \times 20\% = \$1,000$  in taxes; this is 20% of his or her income. An individual with a pre-tax income of \$40,000 would pay  $\$40,000 \times 20\% = \$8,000$  in taxes; this is 20% of his or her income. Since each individual pays the same percentage of income in taxes, regardless of income level, this tax is proportional.
  - On income up to \$10,000, there is a zero marginal tax rate: on each additional \$1 of income in this tax bracket, individuals pay \$0.00 in taxes, which is 0%. On income over \$10,000, there is a 20% marginal tax rate: on each additional \$1 of income in this tax bracket, individuals pay \$0.20 in taxes, which is 20%. An individual with a pre-tax income of \$5,000 would pay  $\$5,000 \times 0\% = \$0$  in taxes; this is 0% of his or her income. An individual with a pre-tax income of \$40,000 would pay  $\$10,000 \times 0\% + \$30,000 \times 20\% = \$6,000$  in taxes; this is  $\$6,000 / \$40,000 \times 100 = 15\%$  of his or her income. This tax is progressive because the percentage of income paid in taxes rises as income rises.

- c. The marginal tax rate is 10% on the first \$10,000 of income: on each additional \$1 of income in this tax bracket, individuals pay \$0.10 in taxes, which is 10%; it is 20% on the next \$10,000 of income: on each additional \$1 of income in this tax bracket, individuals pay \$0.20 in taxes, which is 20%; it is 30% on all income above \$20,000: on each additional \$1 of income in this tax bracket, individuals pay \$0.30 in taxes, which is 30%. An individual with a pre-tax income of \$5,000 would pay  $\$5,000 \times 10\% = \$500$  in taxes; this is 10% of his or her income. An individual with a pre-tax income of \$40,000 would pay  $\$10,000 \times 10\% + \$10,000 \times 20\% + \$20,000 \times 30\% = \$9,000$  in taxes; this is  $\$9,000/\$40,000 \times 100 = 22.5\%$  of his or her income. Again, this tax is progressive because the percentage of income paid in taxes rises as income rises.
- d. For individuals who earn less than \$10,000, the marginal tax rate is 100%, since all additional income is taxed away. For those who earn more than \$10,000, the marginal tax rate is zero: they pay the same amount of tax—\$10,000—regardless of how much they earn over \$10,000. An individual with a pre-tax income of \$5,000 would pay  $\$5,000 \times 100\% = \$5,000$  in taxes; this is 100% of his or her income. An individual with a pre-tax income of \$40,000 would pay \$10,000 in taxes; this is  $\$10,000/\$40,000 \times 100 = 25\%$  of his or her income. This tax policy is regressive because those with higher incomes pay a smaller share of their income in taxes than those with lower incomes.
- e. The tax policy in part d is likely to cause the worst incentive problems. People who make less than \$10,000 if they work will receive zero income after taxes are paid, so there is zero incentive to work.

- 14.** In Transylvania the basic income tax system is fairly simple. The first 40,000 sylvers (the official currency of Transylvania) earned each year are free of income tax. Any additional income is taxed at a rate of 25%. In addition, every individual pays a social security tax, which is calculated as follows: all income up to 80,000 sylvers is taxed at an additional 20%, but there is no additional social security tax on income above 80,000 sylvers.
- a. Calculate the marginal tax rates (including income tax and social security tax) for Transylvanians with the following levels of income: 20,000 sylvers, 40,000 sylvers, and 80,000 sylvers. (*Hint:* You can calculate the marginal tax rate as the percentage of an additional 1 sylver in income that is taxed away.)
  - b. Is the income tax in Transylvania progressive, regressive, or proportional? Is the social security tax progressive, regressive, or proportional?
  - c. Which income group's incentives are most adversely affected by the combined income and social security tax systems?

- Solution**
- 14. a.** An individual who earns 20,000 sylvers pays no income tax but pays 20% of his or her income in social security tax. So the marginal tax rate is 20%.  
 An individual who earns 40,000 sylvers pays no income tax and pays 20% of his or her income in social security tax. But on an additional sylver (that is, on income above 40,000 sylvers) this individual pays a 45% tax (the basic income tax plus the social security tax). So the marginal tax rate is 45%.  
 An individual who earns 80,000 sylvers pays a marginal income tax rate of 25% and 20% in social security tax. But on an additional sylver (that is, on income above 80,000 sylvers), this individual pays only 25% (the income tax rate) because there is no social security tax on income over 80,000 sylvers. So this individual's marginal tax rate is 25%.



- b. The Transylvanian income tax system is progressive because the percentage of income paid in income taxes rises as income rises. But the social security tax system is a mix of proportional and regressive because the percentage of income paid in social security tax is constant at 20% up to an income of 80,000 sylvens, and then it falls to zero as income increases further. This makes the social security tax regressive overall.
- c. In this system, incentive problems are worst for middle-income individuals (between 40,000 and 80,000 sylvens) because they have the highest marginal tax rate, 45%.
- 15.** You work for the Council of Economic Advisers, providing economic advice to the White House. The president wants to overhaul the income tax system and asks your advice. Suppose that the current income tax system consists of a proportional tax of 10% on all income and that there is one person in the country who earns \$110 million; everyone else earns less than \$100 million. The president proposes a tax cut targeted at the very rich so that the new tax system would consist of a proportional tax of 10% on all income up to \$100 million and a marginal tax rate of 0% (no tax) on income above \$100 million. You are asked to evaluate this tax proposal.
- a. For incomes of \$100 million or less, is this proposed tax system progressive, regressive, or proportional? For incomes of more than \$100 million? Explain.
- b. Would this tax system create more or less tax revenue, other things equal? Is this tax system more or less efficient than the current tax system? Explain.

**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



- 15. a.** This tax system is proportional up to an income of \$100 million, but it is regressive for incomes higher than \$100 million. Above \$100 million, the tax is regressive, since higher-income taxpayers pay a smaller percentage of their income in taxes. For instance, the individual with income of \$110 million pays \$10 million  $\times 10\% = \$10$  million in taxes, which is  $\$10 \text{ million} / \$110 \text{ million} \times 100 = 9\%$  of his or her income in taxes. But an individual with an even higher income, say \$200 million, would pay  $\$100 \text{ million} \times 10\% = \$10$  million in taxes, which is  $\$10 \text{ million} / \$200 \text{ million} \times 100 = 5\%$  of his or her income in taxes.
- b.** This tax system would raise almost the same amount of tax revenue, since for all individuals, except for the one richest individual, it is identical to the current tax system. The richest individual pays \$10 million in taxes, except the new tax system now creates an incentive for that individual to work to raise his or her income: an additional dollar of income is now worth exactly one additional dollar. Under the current system, an additional dollar of income for the top earner would only be worth an additional 90 cents. So this tax system is more efficient than the current tax system.



# International Trade

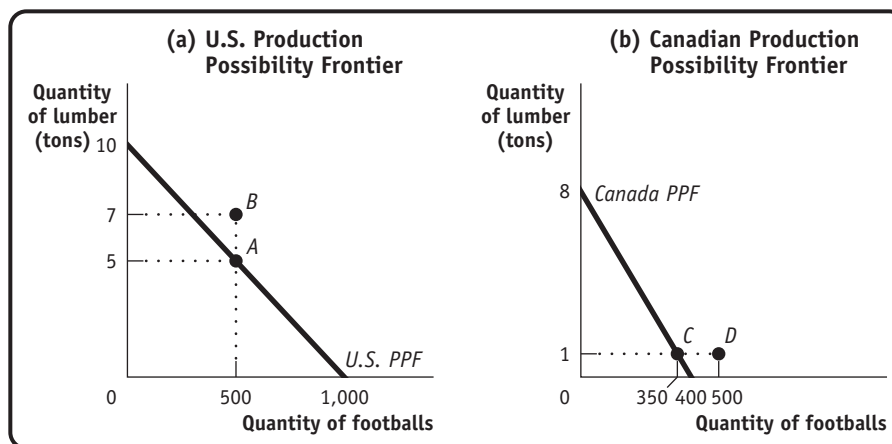
1. Both Canada and the United States produce lumber and footballs with constant opportunity costs. The United States can produce either 10 tons of lumber and no footballs, or 1,000 footballs and no lumber, or any combination in between. Canada can produce either 8 tons of lumber and no footballs, or 400 footballs and no lumber, or any combination in between.
  - a. Draw the U.S. and Canadian production possibility frontiers in two separate diagrams, with footballs on the horizontal axis and lumber on the vertical axis.
  - b. In autarky, if the United States wants to consume 500 footballs, how much lumber can it consume at most? Label this point A in your diagram. Similarly, if Canada wants to consume 1 ton of lumber, how many footballs can it consume in autarky? Label this point C in your diagram.
  - c. Which country has the absolute advantage in lumber production?
  - d. Which country has the comparative advantage in lumber production?

Suppose each country specializes in the good in which it has the comparative advantage, and there is trade.

  - e. How many footballs does the United States produce? How much lumber does Canada produce?
  - f. Is it possible for the United States to consume 500 footballs and 7 tons of lumber? Label this point B in your diagram. Is it possible for Canada at the same time to consume 500 footballs and 1 ton of lumber? Label this point D in your diagram.

## Solution

1. a. The two accompanying diagrams illustrate the U.S. and Canadian production possibility frontiers.



- b. If the United States wants to consume 500 footballs, in autarky it can at most consume 5 tons of lumber, as indicated by point A in panel (a) of the diagram. And if Canada wants to consume 1 ton of lumber, it can at most consume 350 footballs in autarky, as shown by point C in panel (b).
- c. The United States can produce at most 10 tons of lumber, and Canada can produce at most 8 tons. So the United States has the absolute advantage in lumber production.

- d. In the United States, producing 1 additional ton of lumber means forgoing production of 100 footballs: the opportunity cost of 1 ton of lumber is 100 footballs. In Canada, the opportunity cost of 1 ton of lumber is 50 footballs. Since the opportunity cost of lumber production in Canada is lower, Canada has the comparative advantage in lumber production.
  - e. If there is trade, the United States will specialize in the production of footballs and produce 1,000 footballs. Canada will specialize in lumber production and produce 8 tons of lumber.
  - f. With trade, it is possible for the United States to consume 500 footballs and 7 tons of lumber. This is shown by point *B* in the diagram. That leaves exactly 500 footballs and 1 ton of lumber to be consumed by Canada, shown by point *D*.
- 2.** For each of the following trade relationships, explain the likely source of the comparative advantage of each of the exporting countries.
- a. The United States exports software to Venezuela, and Venezuela exports oil to the United States.
  - b. The United States exports airplanes to China, and China exports clothing to the United States.
  - c. The United States exports wheat to Colombia, and Colombia exports coffee to the United States.

## Solution

- 2.**
- a. The United States has the comparative advantage in software production because of a factor endowment: a relatively large supply of human capital. Venezuela has the comparative advantage in oil production because of a factor endowment: large oil reserves.
  - b. The United States has the comparative advantage in airplane production because of a factor endowment: it has a relatively large supply of the human capital needed to produce airplanes. China has the comparative advantage in clothing production because of a factor endowment: it has a relatively large supply of unskilled labor.
  - c. The United States has the comparative advantage in wheat production because of an advantage in climate: it has a climate suitable for growing wheat. Colombia has the comparative advantage in coffee production because of an advantage in climate: it has a climate suitable for growing coffee.
- 3.** The U.S. Census Bureau keeps statistics on U.S. imports and exports on its website. The following steps will take you to the foreign trade statistics. Use them to answer the questions below.
- (i) Go to the U.S. Census Bureau's website at [www.census.gov](http://www.census.gov)
  - (ii) Under the heading "Topics" select "Business" and then select "International Trade" under the section "Data by Sector" in the left menu bar
  - (iii) At the top of the page, select the tab "Data"
  - (iv) In the left menu bar, select "Country/Product Trade"
  - (v) Under the heading "North American Industry Classification System (NAICS)-Based," select "NAICS web application"
  - (vi) In the drop-down menu "3-digit and 6-digit NAICS by country," select the product category you are interested in, and hit "Go"
  - (vii) In the drop-down menu "Select 6-digit NAICS," select the good or service you are interested in, and hit "Go"
  - (viii) In the drop-down menus that allow you to select a month and year, select "December" and "2013," and hit "Go"

- (ix) The right side of the table now shows the import and export statistics for the entire year 2013. For the questions below on U.S. imports, use the column for “Consumption Imports, Customs Value Basis.”
- Look up data for U.S. imports of hats and caps: in step (vi), select “(315) Apparel & Accessories” and in step (vii), select “(315220) Men’s and Boys’ Cut and Sew Apparel.” From which country do we import the most apparel? Which of the three sources of comparative advantage (climate, factor endowments, and technology) accounts for that country’s comparative advantage in apparel production?
  - Look up data for U.S. imports of grapes: in step (vi), select “(111) Agricultural Products” and in step (vii), select “(111332) Grapes.” From which country do we import the most grapes? Which of the three sources of comparative advantage (climate, factor endowments, and technology) accounts for that country’s comparative advantage in grape production?
  - Look up data for U.S. imports of food product machinery: in step (vi), select “(333) Machinery, Except Electrical” and in step (vii), select “333241 Food Product Machinery.” From which country do we import the most food product machinery? Which of the three sources of comparative advantage (climate, factor endowments, and technology) accounts for that country’s comparative advantage in food product machinery?

### Solution

- In 2013, the United States imported the most men’s and boy’s apparel from China: U.S. imports of apparel from China totaled \$846 million. (The runner-up was Vietnam, at \$100 million, followed by Bangladesh, at \$83 million.) China’s comparative advantage comes from a difference in factor endowments: China has an abundance of labor, used to make apparel.
  - In 2013, the United States imported the most grapes from Chile: U.S. imports of grapes from Chile totaled \$740 million. (The distant runner-up was Mexico, at \$464 million.) Chile’s comparative advantage comes from a difference in climate: when it is impossible to grow grapes in the United States during the cold winter months, it is summer in Chile and easy to grow grapes.
  - In 2013, the United States imported the most food product machinery from Germany: U.S. imports of food product machinery from Germany totaled \$174 million. (The runner-up was Italy, at \$129 million.) Germany’s comparative advantage comes from a difference in technology: over a long period of producing machinery, German manufacturers have developed superior production techniques. (Much of the world’s beer is bottled by German beer-bottling machinery.)
- Since 2000, the value of U.S. imports of men’s and boy’s apparel from China has more than tripled. What prediction does the Heckscher-Ohlin model make about the wages received by labor in China?

### Solution

- The value of U.S. imports of hats and caps from China more than tripled from a relatively small \$249 million in 2000 to \$846 million in 2013.
  - As trade increases, the Heckscher-Ohlin model predicts that prices of factors that are abundantly available in a country will rise. In other words, the model predicts that the wages received by labor in China would have risen between 2000 and 2013. (Is this really true? According to China’s National Bureau of Statistics, the average Chinese worker’s wage rose from 9,371 yuan in 2000 to 32,736 yuan in 2013, the latest year for which data were available at the time of writing. Almost none of this increase in wages was due to inflation: between 2000 and 2013, China experienced almost no inflation.)

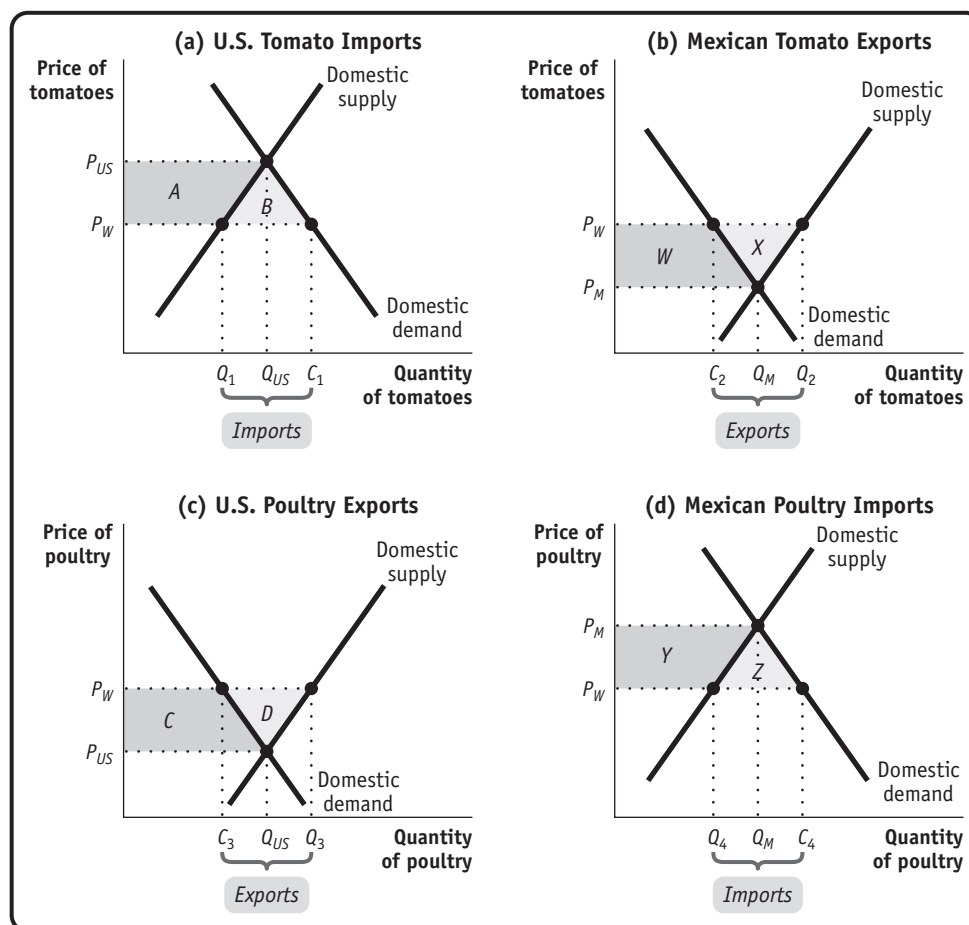
5. Shoes are labor-intensive and satellites are capital-intensive to produce. The United States has abundant capital. China has abundant labor. According to the Heckscher-Ohlin model, which good will China export? Which good will the United States export? In the United States, what will happen to the price of labor (the wage) and to the price of capital?

### Solution

5. The Heckscher-Ohlin model predicts that a country will have a comparative advantage in the good whose production is intensive in the factor the country has abundantly available: the United States has the comparative advantage in satellite production, and China has the comparative advantage in shoe production. So the United States will export satellites, and China will export shoes. In the United States, demand for capital increases, raising the price of capital, but the demand for labor decreases, lowering the wage.
6. Before the North American Free Trade Agreement (NAFTA) gradually eliminated import tariffs on goods, the autarky price of tomatoes in Mexico was below the world price and in the United States was above the world price. Similarly, the autarky price of poultry in Mexico was above the world price and in the United States was below the world price. Draw diagrams with domestic supply and demand curves for each country and each of the two goods. As a result of NAFTA, the United States now imports tomatoes from Mexico and the United States now exports poultry to Mexico. How would you expect the following groups to be affected?
- Mexican and U.S. consumers of tomatoes. Illustrate the effect on consumer surplus in your diagram.
  - Mexican and U.S. producers of tomatoes. Illustrate the effect on producer surplus in your diagram.
  - Mexican and U.S. tomato workers.
  - Mexican and U.S. consumers of poultry. Illustrate the effect on consumer surplus in your diagram.
  - Mexican and U.S. producers of poultry. Illustrate the effect on producer surplus in your diagram.
  - Mexican and U.S. poultry workers.

**Solution**

6. The four accompanying diagrams illustrate the U.S. and Mexican domestic demand and supply curves.



- As shown in panel (b), consumer surplus decreases in Mexico by the size of area  $W$  as the price rises from  $P_M$  to  $P_W$ . As shown in panel (a), consumer surplus increases in the United States by the size of the area  $A + B$  as the price falls from  $P_{US}$  to  $P_W$ .
- As shown in panel (a), production of tomatoes decreases in the United States from  $Q_{US}$  to  $Q_1$ ; producer surplus decreases by area  $A$ . As shown in panel (b), production of tomatoes increases in Mexico from  $Q_M$  to  $Q_2$ , so producer surplus increases by areas  $W + X$ .
- As production of tomatoes decreases in the United States, the demand for U.S. tomato workers falls and so the wages of U.S. tomato workers fall. In Mexico, as the production of tomatoes increases, the wages of Mexican tomato workers rise.
- As shown in panel (d), consumer surplus increases in Mexico by the size of areas  $Y + Z$  as the price falls from  $P_M$  to  $P_W$ . As shown in panel (c), consumer surplus decreases in the United States by the size of area  $C$  as the price rises from  $P_{US}$  to  $P_W$ .
- As shown in panel (d), production of poultry decreases in Mexico, from  $Q_M$  to  $Q_4$ ; so producer surplus in Mexico decreases by area  $Y$ . As shown in panel (c), U.S. production of poultry increases from  $Q_{US}$  to  $Q_3$ ; so producer surplus in the United States increases by areas  $C + D$ .

- f. As production of poultry increases in the United States, the demand for poultry workers rises and so the wages of poultry workers rise. In Mexico, as the production of poultry decreases, the wages of poultry workers fall.
7. The accompanying table indicates the U.S. domestic demand schedule and domestic supply schedule for commercial jet airplanes. Suppose that the world price of a commercial jet airplane is \$100 million.

Price of jet (millions)	Quantity of jets demanded	Quantity of jets supplied
\$120	100	1,000
110	150	900
100	200	800
90	250	700
80	300	600
70	350	500
60	400	400
50	450	300
40	500	200

- a. In autarky, how many commercial jet airplanes does the United States produce, and at what price are they bought and sold?
- b. With trade, what will the price for commercial jet airplanes be? Will the United States import or export airplanes? How many?

### Solution

7. a. In autarky, the equilibrium price will be \$60 million, and 400 airplanes will be bought and sold at that price.
- b. When there is trade, the price rises to the world price of \$100 million. At that price, the domestic quantity supplied is 800, and the domestic quantity demanded is 200. So 600 airplanes are exported.
8. The accompanying table shows the U.S. domestic demand schedule and domestic supply schedule for oranges. Suppose that the world price of oranges is \$0.30 per orange.

Price of orange	Quantity of oranges demanded (thousands)	Quantity of oranges supplied (thousands)
\$1.00	2	11
0.90	4	10
0.80	6	9
0.70	8	8
0.60	10	7
0.50	12	6
0.40	14	5
0.30	16	4
0.20	18	3

- a. Draw the U.S. domestic supply curve and domestic demand curve.
- b. With free trade, how many oranges will the United States import or export?

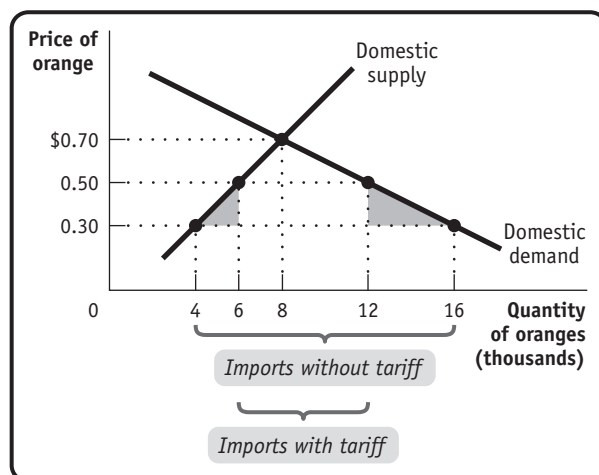


Suppose that the U.S. government imposes a tariff on oranges of \$0.20 per orange.

- c. How many oranges will the United States import or export after introduction of the tariff?
- d. In your diagram, shade the gain or loss to the economy as a whole from the introduction of this tariff.

## Solution

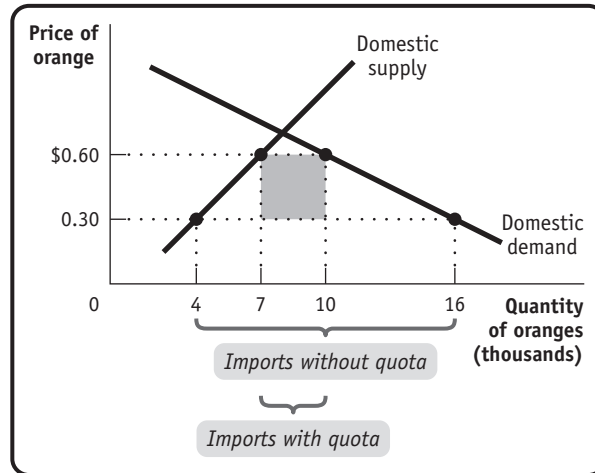
8. a. The U.S. domestic supply and demand curves are illustrated in the accompanying diagram.



- b. With free trade, the price will be the world price, \$0.30, the domestic quantity demanded will be 16,000 oranges, and the domestic quantity supplied will be 4,000 oranges. So the United States will import 12,000 oranges.
  - c. With the tariff, the domestic price will rise to \$0.50. At that price, the domestic quantity demanded will exceed the domestic quantity supplied by 6,000. So the United States will import 6,000 oranges.
  - d. The shaded areas indicate the deadweight loss to the economy as a whole due to the tariff.
9. The U.S. domestic demand schedule and domestic supply schedule for oranges was given in Problem 18. Suppose that the world price of oranges is \$0.30. The United States introduces an import quota of 3,000 oranges and assigns the quota rents to foreign orange exporters.
    - a. Draw the domestic demand and supply curves.
    - b. What will the domestic price of oranges be after introduction of the quota?
    - c. What is the value of the quota rents that foreign exporters of oranges receive?

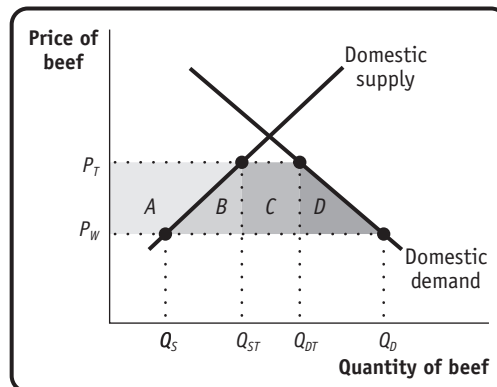
Solution

9. a. The domestic demand and domestic supply curves are shown in the accompanying diagram.



- b. After introduction of the quota, instead of importing  $16,000 - 4,000 = 12,000$  oranges, the United States will import only 3,000 oranges. The price will rise to \$0.60, the price at which the domestic quantity demanded exceeds the domestic quantity supplied by exactly 3,000 oranges.
- c. The foreign exporters of oranges receive quota rent of  $\$0.30 \times 3,000 = \$900$ .

10. The accompanying diagram illustrates the U.S. domestic demand curve and domestic supply curve for beef.



The world price of beef is  $P_W$ . The United States currently imposes an import tariff on beef, so the price of beef is  $P_T$ . Congress decides to eliminate the tariff. In terms of the areas marked in the diagram, answer the following questions.

- With the elimination of the tariff what is the gain/loss in consumer surplus?
- With the elimination of the tariff what is the gain/loss in producer surplus?
- With the elimination of the tariff what is the gain/loss to the government?
- With the elimination of the tariff what is the gain/loss to the economy as a whole?

- 10.**
- As the price falls from  $P_T$  to  $P_W$ , consumer surplus increases by areas  $A + B + C + D$ .
  - As the price falls, producer surplus decreases by area  $A$ .
  - As the tariff is eliminated, the government loses revenue of area  $C$ , which is the amount of imports under the tariff ( $Q_{DT} - Q_{ST}$ ) times the tariff.
  - The gain to the economy as a whole is the gain to consumers minus the loss to producers minus the loss to the government:  $A + B + C + D - A - C = B + D$ .
- 11.** As the United States has opened up to trade, it has lost many of its low-skill manufacturing jobs, but it has gained jobs in high-skill industries, such as the software industry. Explain whether the United States as a whole has been made better off by trade.

**11.** As the United States has opened up to trade, it has specialized in producing goods that use high-skill labor (such as software design) in which it has a comparative advantage, and it has allowed other countries to specialize in producing low-skill manufactured goods in which they have the comparative advantage. As a result, the country has lost low-skill manufacturing jobs (and the wage to low-skill workers has fallen), and it has gained jobs in high-skill industries (and the wage to high-skill workers has risen). That is, demand for labor in exporting industries has risen, and demand for labor in import-competing industries has fallen, as the Heckscher–Ohlin model predicts. But as a result of trade, the United States can now consume more of all goods than before. That is, overall the economy is better off, so the gains to high-skill workers outweigh the losses to low-skill workers.

- 12.** The United States is highly protective of its agricultural industry, imposing import tariffs, and sometimes quotas, on imports of agricultural goods. This chapter presented three arguments for trade protection. For each argument, discuss whether it is a valid justification for trade protection of U.S. agricultural products.

**12.** The three arguments for trade protection are the national security, job creation, and infant industry arguments. Agriculture is not an infant industry, so this argument does not apply. Some argument can be made that agricultural products are necessary for national security: if we depended completely on imports for our agricultural goods, we would be vulnerable if our trading partners cut off our imports. And protecting agriculture does not create jobs. It does protect farming jobs; but it is likely that if agriculture lost its protection from imports, those workers could find other jobs in industries that expand due to lower food costs (such as the restaurant industry). The rationale for protecting agricultural markets from imports must lie elsewhere—in the political power of the farm lobby.

- 13.** In World Trade Organization (WTO) negotiations, if a country agrees to reduce trade barriers (tariffs or quotas), it usually refers to this as a *concession* to other countries. Do you think that this terminology is appropriate?

**13.** The word *concession* implies that when a country lowers its trade barriers, it is giving up something to other countries. As discussed in this chapter, free trade is beneficial to all countries, including the country that lowers its trade barriers. In fact, even if no other country does so, the country that does lower its trade barriers still benefits from trade. By allowing more international trade, each country's economy simply gains overall.

- 14.** Producers in import-competing industries often make the following argument: “Other countries have an advantage in production of certain goods purely because workers abroad are paid lower wages. In fact, American workers are much more productive than foreign workers. So import-competing industries need to be protected.” Is this a valid argument? Explain your answer.

**14.** Even if American workers were better at producing everything than are foreign workers (that is, even if America has the absolute advantage in everything), this does not mean that the United States should restrict trade. What matters for trade is who has the comparative advantage. In fact, other countries will have a comparative advantage in some good or service, and specialization and trade will mean improvements in the welfare of both countries. Claiming that other countries have an advantage only because labor is so cheap relies on the pauper labor fallacy.

**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



- 15.** Assume Saudi Arabia and the United States face the production possibilities for oil and cars shown in the accompanying table.

Saudi Arabia		United States	
Quantity of oil (millions of barrels)	Quantity of cars (millions)	Quantity of oil (millions of barrels)	Quantity of cars (millions)
0	4	0	10.0
200	3	100	7.5
400	2	200	5.0
600	1	300	2.5
800	0	400	0

- What is the opportunity cost of producing a car in Saudi Arabia? In the United States? What is the opportunity cost of producing a barrel of oil in Saudi Arabia? In the United States?
- Which country has the comparative advantage in producing oil? In producing cars?
- Suppose that in autarky, Saudi Arabia produces 200 million barrels of oil and 3 million cars; similarly, that the United States produces 300 million barrels of oil and 2.5 million cars. Without trade, can Saudi Arabia produce more oil *and* more cars? Without trade, can the United States produce more oil *and* more cars? Suppose now that each country specializes in the good in which it has the comparative advantage, and the two countries trade. Also assume that for each country the value of imports must equal the value of exports.
- What is the total quantity of oil produced? What is the total quantity of cars produced?
- Is it possible for Saudi Arabia to consume 400 million barrels of oil and 5 million cars and for the United States to consume 400 million barrels of oil and 5 million cars?
- Suppose that, in fact, Saudi Arabia consumes 300 million barrels of oil and 4 million cars and the United States consumes 500 million barrels of oil and 6 million cars. How many barrels of oil does the United States import? How many cars does the United States export? Suppose a car costs \$10,000 on the world market. How much, then, does a barrel of oil cost on the world market?

**Solution**

- 15.**
- a.** In Saudi Arabia, 1 million cars can be produced by giving up production of 200 million barrels of oil. So the opportunity cost of 1 car in Saudi Arabia is 200 barrels of oil. The opportunity cost of 2.5 million cars in the United States is 100 million barrels of oil, making the opportunity cost of 1 car equal to  $100 \text{ million} / 2.5 \text{ million} = 40$  barrels of oil. The opportunity cost of 1 barrel of oil in Saudi Arabia is 0.005 of a car. The opportunity cost of 1 barrel of oil in the United States is 0.025 of a car.
  - b.** Since the opportunity cost of producing oil is lower in Saudi Arabia, it has the comparative advantage in oil production. And since the opportunity cost of producing cars is lower in the United States, it has the comparative advantage in car production.
  - c.** In autarky, Saudi Arabia cannot produce both more oil *and* more cars. If Saudi Arabia produces 200 million barrels of oil and 3 million cars, it is on its production possibility frontier. This means that it can produce more oil only if it produces fewer cars. The same is true for the United States.
  - d.** If each country specializes, Saudi Arabia will produce 800 million barrels of oil and the United States will produce 10 million cars.
  - e.** It is possible for Saudi Arabia to consume 400 million barrels of oil and for the United States to consume 400 million barrels of oil (for a total of 800 million barrels). And it is possible for Saudi Arabia to consume 5 million cars and for the United States to consume 5 million cars (for a total of 10 million cars).
  - f.** The United States imports 500 million barrels of oil and exports 4 million cars. That is, each car trades for 125 barrels of oil. If a car costs \$10,000 on the world market, then a barrel of oil costs  $\$10,000 / 125 = \$80$ .



# Decision Making by Individuals and Firms

1. Jackie owns and operates a website design business. To keep up with new technology, she spends \$5,000 per year upgrading her computer equipment. She runs the business out of a room in her home. If she didn't use the room as her business office, she could rent it out for \$2,000 per year. Jackie knows that if she didn't run her own business, she could return to her previous job at a large software company that would pay her a salary of \$60,000 per year. Jackie has no other expenses.
  - a. How much total revenue does Jackie need to make in order to break even in the eyes of her accountant? That is, how much total revenue would give Jackie an accounting profit of just zero?
  - b. How much total revenue does Jackie need to make in order for her to want to remain self-employed? That is, how much total revenue would give Jackie an economic profit of just zero?

## Solution

1. a. Jackie's accounting profit is: Total revenue – \$5,000. (The only cost that her accountant would add into the accounting profit calculation is the cost of upgrading her computer equipment.) For her accounting profit to be just equal to zero, her total revenue would have to be \$5,000.
  - b. Jackie's economic profit is: Total revenue – \$5,000 – \$2,000 – \$60,000 = Total revenue – \$67,000. (Cost of equipment upgrade, the opportunity cost of not renting out the room, and the opportunity cost of Jackie's time are all costs that figure into the calculation of economic profit.) For this to be just equal to zero, Jackie's total revenue would have to be \$67,000.
2. You own and operate a bike store. Each year, you receive revenue of \$200,000 from your bike sales, and it costs you \$100,000 to obtain the bikes. In addition, you pay \$20,000 for electricity, taxes, and other expenses per year. Instead of running the bike store, you could become an accountant and receive a yearly salary of \$40,000. A large clothing retail chain wants to expand and offers to rent the store from you for \$50,000 per year. How do you explain to your friends that despite making a profit, it is too costly for you to continue running your store?

## Solution

2. Your yearly accounting profit is:
 

\$200,000 (total revenue)
– \$100,000 (cost of bikes)
– \$20,000 (electricity, taxes, and other expenses)
—————
\$80,000 (accounting profit)

But not renting the store to the retail chain is an opportunity cost, and not being able to make \$40,000 as an accountant is also an opportunity cost, so your yearly economic profit is:

\$80,000 (accounting profit)
– \$40,000 (opportunity cost of your time)
– \$50,000 (opportunity cost of not renting the store)
—————
\$10,000 (economic profit)

So although you make an accounting profit each year, you would be better off renting the store to the large chain and becoming an accountant yourself, since your opportunity cost of continuing to run your own store is too high.

3. Suppose you have just paid a nonrefundable fee of \$1,000 for your meal plan for this academic term. This allows you to eat dinner in the cafeteria every evening.
  - a. You are offered a part-time job in a restaurant where you can eat for free each evening. Your parents say that you should eat dinner in the cafeteria anyway, since you have already paid for those meals. Are your parents right? Explain why or why not.
  - b. You are offered a part-time job in a different restaurant where, rather than being able to eat for free, you receive only a large discount on your meals. Each meal there will cost you \$2; if you eat there each evening this semester, it will add up to \$200. Your roommate says that you should eat in the restaurant since it costs less than the \$1,000 that you paid for the meal plan. Is your roommate right? Explain why or why not.

### Solution

3. a. Your parents are wrong. They are making the mistake of considering sunk costs. Since the \$1,000 that you have already paid for the meal plan is nonrefundable, it should not enter into your decision making now. Your decision of where to eat should depend only on those costs and benefits that are affected by your decision. Since both the cafeteria meals and the restaurant meals are free, you should choose to eat where the benefit to you (convenience, quality of food, and so on) is greater.
  - b. Your roommate is wrong. Since the \$1,000 that you have already paid for the meal plan is nonrefundable, it should not enter into your decision making now. It is a sunk cost. In deciding where to eat, you should weigh the benefit and cost of eating in the restaurant (where each meal costs \$2) against the benefit and cost of eating in the cafeteria (where meals are free). You may decide to eat in the restaurant, but only if that gives you a benefit that is at least \$2 greater than the benefit you get from eating in the cafeteria.
4. You have bought a \$10 ticket in advance for the college soccer game, a ticket that cannot be resold. You know that going to the soccer game will give you a benefit equal to \$20. After you have bought the ticket, you hear that there will be a professional baseball post-season game at the same time. Tickets to the baseball game cost \$20, and you know that going to the baseball game will give you a benefit equal to \$35. You tell your friends the following: "If I had known about the baseball game before buying the ticket to the soccer game, I would have gone to the baseball game instead. But now that I already have the ticket to the soccer game, it's better for me to just go to the soccer game." Are you making the correct decision? Justify your answer by calculating the benefits and costs of your decision.

### Solution

4. Yes, you are making the correct decision. If you had known about the baseball game before buying the ticket to the soccer game, your decision would have been as follows:

Go to the soccer game	Go to the baseball game
\$20 (benefit)	\$35 (benefit)
-\$10 (cost of ticket)	-\$20 (cost of ticket)
<u>          </u>	<u>          </u>
\$10	\$15

Since the baseball game would have given you the greater total profit, you should have gone to the baseball game. But after you have already bought the ticket to the soccer game, your decision is different: the ticket to the soccer game (since it cannot be resold) is now a sunk cost, and you should no longer take it into account. Your decision now looks as follows:



<p><b>Go to the soccer game</b></p> <p>\$20 (benefit)</p> <hr style="width: 50%; margin-left: 0;"/> <p>\$20</p>	<p><b>Go to the baseball game</b></p> <p>\$35 (benefit)</p> <p>-\$20 (cost of ticket)</p> <hr style="width: 50%; margin-left: 0;"/> <p>\$15</p>
---	---

So, since you had already bought the ticket to the soccer game before you heard about the baseball game, it is optimal for you to go to the soccer game.

5. Amy, Bill, and Carla all mow lawns for money. Each of them operates a different lawn mower. The accompanying table shows the total cost to Amy, Bill, and Carla of mowing lawns.

Quantity of lawns mowed	Amy's total cost	Bill's total cost	Carla's total cost
0	\$0	\$0	\$0
1	20	10	2
2	35	20	7
3	45	30	17
4	50	40	32
5	52	50	52
6	53	60	82

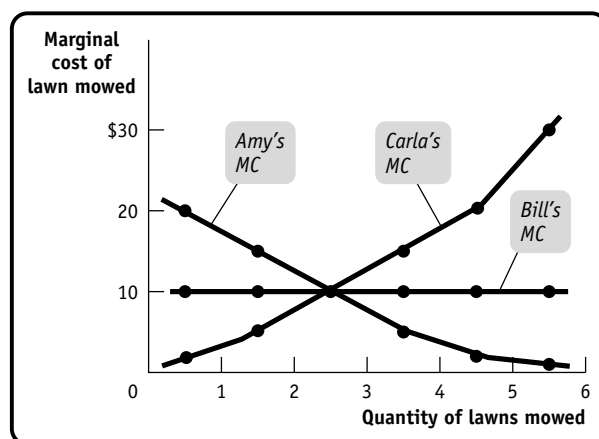
- a. Calculate Amy's, Bill's, and Carla's marginal costs, and draw each of their marginal cost curves.
- b. Who has increasing marginal cost, who has decreasing marginal cost, and who has constant marginal cost?

## Solution

5. a. The accompanying table shows Amy's, Bill's, and Carla's marginal costs.

Quantity of lawns mowed	Amy's total cost	Amy's marginal cost of lawn mowed	Bill's total cost	Bill's marginal cost of lawn mowed	Carla's total cost	Carla's marginal cost of lawn mowed
0	\$0		\$0		\$0	
1	20	\$20	10	\$10	2	\$2
2	35	15	20	10	7	5
3	45	10	30	10	17	10
4	50	5	40	10	32	15
5	52	2	50	10	52	20
6	53	1	60	10	82	30

The accompanying diagram shows Amy's, Bill's, and Carla's marginal cost curves.



b. From the information in the table or from the diagram, you can see that Amy has decreasing marginal cost, Bill has constant marginal cost, and Carla has increasing marginal cost. (Also note that all of them have increasing total cost.)

6. You are the manager of a gym, and you have to decide how many customers to admit each hour. Assume that each customer stays exactly one hour. Customers are costly to admit because they inflict wear and tear on the exercise equipment. Moreover, each additional customer generates more wear and tear than the customer before. As a result, the gym faces increasing marginal cost. The accompanying table shows the marginal costs associated with each number of customers per hour.

Quantity of customers per hour	Marginal cost of customer
0	
1	\$14.00
2	14.50
3	15.00
4	15.50
5	16.00
6	16.50
7	17.00

- a. Suppose that each customer pays \$15.25 for a one-hour workout. Use the profit-maximizing principle of marginal analysis to find the optimal number of customers that you should admit per hour.
- b. You increase the price of a one-hour workout to \$16.25. What is the optimal number of customers per hour that you should admit now?

### Solution

6. a. The marginal benefit of each customer is \$15.25: each additional customer you admit increases the total benefit to the gym by \$15.25. So you should admit three customers per hour. Here is how you could think about that decision. Suppose you currently admit no customers. Admitting the first customer gives the gym a marginal benefit of \$15.25 and a marginal cost of \$14.00. Since the marginal benefit of that first customer exceeds the marginal cost, you want to admit the first cus-

tomers. For the second customer, the marginal benefit (\$15.25) also exceeds the marginal cost (\$14.50), so you want to admit the second customer, too. The same is true for the third customer: the marginal benefit (\$15.25) exceeds the marginal cost (\$15.00), so you also want to admit the third customer. For the fourth customer, however, the marginal cost (\$15.50) exceeds the marginal benefit (\$15.25), so you do not want to admit a fourth customer.

- b. By reasoning similar to that in part a, you now want to admit five customers: for the fifth customer, the marginal benefit (\$16.25) exceeds the marginal cost (\$16.00). For the sixth customer, however, the marginal cost (\$16.50) exceeds the marginal benefit, so you do not want to admit a sixth customer.

7. Georgia and Lauren are economics students who go to a karate class together. Both have to choose how many classes to go to per week. Each class costs \$20. The accompanying table shows Georgia's and Lauren's estimates of the marginal benefit that each of them gets from each class per week.

Quantity of classes	Lauren's marginal benefit of each class	Georgia's marginal benefit of each class
0		
1	\$23	\$28
2	19	22
3	14	15
4	8	7

- a. Use marginal analysis to find Lauren's optimal number of karate classes per week. Explain your answer.
- b. Use marginal analysis to find Georgia's optimal number of karate classes per week. Explain your answer.

## Solution

7. The marginal cost of one more class is always \$20: each additional class that Lauren or Georgia takes will cost an additional \$20.
- a. The optimal number of classes per week for Lauren is one. The marginal benefit to Lauren of the first class is \$23, and the marginal cost is \$20. Since the marginal benefit exceeds the marginal cost, Lauren wants to take that first class. For the second class, Lauren's marginal benefit (\$19) is less than the marginal cost (\$20), so she does not want to take a second class.
- b. Georgia would be better off adding a second class per week. For the second class, the marginal benefit to Georgia (\$22) exceeds the marginal cost (\$20), so she wants to take the second class. For the third class, the marginal cost (\$20) would exceed the marginal benefit (\$15), so Georgia does not want to take the third class. For Georgia, the optimal number of classes per week is two.

8. The Centers for Disease Control and Prevention (CDC) recommended against vaccinating the whole population against the smallpox virus because the vaccination has undesirable, and sometimes fatal, side effects. Suppose the accompanying table gives the data that are available about the effects of a smallpox vaccination program.

Percent of population vaccinated	Deaths due to smallpox	Deaths due to vaccination side effects
0%	200	0
10	180	4
20	160	10
30	140	18
40	120	33
50	100	50
60	80	74

- a. Calculate the marginal benefit (in terms of lives saved) and the marginal cost (in terms of lives lost) of each 10% increment of smallpox vaccination. Calculate the net increase in human lives for each 10% increment in population vaccinated.
- b. Using marginal analysis, determine the optimal percentage of the population that should be vaccinated.

### Solution

8. a. The accompanying table gives the marginal benefit and the marginal cost of smallpox vaccination. The marginal benefit is the additional number of lives saved if we vaccinate an additional 10% of the population. For instance, if instead of vaccinating 0% of the population (resulting in 200 deaths from smallpox), we vaccinate 10% of the population (resulting in 180 deaths from smallpox), we have saved 20 lives. That is, the marginal benefit of vaccinating 10% (instead of 0%) of the population is 20 lives. Repeating this for the step from 10% to 20% vaccination, and so on, gives us the marginal benefit numbers in the table. The marginal cost is the additional number of lives lost if we vaccinate an additional 10% of the population. For instance, if instead of vaccinating 0% of the population (resulting in 0 deaths due to side effects), we vaccinate 10% of the population (resulting in 4 deaths due to side effects), we have lost 4 lives. That is, the marginal cost of vaccinating 10% (instead of 0%) of the population is 4 lives. Repeating this for the step from 10% to 20% vaccination, and so on, gives us the marginal cost numbers in the table.

Percent of population vaccinated	Marginal benefit in lives saved	Marginal cost in lives lost	Net increase in human lives per 10% increment in vaccinations
0	20	4	16
10	20	6	14
20	20	8	12
30	20	15	5
40	20	17	3
50	20	24	- 4
60			

- b. The optimal percentage of the population that should be vaccinated is 50%. Suppose we were vaccinating 40% of the population. Then vaccinating an additional 10% (to bring the total up to 50%) would give us a marginal benefit of 20 lives saved. And vaccinating that additional 10% would give us a marginal cost of 17 lives lost. Since the marginal benefit exceeds the marginal cost, we do indeed want to vaccinate that additional 10% of the population. But do we want to go beyond 50% vaccination? Vaccinating an additional 10% (to bring the total up to 60%) would result in a marginal benefit of 20 lives saved and a marginal cost of 24 lives lost due to side effects. Since the marginal cost exceeds the marginal benefit, we do not want to increase the vaccination rate from 50% to 60%.

9. Patty delivers pizza using her own car, and she is paid according to the number of pizzas she delivers. The accompanying table shows Patty's total benefit and total cost when she works a specific number of hours.

Quantity of hours worked	Total benefit	Total cost
0	\$0	\$0
1	30	10
2	55	21
3	75	34
4	90	50
5	100	70

- a. Use marginal analysis to determine Patty's optimal number of hours worked.  
 b. Calculate the total profit to Patty from working 0 hours, 1 hour, 2 hours, and so on. Now suppose Patty chooses to work for 1 hour. Compare her total profit from working for 1 hour with her total profit from working the optimal number of hours. How much would she lose by working for only 1 hour?

### Solution

9. a. We first need to work out Patty's marginal benefit and marginal cost of each additional hour worked, which are shown in the accompanying table. For instance, as Patty increases the number of hours worked from 2 to 3, her benefit increases from \$55 to \$75; that is, her marginal benefit is \$20. Similarly, as she increases the number of hours worked from 2 to 3, her cost increases from \$21 to \$34; that is, her marginal cost is \$13. Repeating this for increases in the number of hours from 0 to 1, from 1 to 2, and so on, gives the data in the accompanying table.

Quantity of hours worked	Marginal benefit	Marginal cost	Profit
0	\$30	\$10	\$20
1	25	11	14
2	20	13	7
3	15	16	-1
4	10	20	-10

Patty should work for 3 hours because her marginal benefit of going from 2 hours to 3 hours (\$20) exceeds the marginal cost of going from 2 hours to 3 hours (\$13). But if she went from 3 hours to 4 hours, Patty's marginal cost (\$16) would exceed her marginal benefit (\$15). So working that fourth hour is not optimal.

- b. The accompanying table shows Patty's total net gain in the fourth column. The total net gain is the difference between total benefit and total cost.

Quantity of hours worked	Total benefit	Total cost	Total net gain
0	\$0	\$0	\$0
1	30	10	20
2	55	21	34
3	75	34	41
4	90	50	40
5	100	70	30

Patty's loss from working for only 1 hour instead of the optimal 3 hours is  $\$41 - \$20 = \$21$ .

10. Assume De Beers is the sole producer of diamonds. When it wants to sell more diamonds, it must lower its price in order to induce shoppers to buy more. Furthermore, each additional diamond that is produced costs more than the previous one due to the difficulty of mining for diamonds. De Beers's total benefit schedule is given in the accompanying table, along with its total cost schedule.

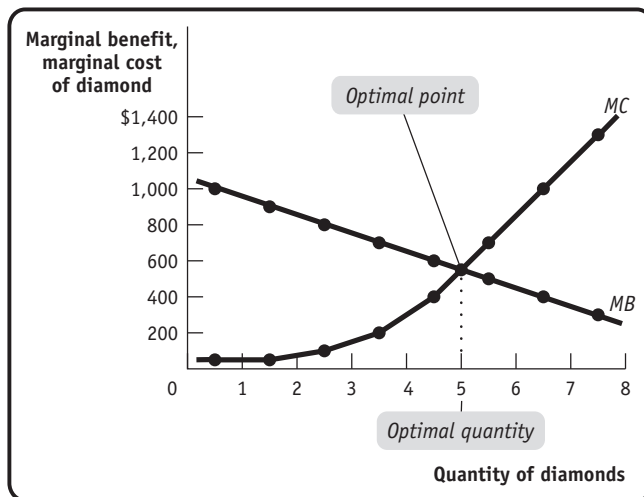
Quantity of diamonds	Total benefit	Total cost
0	\$0	\$0
1	1,000	50
2	1,900	100
3	2,700	200
4	3,400	400
5	4,000	800
6	4,500	1,500
7	4,900	2,500
8	5,200	3,800

- a. Draw the marginal cost curve and the marginal benefit curve and, from your diagram, graphically derive the optimal quantity of diamonds to produce.
- b. Calculate the total profit to De Beers from producing each quantity of diamonds. Which quantity gives De Beers the highest total profit?

**Solution**

10. a. The accompanying table shows the marginal benefit and marginal cost of each diamond. The accompanying diagram graphs marginal benefit and marginal cost. From the diagram, you can conclude that the optimal number of diamonds to produce is 5.

Quantity of diamonds	Total benefit	Marginal benefit	Total cost	Marginal cost
0	\$0		\$0	
1	1,000	\$1,000	50	\$50
2	1,900	900	100	50
3	2,700	800	200	100
4	3,400	700	400	200
5	4,000	600	800	400
6	4,500	500	1,500	700
7	4,900	400	2,500	1,000
8	5,200	300	3,800	1,300



- b. The accompanying table calculates the total profit to De Beers from producing each quantity of diamonds. The quantity that gives De Beers the greatest total profit gain is 5 diamonds. This is, of course, just what you found in part a.

Quantity of diamonds	Total benefit	Total cost	Total profit
0	\$0	\$0	\$0
1	1,000	50	950
2	1,900	100	1,800
3	2,700	200	2,500
4	3,400	400	3,000
5	4,000	800	3,200
6	4,500	1,500	3,000
7	4,900	2,500	2,400
8	5,200	3,800	1,400

- 11.** In each of the following examples, explain whether the decision is rational or irrational. Describe the type of behavior exhibited.
- Kookie's best friend likes to give her gift cards that Kookie can use at her favorite stores. Kookie, however, often forgets to use the cards before their expiration date or loses them. Kookie, though, is careful with her own cash.
  - In 2010, the Panera Bread company opened a store in Clayton, Missouri, that allowed customers to pay any amount they like for their orders; instead of prices, the store listed suggested donations based on the cost of the goods. All profits went to a charitable foundation set up by Panera. In 2011, the store was pleased with the success of the program.
  - Rick has just gotten his teaching degree and has two job offers. One job, replacing a teacher who has gone on leave, will last only two years. It is at a prestigious high school, and he will be paid \$35,000 per year. He thinks he will probably be able to find another good job in the area after the two years are up but isn't sure. The other job, also at a high school, pays \$25,000 per year and is virtually guaranteed for five years; after those five years, he will be evaluated for a permanent teaching position at the school. About 75% of the teachers who start at the school are hired for permanent positions. Rick takes the five-year position at \$25,000 per year.
  - Kimora has planned a trip to Florida during spring break in March. She has several school projects due after her return. Rather than do them in February, she figures she can take her books with her to Florida and complete her projects there.
  - Sahir overpaid when buying a used car that has turned out to be a lemon. He could sell it for parts, but instead he lets it sit in his garage and deteriorate.
  - Barry considers himself an excellent investor in stocks. He selects new stocks by finding ones with characteristics similar to those of his previous winning stocks. He chocks up losing trades to ups and downs in the macroeconomy.

- 11.** **a.** Kookie is behaving irrationally, engaging in mental accounting. By losing the dollars incorporated in the gift cards but not losing her cash, she is valuing a dollar in a gift card less than a dollar in her wallet.
- b.** Customers of Panera Bread are behaving rationally, exhibiting concerns about fairness. They are willing to reduce their own economic payoffs in order to be fair to Panera Bread and the beneficiaries of the Panera charitable foundation.
- c.** Rick is behaving rationally, exhibiting risk aversion. Although he could potentially make more money by teaching at the prestigious high school for two years, this is a riskier proposition than taking the job that is guaranteed for five years.
- d.** Kimora is behaving irrationally, exhibiting unrealistic expectations about her future actions. If she can't finish her projects now, she's unlikely to complete them while on spring break.
- e.** Sahir is behaving irrationally, engaging in loss aversion. If he were behaving rationally, he would recognize the loss incurred by overpaying for the car and move on by selling it for parts. Instead, because he is unwilling to acknowledge the loss, he is continuing to lose money by letting the car deteriorate in his garage.
- f.** Barry is behaving irrationally, overestimating his stock-picking ability. By not learning from his losing trades as well as his winning trades, he is ignoring evidence that he might not be as good an investor as he believes himself to be.



- 12.** You have been hired as a consultant by a company to develop the company's retirement plan, taking into account different types of predictably irrational behavior commonly displayed by employees. State at least two types of irrational behavior employees might display with regard to the retirement plan and the steps you would take to forestall such behavior.

### Solution

- 12.** There are numerous retirement plan policies you could consider to forestall various types of irrational behavior by employees. Here are some examples. Because of status quo bias, many employees do not enroll in company retirement plans. To address this type of predictably irrational behavior, you could suggest that all employees be automatically enrolled in the retirement plan; they should have to actively choose *not* to enroll. To address unrealistic expectations about their future behavior, you could also suggest that employees who choose not to enroll be given the option to be automatically enrolled after a fixed period of time. To address employees' overconfidence in their ability to choose investments, the retirement plan could limit movements between different types of funds. Nonprofessional investors are often overconfident and engage in a lot of speculative investing, such as quickly buying and selling stocks. On average, they have significantly worse investment results than professionals, believing that they are better at spotting winners than they really are.
- 13.** Hiro owns and operates a small business that provides economic consulting services. During the year he spends \$57,000 on travel to clients and other expenses. In addition, he owns a computer that he uses for business. If he didn't use the computer, he could sell it and earn yearly interest of \$100 on the money created through this sale. Hiro's total revenue for the year is \$100,000. Instead of working as a consultant for the year, he could teach economics at a small local college and make a salary of \$50,000.
- What is Hiro's accounting profit?
  - What is Hiro's economic profit?
  - Should Hiro continue working as a consultant, or should he teach economics instead?

### WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



### Solution

- 13. a.** Hiro's accounting profit is:
- |            |                             |
|------------|-----------------------------|
| \$100,000  | (total revenue)             |
| – \$57,000 | (travel and other expenses) |
| \$43,000   | (accounting profit)         |
- b.** Hiro's economic profit is:
- |            |                                 |
|------------|---------------------------------|
| \$43,000   | (accounting profit)             |
| – \$100    | (interest forgone)              |
| – \$50,000 | (salary as economics professor) |
| – \$7,100  | (economic profit)               |
- c.** Since Hiro's economic profit is negative, he would be better off if he didn't operate the consulting business and taught economics instead.



# The Rational Consumer

1. For each of the following situations, decide whether Al has diminishing marginal utility. Explain.
  - a. The more economics classes Al takes, the more he enjoys the subject. And the more classes he takes, the easier each one gets, making him enjoy each additional class even more than the one before.
  - b. Al likes loud music. In fact, according to him, “the louder, the better.” Each time he turns the volume up a notch, he adds 5 utils to his total utility.
  - c. Al enjoys watching reruns of the old sitcom *Friends*. He claims that these episodes are always funny, but he does admit that the more he sees an episode, the less funny it gets.
  - d. Al loves toasted marshmallows. The more he eats, however, the fuller he gets and the less he enjoys each additional marshmallow. And there is a point at which he becomes satiated: beyond that point, more marshmallows actually make him feel worse rather than better.

## Solution

1.
  - a. Al’s marginal utility of economics classes increases as he takes an additional class since he enjoys each class more than the one before. Therefore, he does not have diminishing marginal utility.
  - b. Al’s marginal utility is the same for each additional notch of volume of music, hence he does not have diminishing marginal utility.
  - c. Al has diminishing marginal utility of *Friends* episodes. Although additional episodes increase his total utility, they do so less and less. That is, his marginal utility declines.
  - d. Al has diminishing marginal utility of marshmallows. For a certain range, additional marshmallows add to his total utility, so total utility increases. But total utility increases by less and less. In fact, total utility eventually begins to decline. In other words, his marginal utility becomes smaller and smaller and eventually becomes negative.
2. Use the concept of marginal utility to explain the following: Newspaper vending machines are designed so that once you have paid for one paper, you could take more than one paper at a time. But soda vending machines, once you have paid for one soda, dispense only one soda at a time.

## Solution

2. After you have taken the first newspaper, the marginal utility of the second newspaper is zero: you don’t learn any more news by having two copies of the same paper instead of just one. So once you have paid for the vending machine to open, you will take only one paper. For soda, on the other hand, marginal utility is positive: after you have drunk the first soda, the second will still give you more utility. It will give you less additional utility than the first soda—that is, there is diminishing marginal utility—but the marginal utility of the second soda is still positive. If the vending machine allowed you to take more than one soda at a time after paying for only one, you would. So the soda vending machine has to be designed to prevent you from taking more than one soda, and it does so by dispensing only one soda at a time.

3. Bruno can spend his income on two different goods: Beyoncé MP3s and notebooks for his class notes. For each of the following three situations, decide if the given consumption bundle is within Bruno's consumption possibilities. Then decide if it lies on the budget line or not.
- MP3s cost \$2 each, and notebooks cost \$3 each. Bruno has income of \$60. He is considering a consumption bundle containing 15 MP3s and 10 notebooks.
  - MP3s cost \$2 each, and notebooks cost \$5 each. Bruno has income of \$110. He is considering a consumption bundle containing 20 MP3s and 10 notebooks.
  - MP3s cost \$3 each, and notebooks cost \$10 each. Bruno has income of \$50. He is considering a consumption bundle containing 10 MP3s and 3 notebooks.

### Solution

3. a. This consumption bundle costs  $\$2 \times 15 + \$3 \times 10 = \$60$ , which is exactly equal to Bruno's income of \$60. So the bundle is within Bruno's consumption possibilities. And, since he spends *all* his money, it lies on his budget line.
- b. This consumption bundle costs  $\$2 \times 20 + \$5 \times 10 = \$90$ , which is less than Bruno's income of \$110. So the bundle is within Bruno's consumption possibilities. However, since he does not spend *all* his money, it does not lie on his budget line; it lies below his budget line.
- c. This consumption bundle costs  $\$3 \times 10 = \$10 \times 3 = \$60$ , which is more than Bruno's income of \$50. So the bundle is not within Bruno's consumption possibilities; it lies above his budget line.
4. Bruno, the consumer in Problem 3, is best friends with Bernie, who shares his love for notebooks and Beyoncé MP3s. The accompanying table shows Bernie's utilities from notebooks and Beyoncé MP3s.

Quantity of Notebooks	Utility from Notebooks (utils)	Quantity of MP3s	Utility from MP3s (utils)
0	0	0	0
1	32	2	28
2	60	4	52
3	84	6	72
4	104	8	96
5	120	10	108

The price of a notebook is \$4, the price of an MP3 is \$2, and Bernie has \$20 of income to spend.

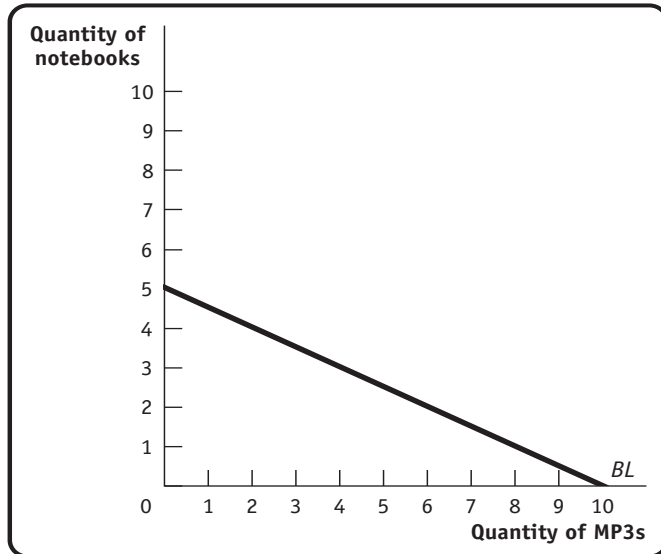
- Which consumption bundles of notebooks and MP3s can Bernie consume if he spends all his income? Illustrate Bernie's budget line with a diagram, putting MP3s on the horizontal axis and notebooks on the vertical axis.
- Calculate the marginal utility of each notebook and the marginal utility of each MP3. Then calculate the marginal utility per dollar spent on notebooks and the marginal utility per dollar spent on MP3s.
- Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on notebooks and the marginal utility per dollar spent on MP3s are illustrated. Using this diagram and the utility-maximizing principle of marginal analysis, predict which bundle—from all the bundles on his budget line—Bernie will choose.

### Solution

4. a. Bernie can consume the following bundles if he spends all his income:

- 0 MP3s, 5 notebooks
- 2 MP3s, 4 notebooks
- 4 MP3s, 3 notebooks
- 6 MP3s, 2 notebooks
- 8 MP3s, 1 notebook
- 10 MP3s, 0 notebooks

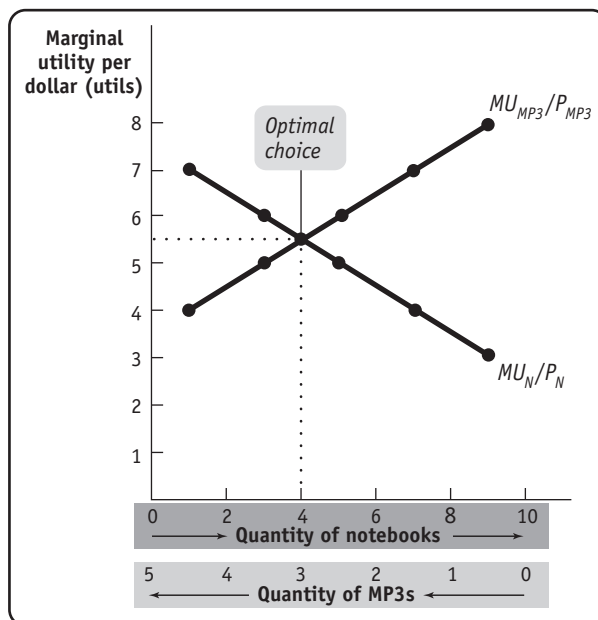
The accompanying diagram shows Bernie's budget line.



b. The accompanying table shows the marginal utility for each notebook and for each MP3, the marginal utility per dollar spent on notebooks, and the marginal utility per dollar spent on MP3s. Note that the utility numbers for notebooks are given in increments of 2: for instance, going from 4 notebooks to 6, utility increases by 50 utils (from 130 utils to 180 utils). Per notebook, this is a marginal utility of 25 utils.

Quantity of notebooks	Utility from notebooks (utils)	Marginal utility per notebook (utils)	Marginal utility per dollar (utils)	Quantity of MP3s	Utility from MP3s (utils)	Marginal utility per MP3 (utils)	Marginal utility per dollar (utils)
0	0	35	7	0	0	80	8
2	70	30	6	1	80	70	7
4	130	25	5	2	150	60	6
6	180	20	4	3	210	50	5
8	220	15	3	4	260	40	4
10	250			5	300		

- c. The utility-maximizing principle of marginal analysis states that the optimal bundle, from all those on a consumer's budget line, is the one at which the marginal utility per dollar spent on each good is equal. The accompanying diagram shows the marginal utility per dollar spent on notebooks and the marginal utility per dollar spent on MP3s. When Bernie consumes 4 notebooks and 3 MP3s, the marginal utility per dollar spent on notebooks is the same as the marginal utility per dollar spent on MP3s, so this is the optimal consumption bundle. It is also the *only* bundle—from all the bundles he can consume and that are on his budget line—for which the marginal utility per dollar is equal for the two goods.



5. For each of the following situations, decide whether the bundle Lakshani is considering is optimal or not. If it is not optimal, how could Lakshani improve her overall level of utility? That is, determine which good she should spend more on and which good should she spend less on.
- Lakshani has \$200 to spend on sneakers and sweaters. Sneakers cost \$50 per pair, and sweaters cost \$20 each. She is thinking about buying 2 pairs of sneakers and 5 sweaters. She tells her friend that the additional utility she would get from the second pair of sneakers is the same as the additional utility she would get from the fifth sweater.
  - Lakshani has \$5 to spend on pens and pencils. Each pen costs \$0.50 and each pencil costs \$0.10. She is thinking about buying 6 pens and 20 pencils. The last pen would add five times as much to her total utility as the last pencil.
  - Lakshani has \$50 per season to spend on tickets to football games and tickets to soccer games. Each football ticket costs \$10 and each soccer ticket costs \$5. She is thinking about buying 3 football tickets and 2 soccer tickets. Her marginal utility from the third football ticket is twice as much as her marginal utility from the second soccer ticket.

## Solution

5. a. This bundle lies on Lakshani's budget line, but the marginal utility per dollar for sneakers and for sweaters is not equal. The marginal utility per pair of sneakers is equal to her marginal utility per sweater. However, since sneakers cost \$50 and sweaters cost only \$20 (that is, sneakers are 2.5 times as expensive as sweaters), Lakshani's marginal utility *per dollar* spent on sweaters is 2.5 times greater than her marginal utility *per dollar* spent on sneakers. That is, she would improve her level of utility if she spent more money on sweaters and less on sneakers.
- b. This bundle lies on Lakshani's budget line. The marginal utility per pen is five times as great as the marginal utility per pencil. However, pens are also five times as expensive as pencils, so her marginal utility per dollar spent on pens is just equal to her marginal utility per dollar spent on pencils. So this is her optimal bundle.
- c. Although Lakshani's marginal utility per dollar spent on soccer tickets is equal to her marginal utility per dollar spent on football tickets, this bundle is not optimal: it does not lie on her budget line. She could buy more of both goods and probably will. But for a precise answer about how many football tickets and how many soccer tickets she will actually buy, we would need more information about her utility at other consumption bundles.
6. Cal "Cool" Cooper has \$200 to spend on cell phones and sunglasses.
- a. Each cell phone costs \$100 and each pair of sunglasses costs \$50. Which bundles lie on Cal's budget line? Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are illustrated. Use this diagram and the utility-maximizing principle of marginal analysis to decide how Cal should allocate his money. That is, from all the bundles on his budget line, which bundle will Cal choose? The accompanying table gives his utility of cell phones and sunglasses.

Quantity of cell phones	Utility from cell phones (utils)	Quantity of sunglasses (pairs)	Utility from sunglasses (utils)
0	0	0	0
1	400	2	600
2	700	4	700

- b. The price of cell phones falls to \$50 each, but the price of sunglasses remains at \$50 per pair. Which bundles lie on Cal's budget line? Draw a diagram like Figure 10-4 in which both the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are illustrated. Use this diagram and the utility-maximizing principle of marginal analysis to decide how Cal should allocate his money. That is, from all the bundles on his budget line, which bundle will Cal choose? The accompanying table gives his utility of cell phones and sunglasses.

Quantity of cell phones	Utility from cell phones (utils)	Quantity of sunglasses (pairs)	Utility from sunglasses (utils)
0	0	0	0
1	400	1	325
2	700	2	600
3	900	3	825
4	1,000	4	700

- c. How does Cal's consumption of cell phones change as the price of cell phones falls? In words, describe the income effect and the substitution effect of this fall in the price of cell phones, assuming that cell phones are a normal good.

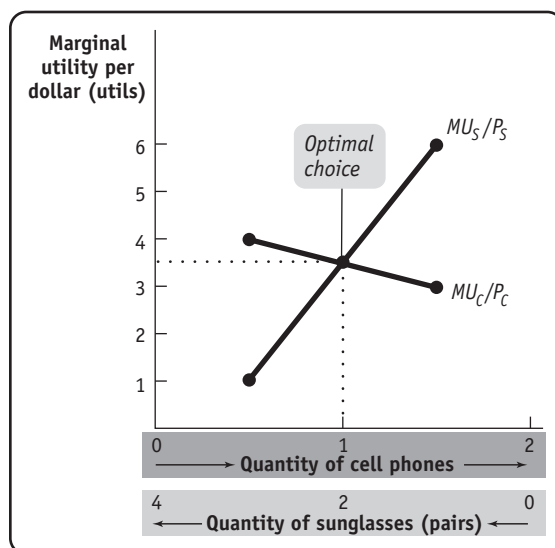
## Solution

6. a. The following bundles lie on Cal's budget line:

0 cell phones, 4 pairs of sunglasses  
 1 cell phone, 2 pairs of sunglasses  
 2 cell phones, 0 pairs of sunglasses

Going from 0 cell phones to 1 cell phone, the marginal utility per cell phone is 400 utils; that is, the marginal utility per dollar spent on cell phones is 4 utils. Going from 1 cell phone to 2 cell phones, the marginal utility per cell phone is 300 utils; that is, the marginal utility per dollar spent on cell phones is 3 utils.

Going from 0 pairs of sunglasses to 2 pairs of sunglasses, the marginal utility per pair is  $600/2 = 300$  utils; that is, the marginal utility per dollar spent on sunglasses is 6 utils. Going from 2 pairs of sunglasses to 4 pairs, the marginal utility per pair is  $100/2 = 50$  utils; that is, the marginal utility per dollar spent on sunglasses is 1 util. The marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are plotted in the accompanying diagram.



Of all the possible bundles Cal could consume (that is, from all the bundles on his budget line), the bundle that contains 1 cell phone and 2 pairs of sunglasses is optimal. At that bundle, the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses are equal. By the utility-maximizing principle of marginal analysis this is Cal's optimal consumption bundle.

- b. The bundles that lie on Cal's budget line are:

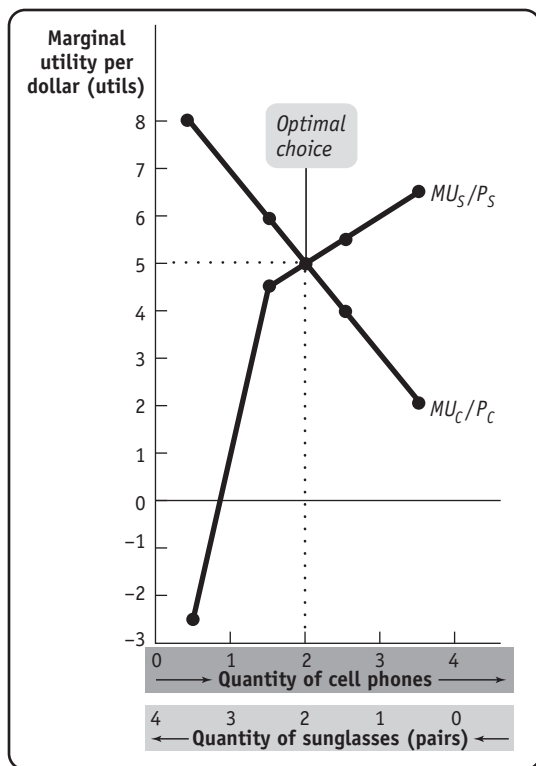
0 cell phones, 4 pairs of sunglasses  
 1 cell phone, 3 pairs of sunglasses  
 2 cell phones, 2 pairs of sunglasses  
 3 cell phones, 1 pair of sunglasses  
 4 cell phones, 0 pairs of sunglasses



The accompanying table calculates marginal utility per cell phone, marginal utility per pair of sunglasses, marginal utility per dollar spent on cell phones, and marginal utility per dollar spent on sunglasses.

Quantity of cell phones	Utility from cell phones (utils)	Marginal utility per cell phone (utils)	Marginal utility per dollar (utils)	Quantity of sunglasses (pairs)	Utility from sunglasses (utils)	Marginal utility per pair (utils)	Marginal utility per dollar (utils)
0	0			0	0		
1	400	400	8	1	325	325	6.5
2	700	300	6	2	600	275	5.5
3	900	200	4	3	825	225	4.5
4	1,000	100	2	4	700	-125	-2.5

The accompanying diagram plots the marginal utility per dollar spent on cell phones and the marginal utility per dollar spent on sunglasses.



From all the bundles on Cal's budget line, the marginal utility per dollar spent on cell phones is the same as the marginal utility per dollar spent on sunglasses at 2 cell phones and 2 pairs of sunglasses. By the utility-maximizing principle of marginal analysis, this is Cal's optimal consumption bundle.

- c. Cal's consumption of cell phones increases from 1 to 2 as the price of cell phones falls. This is due to two effects. The substitution effect says that as the price of cell phones falls, their opportunity cost falls: Cal now has to give up fewer pairs of sunglasses for 1 cell phone. This makes cell phones more attractive, and Cal substitutes cell phones in place of sunglasses. The income effect says that as cell phones become cheaper, Cal gets richer in a real sense: his income now buys more goods. Since cell phones are a normal good, when the purchasing power of Cal's income rises, he consumes more cell phones. Both effects contribute to the fact that as the price of cell phones falls, Cal's consumption of cell phones increases.

7. Damien Matthews is a busy actor. He allocates his free time to watching movies and working out at the gym. The accompanying table shows his utility from the number of times per week he watches a movie or goes to the gym.

Quantity of gym visits per week	Utility from gym visits (utils)	Quantity of movies per week	Utility from movies (utils)
1	100	1	60
2	180	2	110
3	240	3	150
4	280	4	180
5	310	5	190
6	330	6	195
7	340	7	197

Damien has 14 hours per week to spend on watching movies and going to the gym. Each movie takes 2 hours and each gym visit takes 2 hours. (*Hint:* Damien's free time is analogous to income he can spend. The hours needed for each activity are analogous to the price of that activity.)

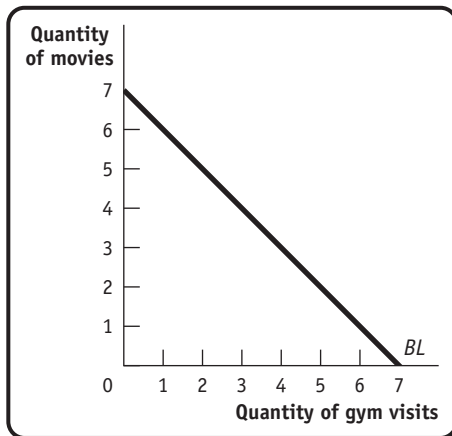
- Which bundles of gym visits and movies can Damien consume per week if he spends all his time either going to the gym or watching movies? Draw Damien's budget line in a diagram with gym visits on the horizontal axis and movies on the vertical axis.
- Calculate the marginal utility of each gym visit and the marginal utility of each movie. Then calculate the marginal utility per hour spent at the gym and the marginal utility per hour spent watching movies.
- Draw a diagram like Figure 10-4 in which both the marginal utility per hour spent at the gym and the marginal utility per hour spent watching movies are illustrated. Use this diagram and the utility-maximizing principle of marginal analysis to decide how Damien should allocate his time.

## Solution

7. a. Damien can consume the following bundles if he spends all his time going to the gym and watching movies:

- 0 gym visits, 7 movies
- 1 gym visit, 6 movies
- 2 gym visits, 5 movies
- 3 gym visits, 4 movies
- 4 gym visits, 3 movies
- 5 gym visits, 2 movies
- 6 gym visits, 1 movie
- 7 gym visits, 0 movies

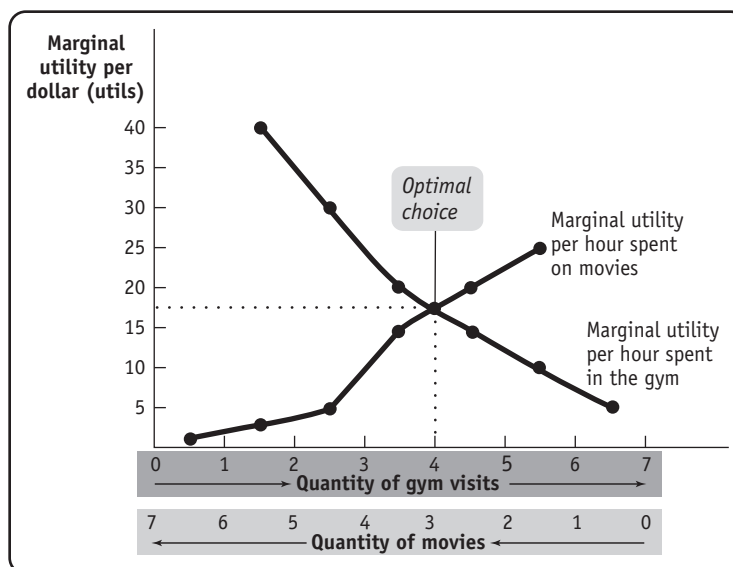
The accompanying diagram illustrates Damien's budget line.



b. The accompanying table shows Damien's marginal utility per gym visit, marginal utility per movie, marginal utility per hour spent on gym visits, and marginal utility per hour spent on movies.

Quantity of gym visits per week	Utility from gym visits (utils)	Marginal utility per gym visit (utils)	Marginal utility per hour (utils)	Quantity of movies per week	Utility from movies (utils)	Marginal utility per movie (utils)	Marginal utility per hour (utils)
1	100	80	40	1	60	50	25
2	180	60	30	2	110	40	20
3	240	40	20	3	150	30	15
4	280	30	15	4	180	10	5
5	310	20	10	5	190	5	2.5
6	330	10	5	6	195	2	1
7	340			7	197		

- c. The accompanying diagram shows Damien's marginal utility per hour spent on gym visits and his marginal utility per hour spent watching movies. Of all the bundles on his budget line, the bundle containing 4 gym visits and 3 movies is optimal: this is the bundle at which the marginal utility per hour spent in the gym is equal to the marginal utility per hour spent watching movies.



8. Anna Jenniferson is an actress who currently spends several hours each week watching movies and going to the gym. On the set of a new movie she meets Damien, the consumer in Problem 7. She tells him that she likes watching movies much more than going to the gym. In fact, she says that if she had to give up seeing 1 movie, she would need to go to the gym twice to make up for the loss in utility from not seeing the movie. A movie takes 2 hours, and a gym visit also lasts 2 hours. Damien tells Anna that she is not watching enough movies. Is he right?

### Solution

8. Damien is right. Since Anna's marginal utility for the last movie is twice as large as the marginal utility for a gym visit, but gym visits and movies "cost" the same in terms of hours spent, Anna's marginal utility per hour spent on movies is twice as large as her marginal utility per hour spent on gym visits. So she should spend more of her time going to movies and less going to the gym.
9. Sven is a poor student who covers most of his dietary needs by eating cheap breakfast cereal, since it contains most of the important vitamins. As the price of cereal increases, he decides to buy even less of other foods and even more breakfast cereal to maintain his intake of important nutrients. This makes breakfast cereal a Giffen good for Sven. Describe in words the substitution effect and the income effect from this increase in the price of cereal. In which direction does each effect move, and why? What does this imply for the slope of Sven's demand curve for cereal?

### Solution

9. As its price increases, cereal becomes relatively less attractive compared to other goods: its opportunity cost is now higher. As a result, Sven will tend to substitute away from cereal. This is the substitution effect. But as the price of cereal increases, the purchasing power of Sven's income falls: in a real sense, Sven is now poorer. Since he spends a large fraction of his income on cereal, this effect is large. So Sven buys less of other foods, since they are normal goods. However, he buys more cereal, so cereal must be an inferior good for him. This is the income effect. In fact, this

effect is so strong that it outweighs the substitution effect: with both effects taken together, Sven consumes more cereal. For a Giffen good, the income effect works opposite to and is stronger than the substitution effect. Since Sven's consumption of cereal rises as the price of cereal rises, his demand curve slopes upward.

- 10.** In each of the following situations, describe the substitution effect and, if it is significant, the income effect. In which direction does each of these effects move? Why?
- Ed spends a large portion of his income on his children's education. Because tuition fees rise, one of his children has to withdraw from college.
  - Homer spends much of his monthly income on home mortgage payments. The interest on his adjustable-rate mortgage falls, lowering his mortgage payments, and Homer decides to move to a larger house.
  - Pam thinks that Spam is an inferior good. Yet as the price of Spam rises, she decides to buy less of it.

### Solution

- 10.**
- As tuition fees rise, college education becomes relatively more expensive compared to other goods. So Ed decides to substitute away from college education and toward other goods. This is the substitution effect. Since tuition takes up a large portion of his income, the income effect will also be significant. As tuition rises, Ed, in a real sense, becomes poorer: the purchasing power of his income falls. As a result, he will buy less of all normal goods. College education is a normal good, so the income effect also moves in the direction of less college education. The effects reinforce each other.
  - As mortgage payments decrease, large homes become cheaper compared to other goods. So Homer will substitute toward buying a larger home. This is the substitution effect. Since he spends much of his income on mortgage payments, the fall in mortgage rates also increases his income in a real sense: the purchasing power of his income is now higher. This implies that Homer will now buy more of all normal goods. Housing is a normal good, so the income effect will also move in the direction of more housing. The effects reinforce each other.
  - As its price rises, Spam becomes relatively more expensive compared to other goods. So Pam will substitute away from Spam and toward other goods. This is the substitution effect. Spam probably does not account for a large portion of Pam's income, so the income effect is likely to be negligible. However, we do know that since Spam is an inferior good, the income effect would make Pam want to consume more of it. As the price of Spam rises, Pam is now, in a real sense, poorer: her income buys fewer goods. Since she is now poorer, she will buy more inferior goods—that is, the income effect will lead her to buy more Spam. However, we know that overall she buys less Spam as its price rises, so the substitution effect outweighs the income effect.

- 11.** Restaurant meals and housing (measured in the number of rooms) are the only two goods that Neha buys. She has income of \$1,000. Initially, she buys a consumption bundle such that she spends exactly half her income on restaurant meals and the other half of her income on housing. Then her income increases by 50%, but the price of restaurant meals increases by 100% (it doubles). The price of housing remains the same. After these changes, if she wanted to, could Neha still buy the same consumption bundle as before?

### Solution

- 11.** Yes, she could. If she spends equally as much money on housing as before, she gets the same number of rooms as before (the price of housing has not changed). However, she now has twice as much money left over as before to spend on restaurant meals (her income increased by 50%). But the price of restaurant meals has doubled also, so she could still buy the same quantity of restaurant meals as before.

- 12.** Scott finds that the higher the price of orange juice, the more money he spends on orange juice. Does that mean that Scott has discovered a Giffen good?

### Solution

- 12.** Scott has not necessarily discovered a Giffen good. For a good to be a Giffen good, the quantity demanded of the good has to increase as its price rises. However, Scott has only found that the amount of money he spends on purchases of orange juice has increased as its price rises. For instance, suppose the price of orange juice were to rise from \$5 per half-gallon to \$10 per half-gallon, and as a result Scott *reduces* the quantity of orange juice demanded from 3 half-gallons to 2 half-gallons. This means that orange juice is not a Giffen good, since the quantity demanded decreases as the price rises. However, Scott's spending on orange juice would have *increased* from  $\$5 \times 3 = \$15$  to  $\$10 \times 2 = \$20$ . So an increase in spending on a good as its price rises need not necessarily imply that the good is a Giffen good.

- 13.** Margo's marginal utility of one dance lesson is 100 utils per lesson. Her marginal utility of a new pair of dance shoes is 300 utils per pair. The price of a dance lesson is \$50 per lesson. She currently spends all her income, and she buys her optimal consumption bundle. What is the price of a pair of dance shoes?

### Solution

- 13.** Since Margo buys her optimal consumption bundle, the marginal utility per dollar spent on dance lessons must be equal to the marginal utility per dollar spent on dance shoes. Here, the marginal utility per dollar spent on dance lessons is 100 utils per lesson/\$50 per lesson = 2 utils per dollar. The marginal utility per dollar spent on dance shoes therefore has to equal 2 utils per dollar. Since the marginal utility of a pair of dance shoes is 300 utils per pair, the price of a pair of shoes has to be \$150 per pair, so that 300 utils per pair/\$150 per pair = 2 utils per dollar.

- 14.** According to data from the U.S. Department of Energy, the average retail price of regular gasoline rose from \$1.16 in 1990 to \$3.24 in 2012, a 180% increase.
- a.** Other things equal, describe the effect of this price increase on the quantity of gasoline demanded. In your explanation, make use of the utility-maximizing principle of marginal analysis and describe income and substitution effects.

In fact, however, other things were not equal. Over the same time period, the prices of other goods and services rose as well. According to data from the Bureau of Labor Statistics, the overall price of a bundle of goods and services consumed by an average consumer rose by 75%.

- b.** Taking into account the rise in the price of gasoline and in overall prices, other things equal, describe the effect on the quantity of gasoline demanded.

However, this is not the end of the story. Between 1990 and 2012, the typical consumer's nominal income increased, too: the U.S. Census Bureau reports that U.S. median household nominal income rose from \$29,943 in 1990 to \$51,017 in 2012, an increase of 70%.

- c.** Taking into account the rise in the price of gasoline, in overall prices, and in consumers' incomes, describe the effect on the quantity of gasoline demanded.

### Solution

- 14. a.** The utility-maximizing principle of marginal analysis states that, at the optimal consumption bundle, the marginal utility per dollar spent on gasoline is equal to the marginal utility per dollar spent on other goods and services. As the price of gasoline rises, other things equal, the marginal utility per dollar spent on gasoline falls. Now the marginal utility per dollar spent on gasoline is less than the marginal utility per dollar spent on other goods and services. But there is a simple

way for the consumer to make him- or herself better off: spend less on gasoline and more on other goods and services. This raises the marginal utility of gasoline, which raises the marginal utility per dollar spent on gasoline; and it lowers the marginal utility of other goods and services, which lowers the marginal utility per dollar spent on other goods and services. This continues until the marginal utility per dollar spent on gasoline is again equal to the marginal utility per dollar spent on other goods and services. That is, the quantity of gasoline demanded falls.

Almost certainly, the whole story is captured by the substitution effect: as the price of gasoline rises, most consumers substitute other goods and services in place of gasoline. Only for consumers for whom spending on gasoline makes up a major portion of their total spending will there be a noticeable income effect: as the price of gasoline rises, they will be made poorer. Since gasoline is a normal good, they will consume less gasoline, further reducing the quantity of gasoline demanded.

- b. First, if all prices had increased by the same percentage, the effect would be the same as if all prices had remained unchanged but the consumer's income had fallen. In other words, the quantity demanded of all normal goods, such as gasoline, would fall.

However, the price of gasoline rose slightly more than the prices of other goods and services. So it is likely that there would still be a substitution effect at work, leading consumers to consume less gasoline.

- c. First, consider the following: If income had increased by the same percentage as the prices of all goods and services, then consumers' optimal consumption bundle would remain unchanged. In fact, however, income increased by more (65%) than did overall prices (only 63%). As a result, consumers would be likely to consume more of all normal goods, including gasoline. Finally, adding in the fact that the price of gasoline increased by more (140%) than did the prices of other goods and services (82%), there would still be some substitution effect at work, leading consumers to substitute other goods and services in place of gasoline. So the overall effect on the quantity of gasoline demanded would, theoretically at least, be inconclusive.

15. Brenda likes to have bagels and coffee for breakfast. The accompanying table shows Brenda's total utility from various consumption bundles of bagels and coffee.

Consumption bundle		
Quantity of bagels	Quantity of coffee (cups)	Total utility (utils)
0	0	0
0	2	28
0	4	40
1	2	48
1	3	54
2	0	28
2	2	56
3	1	54
3	2	62
4	0	40
4	2	66

**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



Suppose Brenda knows she will consume 2 cups of coffee for sure. However, she can choose to consume different quantities of bagels: she can choose either 0, 1, 2, 3, or 4 bagels.

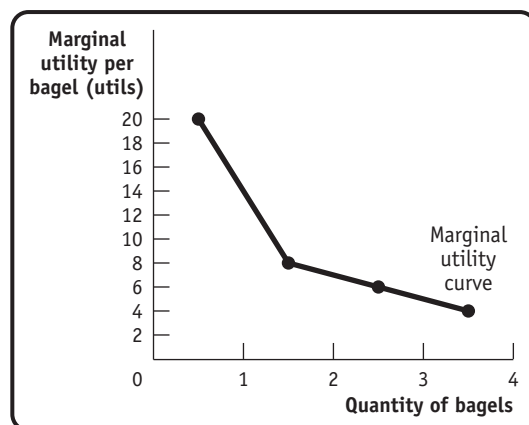
- a. Calculate Brenda's marginal utility from bagels as she goes from consuming 0 bagel to 1 bagel, from 1 bagel to 2 bagels, from 2 bagels to 3 bagels, and from 3 bagels to 4 bagels.
- b. Draw Brenda's marginal utility curve of bagels. Does Brenda have diminishing marginal utility of bagels? Explain.
- c. Brenda has \$8 of income to spend on bagels and coffee. Bagels cost \$2 each, and coffee costs \$2 per cup. Which bundles are on Brenda's budget line? For each of these bundles, calculate the level of utility (in utils) that Brenda enjoys. Which bundle is her optimal bundle?
- d. The price of bagels increases to \$4, but the price of coffee remains at \$2 per cup. Which bundles are now on Brenda's budget line? For each bundle, calculate Brenda's level of utility (in utils). Which bundle is her optimal bundle?
- e. What do your answers to parts a and b imply about the slope of Brenda's demand curve for bagels? Describe the substitution effect and the income effect of this increase in the price of bagels, assuming that bagels are a normal good.

## Solution

15. a. If Brenda consumes 2 cups of coffee, the consumption bundles that are relevant are those in the accompanying table. The first two columns are the bundles, and the third column shows the total utility of each bundle. The fourth column calculates her marginal utility of bagels.

Consumption bundle		Total utility (utils)	Marginal utility per bagel (utils)
Quantity of bagels	Quantity of coffee (cups)		
0	2	28	
1	2	48	
2	2	56	
3	2	62	
4	2	66	

- b. The accompanying diagram shows Brenda's marginal utility of bagels. Since Brenda's marginal utility curve of bagels slopes downward, she has diminishing marginal utility of bagels.





- c. The first two columns in the accompanying table list the bundles that lie on Brenda's budget line, and the third column shows her total utility from these bundles.

Consumption bundle		Total utility (utils)
Quantity of bagels	Quantity of coffee (cups)	
0	4	40
1	3	54
2	2	56
3	1	54
4	0	40

Of all the bundles on her budget line, the bundle that contains 2 bagels and 2 cups of coffee gives Brenda the highest total utility. So this is her optimal bundle.

- d. The first two columns in the accompanying table list the bundles that lie on Brenda's budget line, and the third column shows her total utility from these bundles.

Consumption bundle		Total utility (utils)
Quantity of bagels	Quantity of coffee (cups)	
0	4	40
1	2	48
2	0	28

Of all the bundles on her budget line, the bundle that contains 1 bagel and 2 cups of coffee gives Brenda the highest utility. So this is her optimal bundle.

- e. As the price of bagels increased, Brenda's consumption fell from 2 bagels to 1 bagel, implying that her demand curve for bagels slopes downward. This happens for two reasons. First, the substitution effect: as the price of bagels increases, bagels become relatively less attractive, so Brenda is likely to substitute coffee in place of bagels. Second, the income effect: as the price of bagels increases, it is as if Brenda had become poorer—her money now buys fewer goods than before. Since bagels are a normal good, a reduction in a consumer's real income results in a lower quantity of bagels demanded. The two effects move in the same direction.

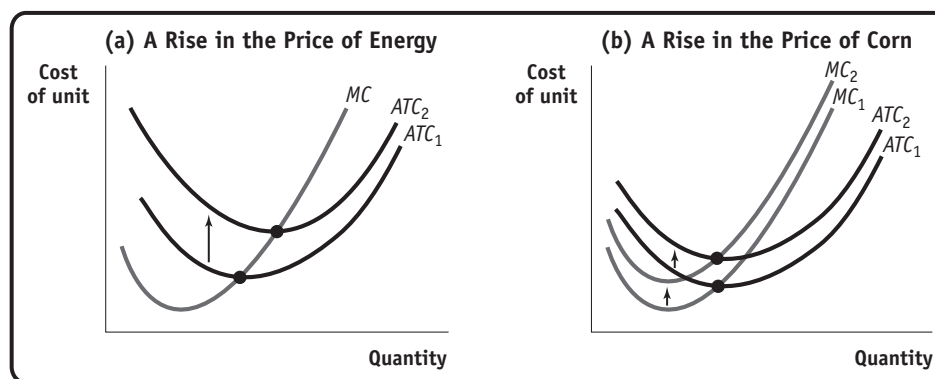


# Behind the Supply Curve: Inputs and Costs

1. Changes in the price of key commodities have a significant impact on a company's bottom line. For virtually all companies, the price of energy is a substantial portion of their costs. In addition, many industries—such as those that produce beef, chicken, high-fructose corn syrup and ethanol—are highly dependent on the price of corn. In particular, corn has seen a significant increase in price.
  - a. Explain how the cost of energy can be both a fixed cost and a variable cost for a company.
  - b. Suppose energy is a fixed cost and energy prices rise. What happens to the company's average total cost curve? What happens to its marginal cost curve? Illustrate your answer with a diagram.
  - c. Explain why the cost of corn is a variable cost but not a fixed cost for an ethanol producer.
  - d. When the cost of corn goes up, what happens to the average total cost curve of an ethanol producer? What happens to its marginal cost curve? Illustrate your answer with a diagram.

## Solution

1. a. Energy required to keep a company operating regardless of how much output is produced represents a fixed cost, such as the energy costs of operating office buildings, factories, and stores that must be maintained independent of the amount of output produced. In addition, energy is a variable cost because producing more output almost always requires using more energy.
- b. When fixed costs increase, so will average total costs. The average total cost curve will shift upward. In panel (a) of the accompanying diagram, this is illustrated by the movement of the average total cost curve from its initial position,  $ATC_1$ , to its new position,  $ATC_2$ . The marginal cost curve is not affected if the variable costs do not change. So the marginal cost curve remains at its initial position,  $MC$ .



- c. Since corn is an input into the production of ethanol, producing a larger quantity of ethanol requires a larger quantity of corn, making corn a variable cost.

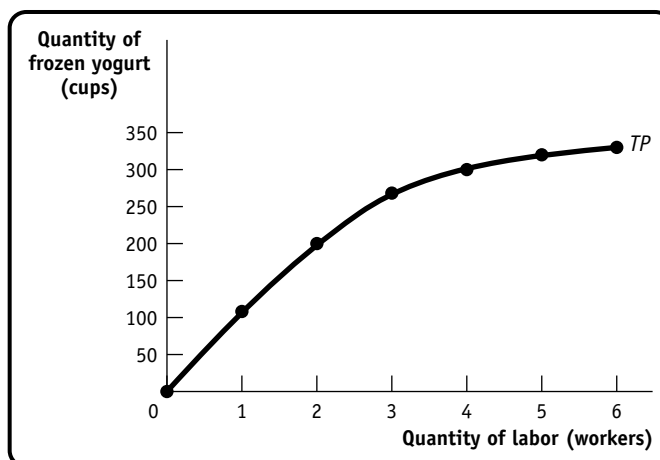
- d. When variable costs increase, so do average total costs and marginal costs. Both curves will shift upward. In panel (b) of the accompanying diagram, the movement of the average total cost curve is illustrated by the shift from its initial position,  $ATC_1$ , to its new position,  $ATC_2$ . The movement of the marginal cost curve is illustrated by the shift from its initial position,  $MC_1$ , to its new position,  $MC_2$ .
2. Marty's Frozen Yogurt is a small shop that sells cups of frozen yogurt in a university town. Marty owns three frozen-yogurt machines. His other inputs are refrigerators, frozen-yogurt mix, cups, sprinkle toppings, and, of course, workers. He estimates that his daily production function when he varies the number of workers employed (and at the same time, of course, yogurt mix, cups, and so on) is as shown in the accompanying table.

Quantity of labor (workers)	Quantity of frozen yogurt (cups)
0	0
1	110
2	200
3	270
4	300
5	320
6	330

- a. What are the fixed inputs and variable inputs in the production of cups of frozen yogurt?
- b. Draw the total product curve. Put the quantity of labor on the horizontal axis and the quantity of frozen yogurt on the vertical axis.
- c. What is the marginal product of the first worker? The second worker? The third worker? Why does marginal product decline as the number of workers increases?

## Solution

2. a. The fixed inputs are those whose quantities do not change as the quantity of output changes: frozen-yogurt machines, refrigerators, and the shop. The variable inputs are those whose quantities do change as the quantity of output changes: frozen-yogurt mix, cups, sprinkle toppings, and workers.
- b. The accompanying diagram illustrates the total product curve.



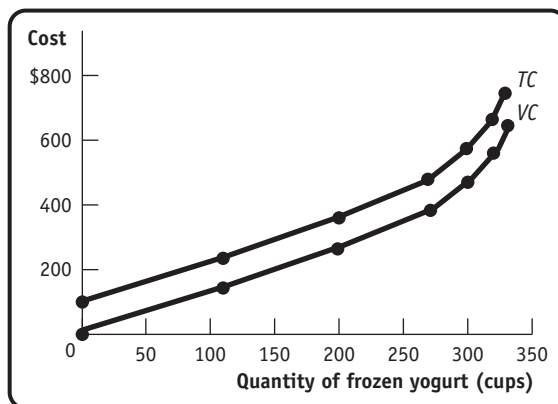
- c. The marginal product, *MPL*, of the first worker is 110 cups. The *MPL* of the second worker is 90 cups. The *MPL* of the third worker is 70 cups. The *MPL* of labor declines as more and more workers are added due to the principle of diminishing returns to labor. Since the number of frozen-yogurt machines is fixed, as workers are added there are fewer and fewer machines for each worker to work with, making each additional worker less and less productive.
3. The production function for Marty's Frozen Yogurt is given in Problem 2. Marty pays each of his workers \$80 per day. The cost of his other variable inputs is \$0.50 per cup of yogurt. His fixed cost is \$100 per day.
- What is Marty's variable cost and total cost when he produces 110 cups of yogurt? 200 cups? Calculate variable and total cost for every level of output given in Problem 2.
  - Draw Marty's variable cost curve. On the same diagram, draw his total cost curve.
  - What is the marginal cost per cup for the first 110 cups of yogurt? For the next 90 cups? Calculate the marginal cost for all remaining levels of output.

### Solution

3. a. Marty's variable cost, *VC*, is his wage cost (\$80 per worker per day) and his other input costs (\$0.50 per cup). His total cost, *TC*, is the sum of the variable cost and his fixed cost of \$100 per day. The answers are given in the accompanying table.

Quantity of frozen yogurt (cups)	Quantity of labor (workers)	<i>VC</i>	<i>TC</i>	<i>MC</i> of cup
0	0	\$0	\$100	
110	1	$1 \times 80 + 110 \times 0.5 = 135$	235	\$1.23
200	2	$2 \times 80 + 200 \times 0.5 = 260$	360	1.39
270	3	$3 \times 80 + 270 \times 0.5 = 375$	475	1.64
300	4	$4 \times 80 + 300 \times 0.5 = 470$	570	3.17
320	5	$5 \times 80 + 320 \times 0.5 = 560$	660	4.50
330	6	$6 \times 80 + 330 \times 0.5 = 645$	745	8.50

- b. The accompanying diagram shows the variable cost and total cost curves.



- c. Marginal cost, *MC*, per cup of frozen yogurt is shown in the table in part a; it is the change in total cost divided by the change in quantity of output.

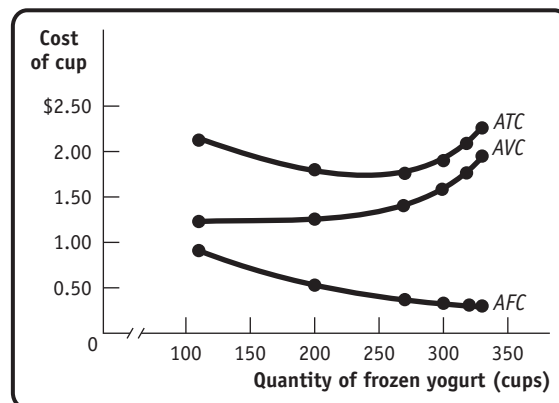
4. The production function for Marty's Frozen Yogurt is given in Problem 2. The costs are given in Problem 3.
- For each of the given levels of output, calculate the average fixed cost (*AFC*), average variable cost (*AVC*), and average total cost (*ATC*) per cup of frozen yogurt.
  - On one diagram, draw the *AFC*, *AVC*, and *ATC* curves.
  - What principle explains why the *AFC* declines as output increases? What principle explains why the *AVC* increases as output increases? Explain your answers.
  - How many cups of frozen yogurt are produced when average total cost is minimized?

## Solution

4. a. The average fixed cost, average variable cost, and average total cost per cup of yogurt are given in the accompanying table. (Numbers are rounded.)

Quantity of frozen yogurt (cups)	<i>VC</i>	<i>TC</i>	<i>AFC</i> of cup	<i>AVC</i> of cup	<i>ATC</i> of cup
0	\$0	\$100	—	—	—
110	135	235	\$0.91	\$1.23	\$2.14
200	260	360	0.50	1.30	1.80
270	375	475	0.37	1.39	1.76
300	470	570	0.33	1.57	1.90
320	560	660	0.31	1.75	2.06
330	645	745	0.30	1.95	2.26

- b. The accompanying diagram shows the *AFC*, *AVC*, and *ATC* curves.



- AFC* declines as output increases due to the spreading effect. The fixed cost is spread over more and more units of output as output increases. *AVC* increases as output increases due to the diminishing returns effect. Due to diminishing returns to labor, it costs more to produce each additional unit of output.
- Average total cost is minimized when 270 cups of yogurt are produced. At lower quantities of output, the fall attributable to the spreading effect dominates changes in average total cost. At higher quantities of output, the rise attributable to the diminishing returns effect dominates changes in average total cost.

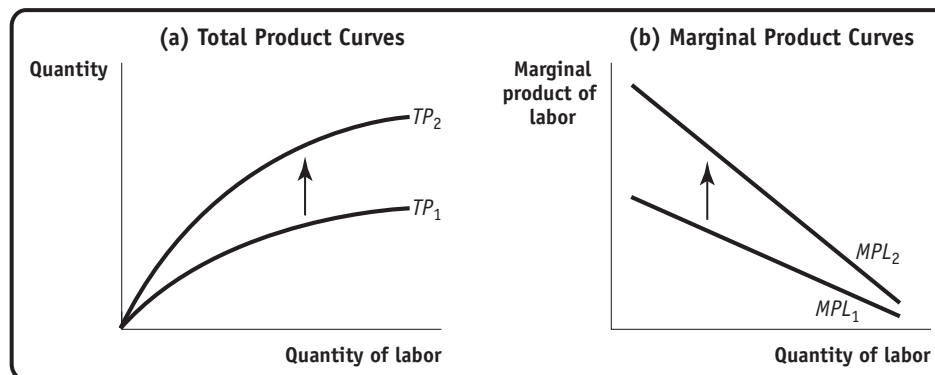
5. Labor costs represent a large percentage of total costs for many firms. According to data from the Bureau of Labor Statistics, U.S. labor costs were up 0.8% in 2013, compared to 2012.
- a. When labor costs increase, what happens to average total cost and marginal cost? Consider a case in which labor costs are only variable costs and a case in which they are both variable and fixed costs.

An increase in labor productivity means each worker can produce more output. Recent data on productivity show that labor productivity in the U.S. nonfarm business sector grew by 1.7% between 1970 and 1999, by 2.6% between 2000 and 2009, and by 1.1% between 2010 and 2013.

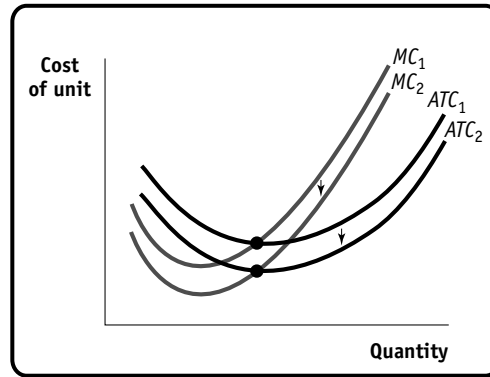
- b. When productivity growth is positive, what happens to the total product curve and the marginal product of labor curve? Illustrate your answer with a diagram.
- c. When productivity growth is positive, what happens to the marginal cost curve and the average total cost curve? Illustrate your answer with a diagram.
- d. If labor costs are rising over time on average, why would a company want to adopt equipment and methods that increase labor productivity?

## Solution

5. a. When labor costs are a variable cost but not a fixed cost, an increase in labor costs leads to an increase in both average total cost and marginal cost. When labor costs are a variable cost and a fixed cost, the result is the same: both the average total cost and the marginal cost increase.
- b. When productivity growth is positive, any given quantity of labor can produce more output, causing the total product curve to shift upward. Since each unit of labor can produce more output, the marginal product of labor will increase and the marginal product of labor curve will shift upward. In panel (a) of the accompanying diagram, the upward shift of the total product curve is illustrated by the movement from its initial position,  $TP_1$ , to its new position,  $TP_2$ . In panel (b), the upward shift of the marginal product of labor curve is illustrated by the movement from its initial position,  $MPL_1$ , to its new position,  $MPL_2$ .



- c. When productivity growth is positive, the marginal cost curve and the average total cost curve will both shift downward, assuming labor costs have not changed. In the accompanying diagram, the movement of the average total cost curve is illustrated by the shift from its initial position,  $ATC_1$ , to its new position,  $ATC_2$ . The movement of the marginal cost curve is illustrated by the shift from its initial position,  $MC_1$ , to its new position,  $MC_2$ .



- d. Rising labor costs will shift the average total cost and marginal cost curves upward. Productivity growth will counteract this, shifting the average total cost and marginal cost curves downward.
6. Magnificent Blooms is a florist specializing in floral arrangements for weddings, graduations, and other events. Magnificent Blooms has a fixed cost associated with space and equipment of \$100 per day. Each worker is paid \$50 per day. The daily production function for Magnificent Blooms is shown in the accompanying table.

Quantity of labor (workers)	Quantity of floral arrangements
0	0
1	5
2	9
3	12
4	14
5	15

- a. Calculate the marginal product of each worker. What principle explains why the marginal product per worker declines as the number of workers employed increases?
- b. Calculate the marginal cost of each level of output. What principle explains why the marginal cost per floral arrangement increases as the number of arrangements increases?



Solution

6. a. *MPL*, shown in the accompanying table for the five workers, is the change in output resulting from the employment of one additional worker per day. *MPL* falls as the quantity of labor increases due to the principle of diminishing returns.

Quantity of labor <i>L</i> (workers)	Quantity of floral arrangements <i>Q</i>	Marginal product of labor <i>MPL</i> = $\Delta Q/\Delta L$ (floral arrangements per worker)	Variable cost <i>VC</i> = number of workers $\times$ wage rate	Total cost <i>TC</i> = <i>FC</i> + <i>VC</i>	Marginal cost of floral arrangement <i>MC</i> = $\Delta TC/\Delta Q$
0	0		\$0	\$100	
1	5	5	50	150	\$10.00 (= 50/5)
2	9	4	100	200	12.50 (= 50/4)
3	12	3	150	250	16.67 (= 50/3)
4	14	2	200	300	25.00 (= 50/2)
5	15	1	250	350	50.00 (= 50/1)

- b. The marginal cost, *MC*, of floral arrangements is the change in total cost divided by the change in output. So, to compute *MC*, we first need to compute total cost,  $TC = FC + VC$ , as shown in the table. *MC* per floral arrangement is also shown in the table. *MC* increases as output increases due again to the principle of diminishing returns.

7. You have the information shown in the accompanying table about a firm's costs. Complete the missing data.

Quantity	<i>TC</i>	<i>MC</i>	<i>ATC</i>	<i>AVC</i>
0	\$20		—	—
1	?	\$20	?	?
2	?	10	?	?
3	?	16	?	?
4	?	20	?	?
5	?	24	?	?

## Solution

7. The accompanying table contains the complete cost data. The total cost of producing one unit of output is the total cost of producing zero units of output plus the marginal cost of increasing output from zero to one, and so forth. The average total cost is just the total cost divided by output. Since the total cost of producing zero output is \$20, the variable cost is  $TC - \$20$ . The average variable cost is then just the variable cost divided by output.

Quantity of output	$TC$	$MC$ of unit	$ATC$ of unit	$AVC$ of unit
0	\$20.00		—	—
1	40.00	\$20.00	\$40.00	\$20.00
2	50.00	10.00	25.00	15.00
3	66.00	16.00	22.00	15.33
4	86.00	20.00	21.50	16.50
5	110.00	24.00	22.00	18.00

8. Evaluate each of the following statements. If a statement is true, explain why; if it is false, identify the mistake and try to correct it.
- A decreasing marginal product tells us that marginal cost must be rising.
  - An increase in fixed cost increases the minimum-cost output.
  - An increase in fixed cost increases marginal cost.
  - When marginal cost is above average total cost, average total cost must be falling.

## Solution

8. a. True. If each additional unit of the input adds less to output than the previous unit (decreasing marginal product), then in order to produce additional output, the firm needs to use increasingly more of the input; that is, the marginal cost of production increases.
- b. True. As the fixed cost rises, the average fixed cost also rises; that is, the spreading effect is now larger. It is the spreading effect that causes average total cost to decline. Since this effect is now larger, it dominates the diminishing returns effect over a greater quantity of output. That is, average total cost decreases over a greater quantity of output.
- c. False. An increase in fixed cost does not change marginal cost. Marginal cost is the additional cost of producing an additional unit of output. Fixed cost does not change as output is increased, and so the additional cost of producing an additional unit of output is independent of the fixed cost.
- d. False. When marginal cost is above average total cost, average total cost must be rising. If the additional cost of producing one more unit of output is greater than what it costs to produce each unit of output on average, then producing that one more unit of output must increase the average total cost.

9. Mark and Jeff operate a small company that produces souvenir footballs. Their fixed cost is \$2,000 per month. They can hire workers for \$1,000 per worker per month. Their monthly production function for footballs is as given in the accompanying table.

Quantity of labor (workers)	Quantity of footballs
0	0
1	300
2	800
3	1,200
4	1,400
5	1,500

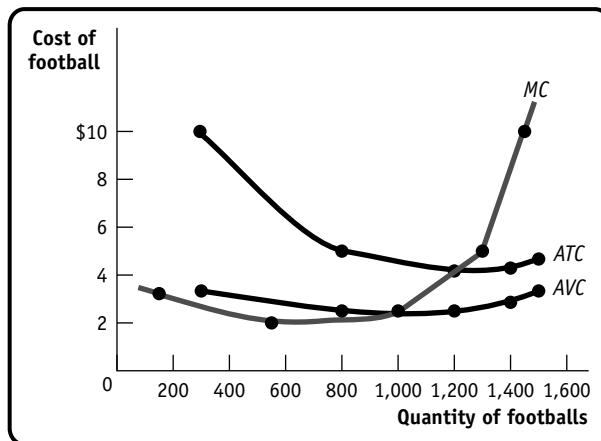
- For each quantity of labor, calculate average variable cost (AVC), average fixed cost (AFC), average total cost (ATC), and marginal cost (MC).
- On one diagram, draw the AVC, ATC, and MC curves.
- At what level of output is Mark and Jeff's average total cost minimized?

### Solution

9. a. The AVC, AFC, ATC, TC, and MC are given in the accompanying table.

Quantity of labor (workers)	Quantity of footballs	AVC of football	AFC of football	ATC of football	TC of footballs	MC of football
0	0	—	—	—	\$2,000.00	
1	300	\$3.33	\$6.67	\$10.00	3,000.00	\$3.33
2	800	2.50	2.50	5.00	4,000.00	2.00
3	1,200	2.50	1.67	4.17	5,000.00	2.50
4	1,400	2.86	1.43	4.29	6,000.00	5.00
5	1,500	3.33	1.33	4.67	7,000.00	10.00

- b. The accompanying diagram shows the AVC, ATC, and MC curves.



- c. According to the table, Mark and Jeff's average total cost is minimized at 1,200 footballs per month, where the ATC is \$4.17.

- 10.** You produce widgets. Currently you produce four widgets at a total cost of \$40.
- What is your average total cost?
  - Suppose you could produce one more (the fifth) widget at a marginal cost of \$5. If you do produce that fifth widget, what will your average total cost be? Has your average total cost increased or decreased? Why?
  - Suppose instead that you could produce one more (the fifth) widget at a marginal cost of \$20. If you do produce that fifth widget, what will your average total cost be? Has your average total cost increased or decreased? Why?

- 10.** **a.** Your average total cost is  $\$40/4 = \$10$  per widget.
- b.** If you produce one more widget, you are producing five widgets at a total cost of  $\$40 + \$5 = \$45$ . Your average total cost is therefore  $\$45/5 = \$9$ . Your average total cost has decreased because the marginal cost of the additional widget is below the average total cost before you produced the additional widget.
- c.** If you produce one more widget, you are producing five widgets at a total cost of  $\$40 + \$20 = \$60$ . Your average total cost is therefore  $\$60/5 = \$12$ . Your average total cost has increased because the marginal cost of the additional widget is above the average total cost before you produced the additional widget.
- 11.** In your economics class, each homework problem set is graded on the basis of a maximum score of 100. You have completed 9 out of 10 of the problem sets for the term, and your current average grade is 88. What range of grades for your 10th problem set will raise your overall average? What range will lower your overall average? Explain your answer.

- 11.** Any grade for your 10th problem set greater than 88 will raise your overall average; any grade lower than 88 will lower it. This is the same principle at work as that for average total cost and marginal cost. If the marginal cost curve (the 10th grade) is above the average total cost curve (the average over the first 9 grades), then the average total cost is rising (that is, the average over the 10 sets is greater than the average over the 9 sets). And if the marginal cost curve (the 10th grade) is below the average total cost curve (the average over the first 9 grades), then the average total cost is falling (that is, the average over the 10 sets is lower than the average over the 9 sets). To see this arithmetically, note that your current average, 88, is found by

$$\frac{\text{Sum of grades for first 9 sets}}{9} = 88 = \text{Average over first 9 sets}$$

Hence,

$$\text{Sum of grades for first 9 sets} = 88 \times 9 = 792$$

So your overall grade—the grade over all 10 problem sets—is

$$\frac{792}{10} + \frac{\text{Grade for 10th set}}{10} = \text{Overall average}$$

If your 10th grade is 90, then your overall grade is

$$\frac{792}{10} + \frac{90}{10} = 79.2 + 9.0 = 88.2$$

which is greater than 88. And if your 10th grade is 86, then your overall grade is

$$\frac{792}{10} + \frac{86}{10} = 79.2 + 8.6 = 87.8$$

which is less than 88.

- 12.** Don owns a small concrete-mixing company. His fixed cost is the cost of the concrete-batching machinery and his mixer trucks. His variable cost is the cost of the sand, gravel, and other inputs for producing concrete; the gas and maintenance for the machinery and trucks; and his workers. He is trying to decide how many mixer trucks to purchase. He has estimated the costs shown in the accompanying table based on estimates of the number of orders his company will receive per week.

Quantity of trucks	FC	VC		
		20 orders	40 orders	60 orders
2	\$6,000	\$2,000	\$5,000	\$12,000
3	7,000	1,800	3,800	10,800
4	8,000	1,200	3,600	8,400

- a. For each level of fixed cost, calculate Don's total cost for producing 20, 40, and 60 orders per week.
- b. If Don is producing 20 orders per week, how many trucks should he purchase and what will his average total cost be? Answer the same questions for 40 and 60 orders per week.

- 12.** a. The answers are given in the accompanying table.

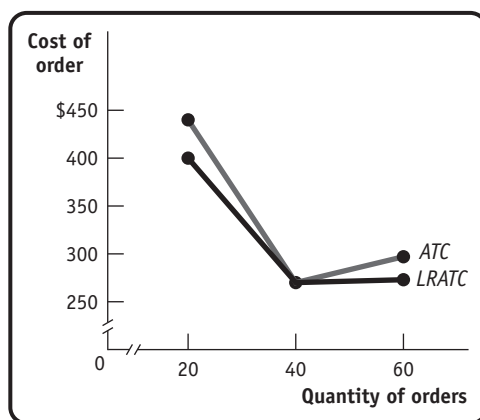
Quantity of trucks	TC		
	20 orders	40 orders	60 orders
2	\$8,000	\$11,000	\$18,000
3	8,800	10,800	17,800
4	9,200	11,600	16,400

- b. Don should choose the number of trucks that minimizes average total cost for each level of output. Given this, Don should buy 2 trucks if he is producing 20 orders per week. His average total cost per order will be \$400. He should buy 3 trucks if he is producing 40 orders per week. His average total cost per order will then be \$270. He should buy 4 trucks if he is producing 60 orders per week. His average total cost per order will then be \$273.
- 13.** Consider Don's concrete-mixing business described in Problem 12. Assume that Don purchased 3 trucks, expecting to produce 40 orders per week.
- a. Suppose that, in the short run, business declines to 20 orders per week. What is Don's average total cost per order in the short run? What will his average total cost per order in the short run be if his business booms to 60 orders per week?
- b. What is Don's long-run average total cost for 20 orders per week? Explain why his short-run average total cost of producing 20 orders per week when the number of trucks is fixed at 3 is greater than his long-run average total cost of producing 20 orders per week.

- c. Draw Don's long-run average total cost curve. Draw his short-run average total cost curve if he owns 3 trucks.

### Solution

13. a. In the short run, producing 20 orders per week with 3 trucks, Don's average total cost per order will be  $(\$7,000 + \$1,800)/20 = \$440$ . If he instead produces 60 orders per week with 3 trucks, his average total cost per order will be \$297.
- b. The long-run average total cost of producing 20 orders per week is \$400 because Don would choose the number of trucks (2 trucks) that minimizes the total cost of producing 20 orders. His short-run average total cost is greater than the long-run minimum because, using 3 trucks, the level of the fixed input is greater than he needs to optimally produce 20 orders per week.
- c. The accompanying diagram shows Don's LRATC and ATC.



14. True or false? Explain your reasoning.
- a. The short-run average total cost can never be less than the long-run average total cost.
- b. The short-run average variable cost can never be less than the long-run average total cost.
- c. In the long run, choosing a higher level of fixed cost shifts the long-run average total cost curve upward.

### Solution

14. a. True. The long-run average total cost is the average total cost you get by choosing the most favorable level of fixed cost in the long run; that is, it is the lowest average total cost that is possible when you can adjust how much of the fixed input you use. In other words, the long-run average total cost of producing a certain level of output is the lowest average total cost with which that level of output can be produced.
- b. False. The long-run average total cost is the lowest average total cost possible. But average variable cost will always be less than average total cost (it is lower than the average total cost by just the amount of the average fixed cost). So short-run average variable cost can be lower than long-run average total cost.
- c. False. In the long run, choosing a higher level of fixed cost allows you to move along and to the right on the long-run average total cost curve. In the long run, if you want to produce a larger quantity of output, you would optimally increase the level of fixed cost (this will decrease the average variable cost). You will do this in such a way as to spend the lowest possible average total cost; that is, you will be on the long-run average total cost curve but farther to the right (at a larger quantity of output).

15. Wolfsburg Wagon (WW) is a small automaker. The accompanying table shows WW's long-run average total cost.

Quantity of cars	LRATC of car
1	\$30,000
2	20,000
3	15,000
4	12,000
5	12,000
6	12,000
7	14,000
8	18,000

- For which levels of output does WW experience increasing returns to scale?
- For which levels of output does WW experience decreasing returns to scale?
- For which levels of output does WW experience constant returns to scale?

- 15.** **a.** WW's long-run average total cost is decreasing over the range of output between 1 and 4 cars. So over that range, WW experiences increasing returns to scale.
- b.** WW's long-run average total cost is increasing over the range of output between 6 and 8 cars. So over that range, WW experiences decreasing returns to scale.
- c.** WW's long-run average total cost is constant over the range of output between 4 and 6 cars. So over that range, WW experiences constant returns to scale.

16. The accompanying table shows a car manufacturer's total cost of producing cars.

Quantity of cars	TC
0	\$500,000
1	540,000
2	560,000
3	570,000
4	590,000
5	620,000
6	660,000
7	720,000
8	800,000
9	920,000
10	1,100,000

- What is this manufacturer's fixed cost?
- For each level of output, calculate the variable cost (VC). For each level of output except zero output, calculate the average variable cost (AVC), average total cost (ATC), and average fixed cost (AFC). What is the minimum-cost output?
- For each level of output, calculate this manufacturer's marginal cost (MC).
- On one diagram, draw the manufacturer's AVC, ATC, and MC curves.

#### WORK IT OUT

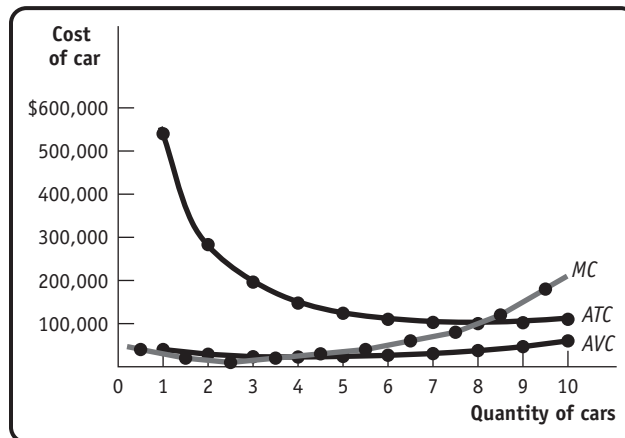
Interactive, step-by-step help solving this problem is available to your students via



- 16.** a. The manufacturer's fixed cost is \$500,000. Even when no output is produced, the manufacturer has a cost of \$500,000.
- b. The accompanying table shows  $VC$ , calculated as  $TC - FC$ ;  $AVC$ , calculated as  $VC/Q$ ;  $ATC$ , calculated as  $TC/Q$ ; and  $AFC$ , calculated as  $FC/Q$ . (Numbers are rounded.) The minimum-cost output is 8 cars, the level at which  $ATC$  is minimized.

Quantity of cars	$TC$	$MC$ of car	$VC$	$AVC$ of car	$ATC$ of car	$AFC$ of car
0	\$500,000		\$0	—	—	—
1	540,000	\$40,000	40,000	\$40,000	\$540,000	\$500,000
2	560,000	20,000	60,000	30,000	280,000	250,000
3	570,000	10,000	70,000	23,333	190,000	166,667
4	590,000	20,000	90,000	22,500	147,500	125,000
5	620,000	30,000	120,000	24,000	124,000	100,000
6	660,000	40,000	160,000	26,667	110,000	83,333
7	720,000	60,000	220,000	31,429	102,857	71,429
8	800,000	80,000	300,000	37,500	<b>100,000</b>	62,500
9	920,000	120,000	420,000	46,667	102,222	55,556
10	1,100,000	180,000	600,000	60,000	110,000	50,000

- c. The table also shows  $MC$ , the additional cost per additional car produced. Notice that  $MC$  is below  $ATC$  for levels of output less than the minimum-cost output and above  $ATC$  for levels of output greater than the minimum-cost output.
- d. The  $AVC$ ,  $ATC$ , and  $MC$  curves are shown in the accompanying diagram.





# Perfect Competition and the Supply Curve

1. For each of the following, is the business a price-taking producer? Explain your answers.
  - a. A cappuccino café in a university town where there are dozens of very similar cappuccino cafés
  - b. The makers of Pepsi-Cola
  - c. One of many sellers of zucchini at a local farmers' market

## Solution

1.
  - a. The cappuccino café is probably a price-taking producer, especially if there are a large number of cafés in town, since each will have a small market share and each produces a standardized product.
  - b. There is only one manufacturer of Pepsi-Cola, and it works hard to differentiate its product from others in the minds of consumers. It is not a price-taking producer.
  - c. Zucchini sellers at the farmers' market are price-taking producers; there are many of them, none of whom can affect the market price for zucchini, which is a standardized product.
2. For each of the following, is the industry perfectly competitive? Referring to market share, standardization of the product, and/or free entry and exit, explain your answers.
  - a. Aspirin
  - b. Alicia Keys concerts
  - c. SUVs

## Solution

2.
  - a. Yes, aspirin is produced in a perfectly competitive industry. Many manufacturers produce aspirin, the product is standardized, and new manufacturers can easily enter and existing manufacturers can easily exit the industry.
  - b. No, Alicia Keys concerts are not produced in a perfectly competitive industry. There is not free entry into the industry—there is only one Alicia Keys.
  - c. No, SUVs are not produced in a perfectly competitive industry. There are only a few manufacturers of SUVs, each holding a large market share, and SUVs are not a standardized product in the minds of consumers.

3. Bob produces Blu-ray movies for sale, which requires a building and a machine that copies the original movie onto a Blu-ray. Bob rents a building for \$30,000 per month and rents a machine for \$20,000 a month. Those are his fixed costs. His variable cost per month is given in the accompanying table.

Quantity of Blu-rays	VC
0	\$0
1,000	5,000
2,000	8,000
3,000	9,000
4,000	14,000
5,000	20,000
6,000	33,000
7,000	49,000
8,000	72,000
9,000	99,000
10,000	150,000

- a. Calculate Bob's average variable cost, average total cost, and marginal cost for each quantity of output.
- b. There is free entry into the industry, and anyone who enters will face the same costs as Bob. Suppose that currently the price of a Blu-ray is \$25. What will Bob's profit be? Is this a long-run equilibrium? If not, what will the price of Blu-ray movies be in the long run?

### Solution

3. a. Bob's average variable cost, average total cost, and marginal cost are shown in the accompanying table.

Quantity of Blu-rays	VC	MC of Blu-ray	AVC of Blu-ray	ATC of Blu-ray
0	\$0.00	—	—	—
1,000	5,000.00	\$5.00	\$5.00	\$55.00
2,000	8,000.00	3.00	4.00	29.00
3,000	9,000.00	1.00	3.00	19.67
4,000	14,000.00	5.00	3.50	16.00
5,000	20,000.00	6.00	4.00	14.00
6,000	33,000.00	13.00	5.50	13.83
7,000	49,000.00	16.00	7.00	14.14
8,000	72,000.00	23.00	9.00	15.25
9,000	99,000.00	27.00	11.00	16.56
10,000	150,000.00	51.00	15.00	20.00

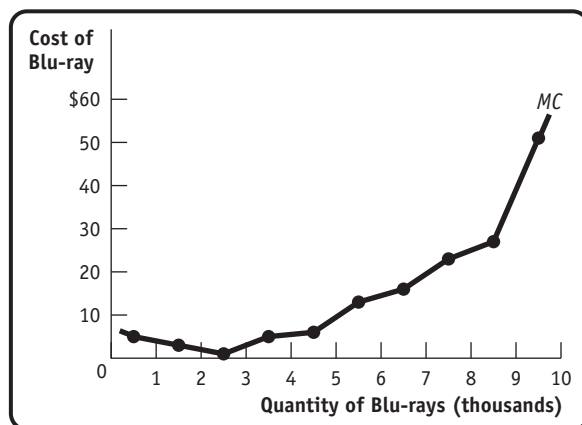
- b. At a price of \$25,  $P = MC$  at a quantity of 8,000, and  $ATC = \$15.25$ . Bob makes a profit of  $\$25 - \$15.25 = \$9.75$  per Blu-ray, for a total profit of  $8,000 \times \$9.75 = \$78,000$ . If there is free entry into the industry, this profit will attract new firms. As firms enter, the price of Blu-rays will eventually fall until it is equal to the minimum average total cost. Here, the average total cost reaches its minimum of \$13.83 at 6,000 Blu-rays per month. So the long-run price of Blu-rays will be \$13.83.
4. Consider Bob's Blu-ray company described in Problem 4. Assume that Blu-ray production is a perfectly competitive industry. For each of the following questions, explain your answers.
- What is Bob's break-even price? What is his shut-down price?
  - Suppose the price of a Blu-ray is \$2. What should Bob do in the short run?
  - Suppose the price of a Blu-ray is \$7. What is the profit-maximizing quantity of Blu-rays that Bob should produce? What will his total profit be? Will he produce or shut down in the short run? Will he stay in the industry or exit in the long run?
  - Suppose instead that the price of Blu-rays is \$20. Now what is the profit-maximizing quantity of Blu-rays that Bob should produce? What will his total profit be now? Will he produce or shut down in the short run? Will he stay in the industry or exit in the long run?

## Solution

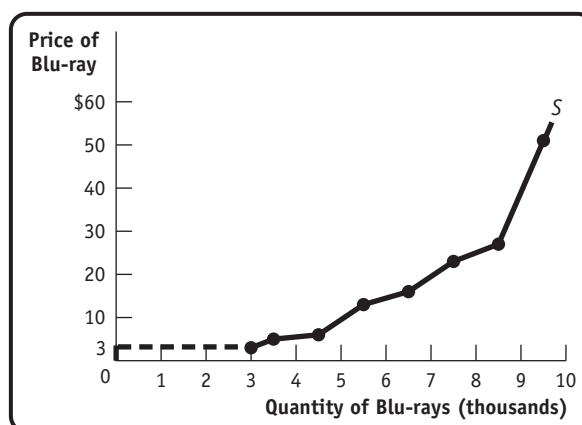
4. a. Bob's break-even price is \$13.83 because this is the minimum average total cost. His shut-down price is \$3, the minimum average variable cost, because below that price his revenue does not even cover his variable cost.
- b. If the price of Blu-rays is \$2, the price is below Bob's shut-down price of \$3. So Bob should shut down in the short run.
- c. If Blu-rays sell for \$7, Bob should produce 5,000 Blu-rays because for any greater quantity his marginal cost exceeds his marginal revenue (the market price). His total profit will be  $-\$35,000$ , a loss of \$35,000, since he loses  $\$7(\text{price}) - \$14(ATC) = \$7$  per Blu-ray produced. In the short run, he will produce because his short-run loss if he were to shut down would be greater; it would equal his fixed costs of \$50,000. In the long run, he will exit the industry because his profit is negative: the price of \$7 per Blu-ray is below his break-even price of \$13.83.
- d. If Blu-rays sell instead for \$20, Bob should produce 7,000 Blu-rays because at this quantity his marginal cost approximately equals his marginal revenue (the market price). His profit per Blu-ray is  $\$20(\text{price}) - \$14.14(ATC) = \$5.86$ , giving him a total profit of  $7,000 \times \$5.86 = \$41,020$ . In the short run, he will produce because he is covering his variable cost (the price is above the shut-down price). In the long run, he will stay in the industry because his profit is not negative (the price is above the break-even price).
5. Consider again Bob's Blu-ray company described in Problem 4.
- Draw Bob's marginal cost curve.
  - Over what range of prices will Bob produce no Blu-rays in the short run?
  - Draw Bob's individual supply curve. In your graph, plot the price range from \$0 to \$60 in increments of \$10.

## Solution

5. a. Bob's marginal cost curve is shown in the accompanying diagram.



- b. Bob will produce no Blu-rays if the price falls below \$3 because \$3 is the lowest point on the average variable cost curve—his shut-down price.
- c. The individual supply curve is shown in the accompanying diagram. It is his MC curve above the minimum average variable cost. At a price below \$3, output is 0, shown by the solid vertical line at the origin.



6. a. A profit-maximizing business incurs an economic loss of \$10,000 per year. Its fixed cost is \$15,000 per year. Should it produce or shut down in the short run? Should it stay in the industry or exit in the long run?
- b. Suppose instead that this business has a fixed cost of \$6,000 per year. Should it produce or shut down in the short run? Should it stay in the industry or exit in the long run?

## Solution

6. a. In the short run, the business should produce. If it shuts down, the short-run annual loss will be \$15,000, its fixed cost; but if it produces, the loss will be only \$10,000. So the business minimizes its short-run loss by producing. In the long run, the business should exit the industry because it is incurring a loss.
- b. In the short run, the business should shut down. If it shuts down, the short-run loss will be \$6,000, its fixed cost; if it continues to produce, the loss will be \$10,000. So the business minimizes its short-run loss by shutting down. In the long run, the firm should exit the industry because it is incurring a loss.

7. The first sushi restaurant opens in town. Initially people are very cautious about eating tiny portions of raw fish, as this is a town where large portions of grilled meat have always been popular. Soon, however, an influential health report warns consumers against grilled meat and suggests that they increase their consumption of fish, especially raw fish. The sushi restaurant becomes very popular and its profit increases.
- What will happen to the short-run profit of the sushi restaurant? What will happen to the number of sushi restaurants in town in the long run? Will the first sushi restaurant be able to sustain its short-run profit over the long run? Explain your answers.
  - Local steakhouses suffer from the popularity of sushi and start incurring losses. What will happen to the number of steakhouses in town in the long run? Explain your answer.

## Solution

7. a. The short-run profit of the sushi restaurant will rise, inducing others to open sushi restaurants. The number of sushi restaurants in town will increase. Over time, as the supply of sushi restaurants increases, the equilibrium price of sushi will decrease, lowering the short-run profit of the original sushi restaurant.
- b. The number of steakhouses in town will decrease in the long run, as owners incur losses and exit from the industry.
8. A perfectly competitive firm has the following short-run total cost:

Quantity	$TC$
0	\$5
1	10
2	13
3	18
4	25
5	34
6	45

Market demand for the firm's product is given by the following market demand schedule:

Price	Quantity demanded
\$12	300
10	500
8	800
6	1,200
4	1,800

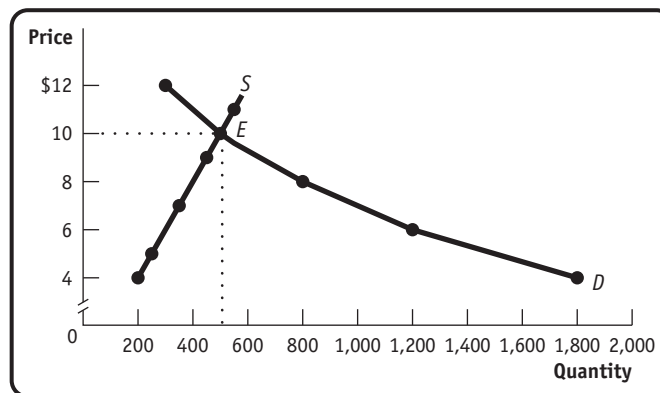
- Calculate this firm's marginal cost and, for all output levels except zero, the firm's average variable cost and average total cost.
- There are 100 firms in this industry that all have costs identical to those of this firm. Draw the short-run industry supply curve. In the same diagram, draw the market demand curve.
- What is the market price, and how much profit will each firm make?

## Solution

8. a. This firm's fixed cost is \$5, since even when the firm produces no output, it incurs a total cost of \$5. The marginal cost (*MC*), average variable cost (*AVC*), and average total cost (*ATC*) are given in the accompanying table.

Quantity	<i>TC</i>	<i>MC</i>	<i>AVC</i>	<i>ATC</i>
0	\$5.00		—	—
1	10.00	\$5.00	\$5.00	\$10.00
2	13.00	3.00	4.00	6.50
3	18.00	5.00	4.33	6.00
4	25.00	7.00	5.00	6.25
5	34.00	9.00	5.80	6.80
6	45.00	11.00	6.67	7.50

- b. This firm's minimum average variable cost is \$4 at 2 units of output. So the firm will produce only if the price is greater than \$4, making its individual supply curve the same as its marginal cost curve above the shut-down price of \$4. The same is true for all other firms in the industry. That is, if the price is \$4, the quantity supplied by all 100 firms is 200. The quantity supplied by all 100 firms at a price of \$6 is 300, and so on. The accompanying diagram illustrates this principle.



- c. The quantity supplied equals the quantity demanded at a price of \$10—the (short-run) market equilibrium price. So the quantity bought and sold in this market is 500 units. Each firm will maximize profit by producing 5 units of output—the greatest quantity at which price equals or exceeds marginal cost. At 5 units of output, each firm's revenue is  $\$10 \times 5 = \$50$ . Its total cost is \$34. So it makes a profit of \$16.

9. A new vaccine against a deadly disease has just been discovered. Presently, 55 people die from the disease each year. The new vaccine will save lives, but it is not completely safe. Some recipients of the shots will die from adverse reactions. The projected effects of the inoculation are given in the accompanying table:

Percent of population inoculated	Total deaths due to disease	Total deaths due to inoculation	Marginal benefit of inoculation	Marginal cost of inoculation	"Profit" of inoculation
0	55	0	—	—	—
10	45	0	—	—	—
20	36	1	—	—	—
30	28	3	—	—	—
40	21	6	—	—	—
50	15	10	—	—	—
60	10	15	—	—	—
70	6	20	—	—	—
80	3	25	—	—	—
90	1	30	—	—	—
100	0	35	—	—	—

- a. What are the interpretations of "marginal benefit" and "marginal cost" here? Calculate marginal benefit and marginal cost per each 10% increase in the rate of inoculation. Write your answers in the table.
- b. What proportion of the population should optimally be inoculated?
- c. What is the interpretation of "profit" here? Calculate the profit for all levels of inoculation.

9. a. The "marginal benefit" is the additional lives saved due to inoculation. The "marginal cost" is the additional deaths due to inoculation. The values are given in the accompanying table.

Percent of population inoculated	Total deaths due to disease	Total deaths due to inoculation	Marginal benefit of inoculation	Marginal cost of inoculation	"Profit" of inoculation
0	55	0	10	0	0
10	45	0	9	1	10 - 0 = 10
20	36	1	8	2	19 - 1 = 18
30	28	3	7	3	27 - 3 = 24
40	21	6	6	4	34 - 6 = 28
50	15	10	5	5	40 - 10 = 30
60	10	15	4	5	45 - 15 = 30
70	6	20	3	5	49 - 20 = 29
80	3	25	2	5	52 - 25 = 27
90	1	30	1	5	54 - 30 = 24
100	0	35	—	—	55 - 35 = 20

- b. People should be inoculated until the marginal cost equals the marginal benefit from the inoculations. This occurs when  $MB = MC = 5$ , at which point 50% or 60% of the population should be inoculated (both result in the greatest number of lives saved).
  - c. “Profit” is total lives saved minus total lives lost. The profit at each level of inoculation in the population is shown in the table. The maximum number of lives saved is 30, which occurs at inoculation levels of both 50% and 60%.
- 10.** Evaluate each of the following statements. If a statement is true, explain why; if it is false, identify the mistake and try to correct it.
- a. A profit-maximizing firm in a perfectly competitive industry should select the output level at which the difference between the market price and marginal cost is greatest.
  - b. An increase in fixed cost lowers the profit-maximizing quantity of output produced in the short run.

### Solution

- 10.**
- a. False. For a profit-maximizing firm in a perfectly competitive industry, profit is maximized by producing a quantity at which marginal cost is equal to the market price.
  - b. False. Changes in fixed cost do not affect marginal cost and so do not change the profit-maximizing quantity of output produced. Changes in fixed cost do, however, change the amount of profit earned and the firm’s break-even price: the higher the fixed cost, the higher the firm’s break-even price and the lower its profit.
- 11.** The production of agricultural products like wheat is one of the few examples of a perfectly competitive industry. In this question, we analyze results from a study released by the U.S. Department of Agriculture about wheat production in the United States back in 2013.
- a. The average variable cost per acre planted with wheat was \$127 per acre. Assuming a yield of 44 bushels per acre, calculate the average variable cost per bushel of wheat.
  - b. The average price of wheat received by a farmer in 2013 was \$7.58 per bushel. Do you think the average farm would have exited the industry in the short run? Explain.
  - c. With a yield of 44 bushels of wheat per acre, the average total cost per farm was \$4.80 per bushel. The harvested acreage for rye (a type of wheat) in the United States increased from 242,000 in 2010 to 306,000 in 2013. Using the information on prices and costs here and in parts a and b, explain why this might have happened.
  - d. Using the above information, do you think the prices of wheat were higher or lower prior to 1998? Why?

### Solution

- 11.**
- a. Since the yield is 44 bushels per acre, we know that producing 44 bushels of wheat is associated with an average variable cost of \$127. So the production of 1 bushel of wheat is associated with an average variable cost of  $\$127/44$  bushels = \$2.89 per bushel.
  - b. We would not expect the average farm to have exited the industry in the short run because the price it received for wheat, \$7.58 per bushel, was greater than the average variable cost of production, \$2.89 per bushel.
  - c. Because wheat production increased over the period, we would expect the price in 2010 to be greater than \$4.80. The average farm would increase wheat production and more farms would have entered the industry in the long run because the price it received per bushel was greater than the average total cost of production.



The farm was reaping an economic profit by operating. So the increase in the harvested acreage of wheat should have been expected after 2010. Indeed, the price of wheat in 2010 was \$5.80 per bushel.

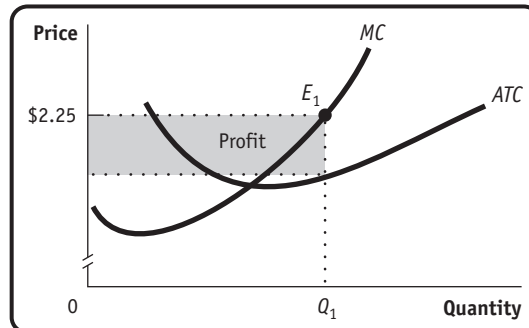
- d. Assuming the cost of wheat production remains relatively constant, with current prices greater than the average cost of production, we would expect more farmers to enter the wheat market and existing farmers to increase their acreage of planted wheat. We should see the amount of harvested wheat increase.

**12.** The accompanying table presents prices for washing and ironing a man's shirt taken from a survey of California dry cleaners.

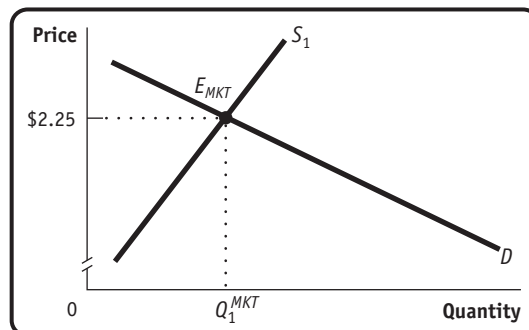
Dry Cleaner	City	Price
A-1 Cleaners	Santa Barbara	\$1.50
Regal Cleaners	Santa Barbara	1.95
St. Paul Cleaners	Santa Barbara	1.95
Zip Kleen Dry Cleaners	Santa Barbara	1.95
Effie the Tailor	Santa Barbara	2.00
Magnolia Too	Goleta	2.00
Master Cleaners	Santa Barbara	2.00
Santa Barbara Cleaners	Goleta	2.00
Sunny Cleaners	Santa Barbara	2.00
Casitas Cleaners	Carpinteria	2.10
Rockwell Cleaners	Carpinteria	2.10
Norvelle Bass Cleaners	Santa Barbara	2.15
Ablitt's Fine Cleaners	Santa Barbara	2.25
California Cleaners	Goleta	2.25
Justo the Tailor	Santa Barbara	2.25
Pressed 4 Time	Goleta	2.50
King's Cleaners	Goleta	2.50

- a. What is the average price per shirt washed and ironed in Goleta? In Santa Barbara?
- b. Draw typical marginal cost and average total cost curves for California Cleaners in Goleta, assuming it is a perfectly competitive firm but is making a profit on each shirt in the short run. Mark the short-run equilibrium point and shade the area that corresponds to the profit made by the dry cleaner.
- c. Assume \$2.25 is the short-run equilibrium price in Goleta. Draw a typical short-run demand and supply curve for the market. Label the equilibrium point.
- d. Observing profits in the Goleta area, another dry cleaning service, Diamond Cleaners, enters the market. It charges \$1.95 per shirt. What is the new average price of washing and ironing a shirt in Goleta? Illustrate the effect of entry on the average Goleta price by a shift of the short-run supply curve, the demand curve, or both.
- e. Assume that California Cleaners now charges the new average price and just breaks even (that is, makes zero economic profit) at this price. Show the likely effect of the entry on your diagram in part b.
- f. If the dry cleaning industry is perfectly competitive, what does the average difference in price between Goleta and Santa Barbara imply about costs in the two areas?

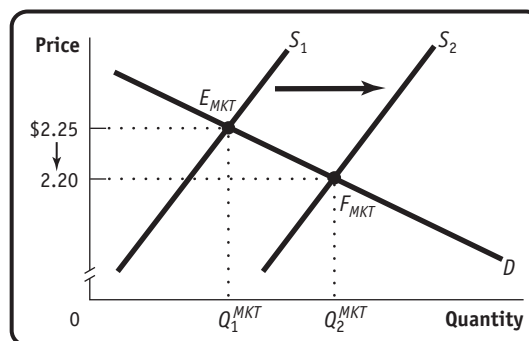
- 12.** a. The average price per shirt washed and ironed, the sum of prices charged by each cleaner in that town divided by the number of cleaners in that town, is \$2.25 in Goleta and \$2.00 in Santa Barbara.
- b. The marginal cost curve ( $MC$ ) cuts through the average total cost curve ( $ATC$ ) at the lowest point of the  $ATC$  curve. Since California Cleaners is making a profit, price has to be above the break-even price (the minimum average total cost). Given this, California Cleaners maximizes its profit (shown by the shaded area) by producing quantity  $Q_1$  in the accompanying diagram—the quantity at which its marginal cost equals the market price.



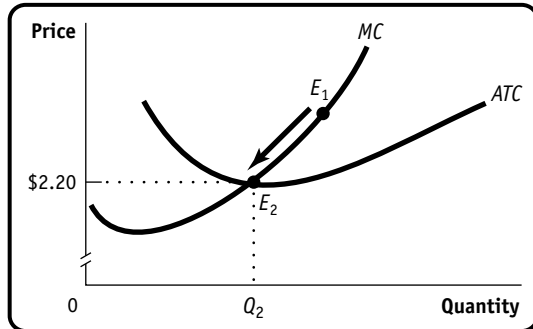
- c. The accompanying diagram shows the short-run market supply curve and the market demand curve.



- d. The entry of a new firm increases the quantity supplied at each price and shifts the supply curve to the right, as indicated by the move from  $S_1$  to  $S_2$  in the accompanying diagram. So the new equilibrium corresponds to a lower equilibrium price, \$2.20, and a higher equilibrium quantity.



- e. Since California Cleaners breaks even at \$2.20 a shirt, it must be operating at the minimum of its average total cost curve. The likely effect on the diagram in part b is shown below.



- f. Since, in the long run, firms break even in a perfectly competitive industry, costs have to be higher in Goleta than in Santa Barbara.

13. Kate's Katering provides catered meals, and the catered meals industry is perfectly competitive. Kate's machinery costs \$100 per day and is the only fixed input. Her variable cost consists of the wages paid to the cooks and the food ingredients. The variable cost per day associated with each level of output is given in the accompanying table.

Quantity of meals	VC
0	\$0
10	200
20	300
30	480
40	700
50	1,000

- Calculate the total cost, the average variable cost, the average total cost, and the marginal cost for each quantity of output.
- What is the break-even price and quantity? What is the shut-down price and quantity?
- Suppose that the price at which Kate can sell catered meals is \$21 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?
- Suppose that the price at which Kate can sell catered meals is \$17 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?
- Suppose that the price at which Kate can sell catered meals is \$13 per meal. In the short run, will Kate earn a profit? In the short run, should she produce or shut down?

**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



## Solution

- 13. a.** From Kate's variable cost (*VC*), the accompanying table calculates Kate's total cost (*TC*), average variable cost (*AVC*), average total cost (*ATC*), and marginal cost (*MC*).

Quantity of meals	<i>VC</i>	<i>TC</i>	<i>MC</i> of meal	<i>AVC</i> of meal	<i>ATC</i> of meal
0	\$0.00	\$100.00		—	—
10	200.00	300.00	\$20.00	\$20.00	\$30.00
20	300.00	400.00	10.00	15.00	20.00
30	480.00	580.00	18.00	16.00	19.33
40	700.00	800.00	22.00	17.50	20.00
50	1,000.00	1,100.00	30.00	20.00	22.00

- b.** Kate's break-even price, the minimum average total cost, is \$19.33, at an output quantity of 30 meals. Kate's shut-down price, the minimum average variable cost, is \$15, at an output of 20 meals.
- c.** When the price is \$21, Kate will make a profit: the price is above her break-even price. And since the price is above her shut-down price, Kate should produce in the short run, not shut down.
- d.** When the price is \$17, Kate will incur a loss: the price is below her break-even price. But since the price is above her shut-down price, Kate should produce in the short run, not shut down.
- e.** When the price is \$13, Kate would incur a loss if she were to produce: the price is below her break-even price. And since the price is also below her shut-down price, Kate should shut down in the short run.

# Monopoly

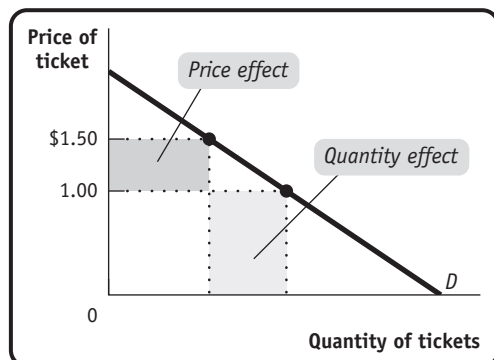
1. Each of the following firms possesses market power. Explain its source.
  - a. Merck, the producer of the patented cholesterol-lowering drug Zetia
  - b. WaterWorks, a provider of piped water
  - c. Chiquita, a supplier of bananas and owner of most banana plantations
  - d. The Walt Disney Company, the creators of Mickey Mouse

## Solution

1.
  - a. Merck has a patent for Zetia. This is an example of a government-created barrier to entry, which gives Merck market power.
  - b. There are increasing returns to scale in the provision of piped water. There is a large fixed cost associated with building a network of water pipes to each household; the more water delivered, the lower its average total cost becomes. This gives WaterWorks a cost advantage over other companies, which gives WaterWorks market power.
  - c. Chiquita controls most banana plantations. Control over a scarce resource gives Chiquita market power.
  - d. The Walt Disney Company has the copyright on animations featuring Mickey Mouse. This is another example of a government-created barrier to entry that gives the Walt Disney Company market power.
2. Skyscraper City has a subway system, for which a one-way fare is \$1.50. There is pressure on the mayor to reduce the fare by one-third, to \$1.00. The mayor is dismayed, thinking that this will mean Skyscraper City is losing one-third of its revenue from sales of subway tickets. The mayor's economic adviser reminds her that she is focusing only on the price effect and ignoring the quantity effect. Explain why the mayor's estimate of a one-third loss of revenue is likely to be an overestimate. Illustrate with a diagram.

## Solution

2. A reduction in fares from \$1.50 to \$1.00 will reduce the revenue on each ticket that is currently sold by one-third; this is the price effect. But a reduction in price will lead to more tickets being sold at the lower price of \$1.00, which creates additional revenue; this is the quantity effect. The accompanying diagram illustrates this.



The price effect is the loss of revenue on all the currently sold tickets. The quantity effect is the increase in revenue from increased sales as a result of the lower price.

3. Bob, Bill, Ben, and Brad Baxter have just made a documentary movie about their basketball team. They are thinking about making the movie available for download on the Internet, and they can act as a single-price monopolist if they choose to. Each time the movie is downloaded, their Internet service provider charges them a fee of \$4. The Baxter brothers are arguing about which price to charge customers per download. The accompanying table shows the demand schedule for their film.

Price of download	Quantity of downloads demanded
\$10	0
8	1
6	3
4	6
2	10
0	15

- Calculate the total revenue and the marginal revenue per download.
- Bob is proud of the film and wants as many people as possible to download it. Which price would he choose? How many downloads would be sold?
- Bill wants as much total revenue as possible. Which price would he choose? How many downloads would be sold?
- Ben wants to maximize profit. Which price would he choose? How many downloads would be sold?
- Brad wants to charge the efficient price. Which price would he choose? How many downloads would be sold?

### Solution

3. a. The accompanying table calculates total revenue (*TR*) and marginal revenue (*MR*). Recall that marginal revenue is the additional revenue *per unit of output*, that is,  $\Delta TR/\Delta Q$ .

Price of download	Quantity of downloads demanded	<i>TR</i>	<i>MR</i>
\$10	0	\$0	
8	1	8	\$8
6	3	18	5
4	6	24	2
2	10	20	-1
0	15	0	-4

- Bob would charge \$0. At that price, there would be 15 downloads, the largest quantity they can sell.
- Bill would charge \$4. At that price, total revenue is greatest (\$24). At that price, there would be 6 downloads.
- Ben would charge \$6. At that price, there would be 3 downloads. For any more downloads, marginal revenue would be below marginal cost, and so further downloads would lose the Baxters' money.
- Brad would charge \$4. A price equal to marginal cost is efficient. At that price, there would be 6 downloads.

4. Jimmy has a room that overlooks, from some distance, a major league baseball stadium. He decides to rent a telescope for \$50.00 a week and charge his friends and classmates to use it to peep at the game for 30 seconds. He can act as a single-price monopolist for renting out “peeps.” For each person who takes a 30-second peep, it costs Jimmy \$0.20 to clean the eyepiece. The accompanying table shows the information Jimmy has gathered about the demand for the service in a given week.

Price of peep	Quantity of peeps demanded
\$1.20	0
1.00	100
0.90	150
0.80	200
0.70	250
0.60	300
0.50	350
0.40	400
0.30	450
0.20	500
0.10	550

- For each price in the table, calculate the total revenue from selling peeps and the marginal revenue per peep.
- At what quantity will Jimmy’s profit be maximized? What price will he charge? What will his total profit be?
- Jimmy’s landlady complains about all the visitors coming into the building and tells Jimmy to stop selling peeps. Jimmy discovers, however, that if he gives the landlady \$0.20 for every peep he sells, she will stop complaining. What effect does the \$0.20-per-peep bribe have on Jimmy’s marginal cost per peep? What is the new profit-maximizing quantity of peeps? What effect does the \$0.20-per-peep bribe have on Jimmy’s total profit?

### Solution

4. a. Total revenue (TR) and marginal revenue (MR) are given in the accompanying table.

Price of peep	Quantity of peeps demanded	TR	MR
\$1.20	0	\$0	
1.00	100	100	\$1.00
0.90	150	135	0.70
0.80	200	160	0.50
0.70	250	175	0.30
0.60	300	180	0.10
0.50	350	175	-0.10
0.40	400	160	-0.30
0.30	450	135	-0.50
0.20	500	100	-0.70
0.10	550	55	-0.90

- b. Jimmy's profit will be maximized when he sells 250 peeps, since for the first 250 peeps his marginal revenue exceeds his marginal cost of \$0.20. He will charge \$0.70 per peep. His total profit is  $(250 \times \$0.70) - (250 \times \$0.20) - \$50.00 = \$75.00$ .
- c. When Jimmy pays the landlady \$0.20 per peep, his marginal cost increases to \$0.40 per peep, so the profit-maximizing quantity decreases to 200 and the profit-maximizing price increases to \$0.80. His total profit will now be  $(200 \times \$0.80) - (200 \times \$0.40) - \$50.00 = \$30.00$ .

5. Suppose that De Beers is a single-price monopolist in the market for diamonds. De Beers has five potential customers: Raquel, Jackie, Joan, Mia, and Sophia. Each of these customers will buy at most one diamond—and only if the price is just equal to, or lower than, her willingness to pay. Raquel's willingness to pay is \$400; Jackie's, \$300; Joan's, \$200; Mia's, \$100; and Sophia's, \$0. De Beers's marginal cost per diamond is \$100. This leads to the demand schedule for diamonds shown in the accompanying table.

Price of diamond	Quantity of diamonds demanded
\$500	0
400	1
300	2
200	3
100	4
0	5

- a. Calculate De Beers's total revenue and its marginal revenue. From your calculation, draw the demand curve and the marginal revenue curve.
- b. Explain why De Beers faces a downward-sloping demand curve.
- c. Explain why the marginal revenue from an additional diamond sale is less than the price of the diamond.
- d. Suppose De Beers currently charges \$200 for its diamonds. If it lowers the price to \$100, how large is the price effect? How large is the quantity effect?
- e. Add the marginal cost curve to your diagram from part a and determine which quantity maximizes De Beers's profit and which price De Beers will charge.

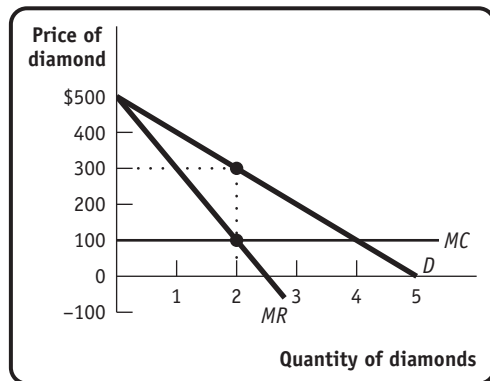
### Solution

5. a. Total revenue (*TR*) and marginal revenue (*MR*) are given in the accompanying table.

Price of diamond	Quantity of diamonds demanded	<i>TR</i>	<i>MR</i>
\$500	0	\$0	
400	1	400	\$400
300	2	600	200
200	3	600	0
100	4	400	-200
0	5	0	-400



The accompanying diagram illustrates De Beers's demand curve and marginal revenue (MR) curve.



- b. De Beers is the only producer of diamonds, so its demand curve is the market demand curve. And the market demand curve slopes downward: the lower the price, the more customers will buy diamonds.
- c. If De Beers lowers the price sufficiently to sell one more diamond, it earns extra revenue equal to the price of that one extra diamond. This is the quantity effect of lowering the price. But there is also a price effect: lowering the price means that De Beers also has to lower the price on all other diamonds, and that lowers its revenue. So the marginal revenue of selling an additional diamond is less than the price at which the additional diamond can be sold.
- d. If the price is \$200, then De Beers sells to Raquel, Jackie, and Joan. If it lowers the price to \$100, it will also sell a diamond to Mia. The price effect is that De Beers loses \$100 (the amount by which it lowered the price) each from selling to Raquel, Jackie, and Joan. So the price effect lowers De Beers's revenue by  $3 \times \$100 = \$300$ . The quantity effect is that De Beers sells one more diamond (to Mia), at \$100. So the quantity effect is to raise De Beers's revenue by \$100.
- e. The marginal cost (MC) curve is constant at \$100, as shown in the diagram. Marginal revenue equals marginal cost at a quantity of 2 diamonds. So De Beers will sell 2 diamonds at a price of \$300 each.

6. Use the demand schedule for diamonds given in Problem 5. The marginal cost of producing diamonds is constant at \$100. There is no fixed cost.
  - a. If De Beers charges the monopoly price, how large is the individual consumer surplus that each buyer experiences? Calculate total consumer surplus by summing the individual consumer surpluses. How large is producer surplus?

Suppose that upstart Russian and Asian producers enter the market and it becomes perfectly competitive.

  - b. What is the perfectly competitive price? What quantity will be sold in this perfectly competitive market?
  - c. At the competitive price and quantity, how large is the consumer surplus that each buyer experiences? How large is total consumer surplus? How large is producer surplus?
  - d. Compare your answer to part c to your answer to part a. How large is the dead-weight loss associated with monopoly in this case?

## Solution

6. a. The monopoly price is \$300. At that price Raquel and Jackie buy diamonds. Raquel's consumer surplus is  $\$400 - \$300 = \$100$ ; Jackie's is  $\$300 - \$300 = \$0$ . So total consumer surplus is  $\$100 + \$0 = \$100$ . Producer surplus is  $\$300 - \$100 = \$200$  for each diamond sold;  $2 \times \$200 = \$400$ .
- b. In a perfectly competitive market,  $P = MC$ . That is, the perfectly competitive price is \$100, and at that price 4 diamonds will be sold—to Raquel, Jackie, Joan, and Mia.
- c. At the competitive price, Raquel's consumer surplus is  $\$400 - \$100 = \$300$ ; Jackie's,  $\$300 - \$100 = \$200$ ; Joan's,  $\$200 - \$100 = \$100$ ; and Mia's,  $\$100 - \$100 = \$0$ . So total consumer surplus is  $\$300 + \$200 + \$100 + \$0 = \$600$ . Since the price is equal to marginal cost, there is no producer surplus.
- d. Under perfect competition, the sum of consumer and producer surplus is  $\$600 + \$0 = \$600$ . Under monopoly, the sum of consumer and producer surplus is  $\$100 + \$400 = \$500$ . So the loss of surplus to society from monopoly—the deadweight loss—is  $\$600 - \$500 = \$100$ .
7. Use the demand schedule for diamonds given in Problem 5. De Beers is a monopolist, but it can now price-discriminate perfectly among all five of its potential customers. De Beers's marginal cost is constant at \$100. There is no fixed cost.
- a. If De Beers can price-discriminate perfectly, to which customers will it sell diamonds and at what prices?
- b. How large is each individual consumer surplus? How large is total consumer surplus? Calculate producer surplus by summing the producer surplus generated by each sale.

## Solution

7. a. If De Beers can price-discriminate perfectly, it will charge each customer that customer's willingness to pay. That is, it will charge Raquel \$400, Jackie \$300, Joan \$200, and Mia \$100. De Beers does not want to sell to Sophia since she will only buy at a price of \$0, and that would be below De Beers's marginal cost.
- b. Since each consumer is charged exactly her willingness to pay, there is no consumer surplus. De Beers's producer surplus is  $\$400 - \$100 = \$300$  from selling to Raquel;  $\$300 - \$100 = \$200$  from selling to Jackie;  $\$200 - \$100 = \$100$  from selling to Joan;  $\$100 - \$100 = \$0$  from selling to Mia. So producer surplus is  $\$300 + \$200 + \$100 + \$0 = \$600$ .
8. Download Records decides to release an album by the group Mary and the Little Lamb. It produces the album with no fixed cost, but the total cost of creating a digital album and paying Mary her royalty is \$6 per album. Download Records can act as a single-price monopolist. Its marketing division finds that the demand schedule for the album is as shown in the accompanying table.

Price of album	Quantity of albums demanded
\$22	0
20	1,000
18	2,000
16	3,000
14	4,000
12	5,000
10	6,000
8	7,000

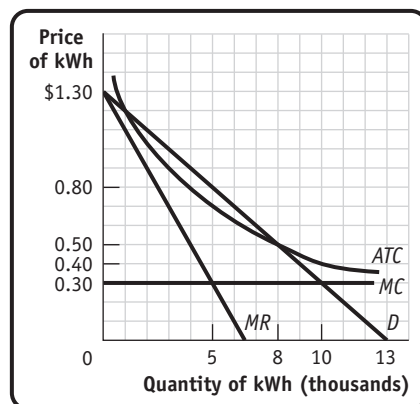
- a. Calculate the total revenue and the marginal revenue per album.
- b. The marginal cost of producing each album is constant at \$6. To maximize profit, what level of output should Download Records choose, and which price should it charge for each album?
- c. Mary renegotiates her contract and will be paid a higher royalty per album. So the marginal cost rises to be constant at \$14. To maximize profit, what level of output should Download Records now choose, and which price should it charge for each album?

### Solution

8. a. Total revenue (*TR*) and marginal revenue per album (*MR*) is shown in the accompanying table.

Price of album	Quantity of albums demanded	<i>TR</i>	<i>MR</i>
\$22	0	\$0	
20	1,000	20,000	\$20
18	2,000	36,000	16
16	3,000	48,000	12
14	4,000	56,000	8
12	5,000	60,000	4
10	6,000	60,000	0
8	7,000	56,000	-4

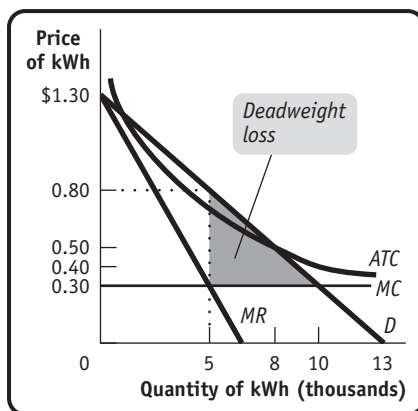
- b. If the marginal cost of each album is \$6, Download Records will maximize profit by producing 4,000 albums, since for each album up to 4,000, marginal revenue is greater than marginal cost. For any further albums, marginal cost would exceed marginal revenue. Producing 4,000 albums, Download Records will charge \$14 for each album.
  - c. If the marginal cost of each album is \$14, Download Records will maximize profit by producing 2,000 albums, and it will charge \$18 per album.
9. This diagram illustrates your local electricity company's natural monopoly. It shows the demand curve for kilowatt-hours (kWh) of electricity, the company's marginal revenue (*MR*) curve, its marginal cost (*MC*) curve, and its average total cost (*ATC*) curve. The government wants to regulate the monopolist by imposing a price ceiling.



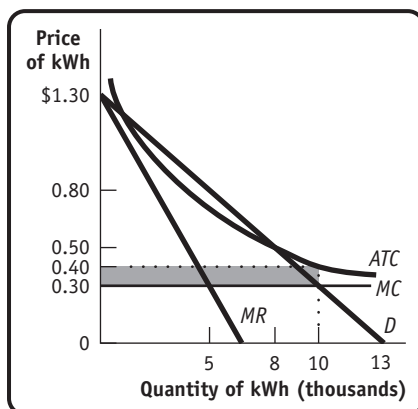
- a. If the government does not regulate this monopolist, which price will it charge? Illustrate the inefficiency this creates by shading the deadweight loss from monopoly.
- b. If the government imposes a price ceiling equal to the marginal cost, \$0.30, will the monopolist make profits or lose money? Shade the area of profit (or loss) for the monopolist. If the government does impose this price ceiling, do you think the firm will continue to produce in the long run?
- c. If the government imposes a price ceiling of \$0.50, will the monopolist make a profit, lose money, or break even?

## Solution

9. a. The monopolist would choose a price of \$0.80. Deadweight loss is shaded and labeled in the accompanying figure.



- b. If the government imposes a price ceiling of \$0.30, the quantity demanded is 10,000. The monopolist will incur a loss equal to the shaded rectangle in the accompanying figure. Since the firm is incurring a loss, in the long run it will exit the market.



- c. If the government imposes a price ceiling of \$0.50, the quantity demanded is 8,000. The price equals the monopolist's average total cost, and so the firm will make zero profit.

- 10.** The Collegetown movie theater serves two kinds of customers: students and professors. There are 900 students and 100 professors in town. Each student's willingness to pay for a movie ticket is \$5. Each professor's willingness to pay for a movie ticket is \$10. Each will buy only one ticket. The movie theater's marginal cost per ticket is constant at \$3, and there is no fixed cost.
- Suppose the movie theater cannot price-discriminate and charges both students and professors the same price per ticket. If the movie theater charges \$5, who will buy tickets and what will the movie theater's profit be? How large is consumer surplus?
  - If the movie theater charges \$10, who will buy movie tickets and what will the movie theater's profit be? How large is consumer surplus?
  - Now suppose that, if it chooses to, the movie theater can price-discriminate between students and professors by requiring students to show their student ID. If the movie theater charges students \$5 and professors \$10, how much profit will the movie theater make? How large is consumer surplus?

### Solution

- 10.**
- If the movie theater charges \$5 per ticket, both students and professors will buy tickets. The movie theater will sell to 1,000 customers (students and professors), at a price of \$5 each. Since the movie theater's cost per ticket is \$3, its profit is \$2 per ticket for a total profit of  $1,000 \times \$2 = \$2,000$ . Students will experience no consumer surplus, but each of the 100 professors will experience consumer surplus of  $\$10 - \$5 = \$5$  for a total consumer surplus of  $100 \times \$5 = \$500$ .
  - If the movie theater charges \$10 per ticket, only professors will buy tickets. The movie theater will sell to 100 customers (professors) at a price of \$10 each. Since the movie theater's cost per ticket is \$3, its profit is \$7 per ticket for a total profit of  $100 \times \$7 = \$700$ . Students experience no consumer surplus since they do not buy any tickets. Each of the 100 professors experiences no consumer surplus since the price is equal to their willingness to pay. So consumer surplus is \$0.
  - If the movie theater charges students a price of \$5, it sells 900 tickets at a profit of  $\$5 - \$3 = \$2$  each for a profit from selling to students of  $900 \times \$2 = \$1,800$ . Charging professors \$10, it sells 100 tickets at a profit of  $\$10 - \$3 = \$7$  each for a profit from selling to professors of  $100 \times \$7 = \$700$ . So the theater's total profit is  $\$1,800 + \$700 = \$2,500$ . Since each customer is charged exactly his or her willingness to pay, there is no consumer surplus.
- 11.** A monopolist knows that in order to expand the quantity of output it produces from 8 to 9 units it must lower the price of its output from \$2 to \$1. Calculate the quantity effect and the price effect. Use these results to calculate the monopolist's marginal revenue of producing the 9th unit. The marginal cost of producing the 9th unit is positive. Is it a good idea for the monopolist to produce the 9th unit?

### Solution

- 11.** The quantity effect is \$1 (the increase in total revenue from selling the 9th unit at \$1). The price effect is  $8 \times (-\$1) = -\$8$  (the decrease in total revenue from having to lower the price of 8 units by \$1 each). So the marginal revenue of producing the 9th unit is  $\$1 - \$8 = -\$7$ . Since marginal revenue is negative, producing the 9th unit is definitely not a good idea: it lowers revenue (since marginal revenue is negative) and increases the total cost (since marginal cost is positive). So it will definitely lower profit. Instead, the monopolist should produce less output.

- 12.** In the United States, the Federal Trade Commission (FTC) is charged with promoting competition and challenging mergers that would likely lead to higher prices. Several years ago, Staples and Office Depot, two of the largest office supply superstores, announced their agreement to merge.
- Some critics of the merger argued that, in many parts of the country, a merger between the two companies would create a monopoly in the office supply superstore market. Based on the FTC's argument and its mission to challenge mergers that would likely lead to higher prices, do you think it allowed the merger?
  - Staples and Office Depot argued that, while in some parts of the country they might create a monopoly in the office supply superstore market, the FTC should consider the larger market for all office supplies, which includes many smaller stores that sell office supplies (such as grocery stores and other retailers). In that market, Staples and Office Depot would face competition from many other, smaller stores. If the market for all office supplies is the relevant market that the FTC should consider, would it make the FTC more or less likely to allow the merger?

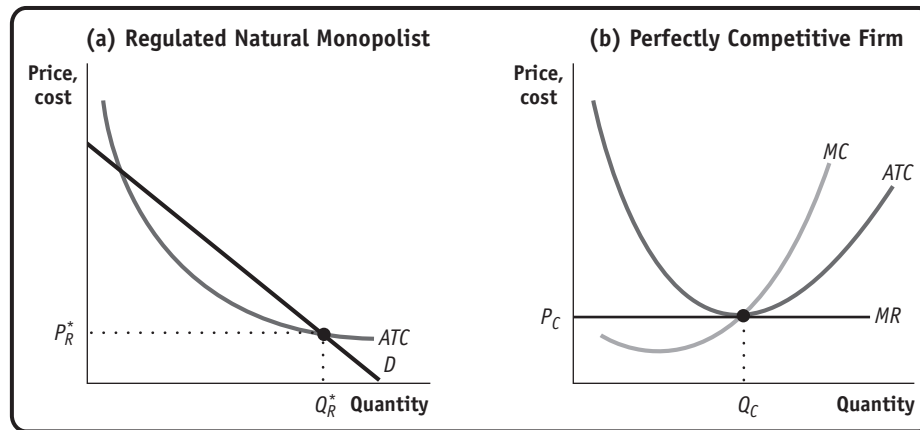
### Solution

- 12.**
- If Staples and Office Depot create a monopoly, they will be able to reduce the quantity of output and raise prices, which would create inefficiency in the form of deadweight loss. Since the FTC is charged with challenging mergers that would likely lead to higher prices, you should think that the FTC would not allow this merger. And, in fact, in a court ruling in 1997, the FTC was able to prevent the merger.
  - If the relevant market is the market for all office supplies, the merger between Staples and Office Depot would not create a monopoly, and the companies would not be able to raise prices to the same extent. If this were the relevant market, it would make the FTC more likely to allow the merger. This illustrates the importance of what economists call "market definition"—deciding what the correct market is: in this example, the office supply superstore market or the market for all office supplies.
- 13.** Prior to the late 1990s, the same company that generated your electricity also distributed it to you over high-voltage lines. Since then, 16 states and the District of Columbia have begun separating the generation from the distribution of electricity, allowing competition between electricity generators and between electricity distributors.
- Assume that the market for electricity distribution was and remains a natural monopoly. Use a graph to illustrate the market for electricity distribution if the government sets price equal to average total cost.
  - Assume that deregulation of electricity generation creates a perfectly competitive market. Also assume that electricity generation does not exhibit the characteristics of a natural monopoly. Use a graph to illustrate the cost curves in the long-run equilibrium for an individual firm in this industry.

### Solution

- 13.**
- The market for electricity distribution is shown in panel (a) of the accompanying diagram. Electricity distribution has the characteristics of a natural monopoly: the large fixed cost of building the electric grid, combined with the low marginal cost of routing electricity over the grid, give this industry increasing returns to scale over the relevant output range. If the government sets the price equal to average total cost, at  $P_R^*$ , the natural monopolist will produce quantity  $Q_R^*$ . In this case, the monopolist will make zero economic profit.

- b. The cost curves of an individual electricity generator are shown in panel (b). Since the market is perfectly competitive, in the long run, price,  $P_C$ , will be equal to minimum average total cost, and the individual generator will produce electricity at the quantity  $Q_C$ , where marginal cost is just equal to the market price.



14. Explain the following situations.
- In Europe, many cell phone service providers give away for free what would otherwise be very expensive cell phones when a service contract is purchased. Why might a company want to do that?
  - In the United Kingdom, the country's antitrust authority prohibited the cell phone service provider Vodaphone from offering a plan that gave customers free calls to other Vodaphone customers. Why might Vodaphone have wanted to offer these calls for free? Why might a government want to step in and ban this practice? Why might it not be a good idea for a government to interfere in this way?

- Solution**
14. a. Cell phone service is a good characterized by network externalities: the more people you can reach while they are away from their fixed-line phones, the greater your utility from having a phone that allows you to reach others when you are also away from your fixed-line phone. This is an industry that exhibits positive feedback: once the market reaches critical mass, the number of cell phones in use increases rapidly. So if a company gives away phones for free (or below cost), it can attract more customers and the market reaches critical mass more quickly.
- b. By offering free calls to other Vodaphone subscribers, the company was attempting to tip the market and attract customers to its service. This can be seen as an anti-competitive practice that leads to monopolization, which is why a government might want to ban the practice. However, banning Vodaphone from creating and exploiting its monopoly position might stifle the company's incentive to innovate and invent new services (such as text messaging, transmission of pictures by phone, and so on).

15. The 2014 announcement that Time Warner Cable and Comcast intended to merge prompted questions of monopoly because the combined company would supply cable access to an overwhelming majority of Americans. It also raised questions of monopsony since the combined company would be virtually the only purchaser of programming for broadcast shows. Assume the merger occurs: in each of the following, determine whether it is evidence of monopoly, monopsony, or neither.
- The monthly cable fee for consumers increases significantly more than the increase in the cost of producing and delivering programs over cable.
  - Companies that advertise on cable TV find that they must pay higher rates for advertising.

- c. Companies that produce broadcast shows find they must produce more shows for the same amount they were paid before.
- d. Consumers find that there are more shows available for the same monthly cable fee.

**Solution**

15. a. This is evidence of monopoly power by the combined cable company. It is capturing surplus from consumers by raising prices higher than an increase in the cost of production.
- b. This is evidence of monopoly power by the combined cable company. Companies that purchase cable advertising are consumers of cable airtime. They are losing surplus by being forced to pay higher prices.
- c. This is evidence of monopsony power by the combined cable company. The production companies have only one buyer of their goods, the combined cable company. The cable company is capturing surplus by paying the production company a lower price per show.
- d. This is evidence of neither monopoly or monopsony. Consumers are enjoying more surplus because there is more product available for the same price.

16. Walmart is the world's largest retailer. As a consequence, it has sufficient bargaining power to push its suppliers to lower their prices so it can honor its slogan of "Always Low Prices" for its customers.
- a. Is Walmart acting like a monopolist or monopsonist when purchasing goods from suppliers? Explain.
  - b. How does Walmart affect the consumer surplus of its customers? The producer surplus of its suppliers?
  - c. Over time, what is likely to happen to the quality of products produced by Walmart suppliers?

**Solution**

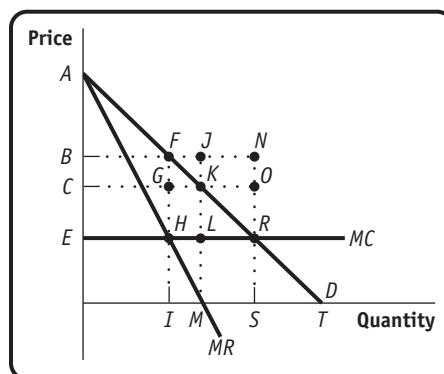
16. a. Walmart is acting like a monopsonist. It behaves like a sole buyer with its suppliers, compelling them to lower their prices to Walmart.
- b. Walmart increases the consumer surplus to its customers because they are able to purchase goods at lower prices. It lowers the producer surplus going to its suppliers as they are required to sell at a lower price.
- c. Over time the quality of products produced by Walmart suppliers is likely to decline as the suppliers are getting insufficient surplus to maintain quality.

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17. Consider an industry with the demand curve (D) and marginal cost curve (MC) shown in the accompanying diagram. There is no fixed cost. If the industry is a single-price monopoly, the monopolist's marginal revenue curve would be MR. Answer the following questions by naming the appropriate points or areas.





- a. If the industry is perfectly competitive, what will be the total quantity produced? At what price?
- b. Which area reflects consumer surplus under perfect competition?
- c. If the industry is a single-price monopoly, what quantity will the monopolist produce? Which price will it charge?
- d. Which area reflects the single-price monopolist's profit?
- e. Which area reflects consumer surplus under single-price monopoly?
- f. Which area reflects the deadweight loss to society from single-price monopoly?
- g. If the monopolist can price-discriminate perfectly, what quantity will the perfectly price-discriminating monopolist produce?

### Solution

17. a. In a perfectly competitive industry, each firm maximizes profit by producing the quantity at which price equals marginal cost. That is, all firms together produce a quantity  $S$ , corresponding to point  $R$ , where the marginal cost curve crosses the demand curve. Price will be equal to marginal cost,  $E$ .
- b. Consumer surplus is the area under the demand curve and above price. In part a, we saw that the perfectly competitive price is  $E$ . Consumer surplus in perfect competition is therefore the triangle  $ARE$ .
- c. A single-price monopolist produces the quantity at which marginal cost equals marginal revenue, that is, quantity  $I$ . Accordingly, the monopolist charges price  $B$ , the highest price it can charge if it wants to sell quantity  $I$ .
- d. The single-price monopolist's profit per unit is the difference between price and the average total cost. Since there is no fixed cost and the marginal cost is constant (each unit costs the same to produce), the marginal cost is the same as the average total cost. That is, profit per unit is the distance  $BE$ . Since the monopolist sells  $I$  units, its profit is  $BE$  times  $I$ , or the rectangle  $BEHF$ .
- e. Consumer surplus is the area under the demand curve and above the price. In part c, we saw that the monopoly price is  $B$ . Consumer surplus in monopoly is therefore the triangle  $AFB$ .
- f. Deadweight loss is the surplus that would have been available (either to consumers or producers) under perfect competition but that is lost when there is a single-price monopolist. It is the triangle  $FRH$ .
- g. If a monopolist can price-discriminate perfectly, it will sell the first unit at price  $A$ , the second unit at a slightly lower price, and so forth. That is, it will extract from each consumer just that consumer's willingness to pay, as indicated by the demand curve. It will sell  $S$  units, because for the last unit, it can just make a consumer pay a price of  $E$  (equal to its marginal cost), and that just covers its marginal cost of producing that last unit. For any further units, it could not make any consumer pay more than its marginal cost, and it therefore stops selling units at quantity  $S$ .



# Oligopoly

1. The accompanying table presents market share data for the U.S. breakfast cereal market.

Company	Market Share
Kellogg	28%
General Mills	28
PepsiCo (Quaker Oats)	14
Kraft	13
Private Label	11
Other	6

Source: Advertising Age

- a. Use the data provided to calculate the Herfindahl–Hirschman Index (HHI) for the market.  
b. Based on this HHI, what type of market structure is the U.S. breakfast cereal market?

## Solution

1. a. The HHI is  $28^2 + 28^2 + 14^2 + 13^2 + 11^2 + 6^2 = 900 + 676 + 196 + 169 + 121 + 36 = 2098$ .  
b. Since the HHI is less than 2,500, the industry is somewhat competitive.
2. The accompanying table shows the demand schedule for vitamin D. Suppose that the marginal cost of producing vitamin D is zero.

Price of vitamin D (per ton)	Quantity of vitamin D demanded (tons)
\$8	0
7	10
6	20
5	30
4	40
3	50
2	60
1	70

- a. Assume that BASF is the only producer of vitamin D and acts as a monopolist. It currently produces 40 tons of vitamin D at \$4 per ton. If BASF were to produce 10 more tons, what would be the price effect for BASF? What would be the quantity effect? Would BASF have an incentive to produce those 10 additional tons?

- b. Now assume that Roche enters the market by also producing vitamin D and the market is now a duopoly. BASF and Roche agree to produce 40 tons of vitamin D in total, 20 tons each. BASF cannot be punished for deviating from the agreement with Roche. If BASF, on its own, were to deviate from that agreement and produce 10 more tons, what would be the price effect for BASF? What would be the quantity effect for BASF? Would BASF have an incentive to produce those 10 additional tons?

## Solution

2. a. If BASF produces 10 more tons, it now produces 50 tons and the price would fall to \$3 per ton. That is, on each of the 40 tons it was already producing, it would lose \$1. So the price effect is  $40 \times (-\$1) = -\$40$ . Since BASF produces an additional 10 tons and sells them at \$3, the quantity effect is  $10 \times \$3 = \$30$ . So BASF gains \$30 revenue from producing 10 additional tons, but it loses \$40 revenue from producing those 10 additional tons. Since the marginal cost is zero, additional production does not change BASF's cost. Since BASF loses revenue, it has no incentive to produce the 10 additional tons.
- b. If BASF produces 10 more tons, the total produced is now 50 tons and the price would fall to \$3. That is, on each of the 20 tons it was already producing, it would lose \$1. So the price effect is  $20 \times (-\$1) = -\$20$ . Since BASF produces an additional 10 tons and sells them at \$3, the quantity effect is  $10 \times \$3 = \$30$ . So BASF gains \$30 revenue from producing 10 additional tons, and it loses only \$20 revenue, resulting in an overall increase in revenue of \$10. Since the marginal cost is zero, there is no change to BASF's cost. Since producing the 10 additional tons raises BASF's revenue by \$10, BASF does have an incentive to produce 10 additional tons.
3. The market for olive oil in New York City is controlled by two families, the Sopranos and the Contraltos. Both families will ruthlessly eliminate any other family that attempts to enter the New York City olive oil market. The marginal cost of producing olive oil is constant and equal to \$40 per gallon. There is no fixed cost. The accompanying table gives the market demand schedule for olive oil.

Price of olive oil (per gallon)	Quantity of olive oil demanded (gallons)
\$100	1,000
90	1,500
80	2,000
70	2,500
60	3,000
50	3,500
40	4,000
30	4,500
20	5,000
10	5,500

- a. Suppose the Sopranos and the Contraltos form a cartel. For each of the quantities given in the table, calculate the total revenue for their cartel and the marginal revenue for each additional gallon. How many gallons of olive oil would the cartel sell in total and at what price? The two families share the market equally (each produces half of the total output of the cartel). How much profit does each family make?

- b. Uncle Junior, the head of the Soprano family, breaks the agreement and sells 500 more gallons of olive oil than under the cartel agreement. Assuming the Contraltos maintain the agreement, how does this affect the price for olive oil and the profits earned by each family?
- c. Anthony Contralto, the head of the Contralto family, decides to punish Uncle Junior by increasing his sales by 500 gallons as well. How much profit does each family earn now?

### Solution

3. a. The accompanying table shows the total revenue and the marginal revenue for the cartel. Since a cartel acts like a monopolist, it will maximize profit by producing up to the point where marginal cost equals marginal revenue. For all gallons up to 2,000 gallons, marginal revenue is greater than marginal cost. Producing any more would mean that marginal revenue is less than marginal cost. So the cartel will produce 2,000 gallons and sell them at \$80 each. Since the two families share the market equally, each family has revenue of  $1,000 \times \$80 = \$80,000$ . The marginal cost per gallon is constant at \$40, so the total cost (remember there is no fixed cost!) of producing 1,000 gallons is \$40,000. So each family makes a profit of  $\$80,000 - \$40,000 = \$40,000$ .

Price of olive oil (per gallon)	Quantity of olive oil demanded (gallons)	Total revenue	Marginal revenue
\$100	1,000	\$100,000	
			\$70
90	1,500	135,000	
			50
80	2,000	160,000	
			30
70	2,500	175,000	
			10
60	3,000	180,000	
			-10
50	3,500	175,000	
			-30
40	4,000	160,000	
			-50
30	4,500	135,000	
			-70
20	5,000	100,000	
			-90
10	5,500	55,000	

b. Now the Sopranos sell 1,500 gallons and the Contraltos sell 1,000 gallons, for a total output of 2,500 gallons. So the price falls to \$70 per gallon. The Sopranos have revenue of  $1,500 \times \$70 = \$105,000$  and cost of  $1,500 \times \$40 = \$60,000$ . So their profit is  $\$105,000 - \$60,000 = \$45,000$ . The Contraltos have revenue of  $1,000 \times \$70 = \$70,000$  and cost of  $1,000 \times \$40 = \$40,000$ . So their profit is  $\$70,000 - \$40,000 = \$30,000$ .

- c. If both the Contraltos and the Sopranos sell 1,500 gallons each, the total output in this duopoly is 3,000 gallons, and the price falls to \$60 per gallon. Each family has revenue of  $1,500 \times \$60 = \$90,000$  and cost of  $1,500 \times \$40 = \$60,000$ . So each family's profit is \$30,000.
4. In France, the market for bottled water is controlled by two large firms, Perrier and Evian. Each firm has a fixed cost of €1 million and a constant marginal cost of €2 per liter of bottled water (€1 = 1 euro). The following table gives the market demand schedule for bottled water in France.

Price of bottled water (per liter)	Quantity of bottled water demanded (millions of liters)
€10	0
9	1
8	2
7	3
6	4
5	5
4	6
3	7
2	8
1	9

- a. Suppose the two firms form a cartel and act as a monopolist. Calculate marginal revenue for the cartel. What will the monopoly price and output be? Assuming the firms divide the output evenly, how much will each produce and what will each firm's profits be?
- b. Now suppose Perrier decides to increase production by 1 million liters. Evian doesn't change its production. What will the new market price and output be? What is Perrier's profit? What is Evian's profit?
- c. What if Perrier increases production by 3 million liters? Evian doesn't change its production. What would its output and profits be relative to those in part b?
- d. What do your results tell you about the likelihood of cheating on such agreements?

## Solution

4. a. The accompanying table calculates total revenue and marginal revenue for the cartel. The cartel maximizes profit by producing whenever marginal revenue is greater than marginal cost (which here is €2). That is, the cartel produces a quantity of 4 million liters and sells them at a price of €6 per liter. If the firms divide production equally, each produces 2 million liters and has revenue of 2 million × €6 = €12 million. Since the fixed cost is €1 million and each liter's marginal cost is €2, each firm has profit of €12 million – €1 million – (2 million × €2) = €7 million.

Price of bottled water (per liter)	Quantity of bottled water demanded (millions of liters)	Total revenue (millions)	Marginal revenue (millions)
€10	0	€0	
			€9
9	1	9	7
8	2	16	5
7	3	21	3
6	4	24	1
5	5	25	-1
4	6	24	-3
3	7	21	-5
2	8	16	-7
1	9	9	

- b. If Perrier increases production by 1 million liters, the total produced now is 5 million liters and the price is €5. Perrier now produces 3 million liters and so has profit of (3 million × €5) – €1 – (3 million × €2) = €8 million. Evian's profit, however, falls to (2 million × €5) – €1 million – (2 million × €2) = €5.
- c. If Perrier increases production by 3 million liters, the total produced is 7 million liters and the price is €3. Perrier produces 5 million liters and so has profit of (5 million × €3) – €1 million – (5 million × €2) = €4 million. This profit is lower than in part b. This implies that although Perrier has an incentive to increase production somewhat, it does not have an incentive to increase production dramatically.
- d. Since each firm can significantly increase its profit by moderately increasing production, the likelihood of cheating is high.

5. Suppose that the fisheries agreement in Problem 5 breaks down, so that the fleets behave noncooperatively. Assume that the United States and the EU each can send out either one or two fleets. The more fleets in the area, the more fish they catch in total but the lower the catch of each fleet. The accompanying matrix shows the profit (in dollars) per week earned by the two sides.

		EU	
		1 fleet	2 fleets
U.S.	1 fleet	\$10,000 profit \$10,000 profit	\$12,000 profit \$4,000 profit
	2 fleets	\$4,000 profit \$12,000 profit	\$7,500 profit \$7,500 profit

- a. What is the noncooperative Nash equilibrium? Will each side choose to send out one or two fleets?
- b. Suppose that the fish stocks are being depleted. Each region considers the future and comes to a tit-for-tat agreement whereby each side will send only one fleet out as long as the other does the same. If either of them breaks the agreement and sends out a second fleet, the other will also send out two and will continue to do so until its competitor sends out only one fleet. If both play this tit-for-tat strategy, how much profit will each make every week?

## Solution

5. a. If the European Union has only one fleet, the United States will have a higher profit if it sends out two fleets (\$12,000 rather than \$10,000). If the EU sends out two fleets, the United States will have a higher profit if it also sends out two fleets (\$7,500 rather than \$4,000). The same reasoning will persuade the EU that its best strategy is also to send out two fleets whether the United States sends out one or two. Both parties will send out two fleets, each earning only \$7,500 each instead of the \$10,000 they would each have earned if they had each limited themselves to one fleet.
- b. If both play a tit-for-tat strategy, they each will begin by sending out one fleet. The week after that, each does what the other one did the week before—that is, each again sends out one fleet, and so on. As a result, the United States and the EU will each have a profit of \$10,000 every week.



6. Untied and Air “R” Us are the only two airlines operating flights between Collegetown and Bigtown. That is, they operate in a duopoly. Each airline can charge either a high price or a low price for a ticket. The accompanying matrix shows their payoffs, in profits per seat (in dollars), for any choice that the two airlines can make.

		Air “R” Us	
		Low price	High price
Untied	Low price	\$20 profit \$20 profit	\$0 profit \$50 profit
	High price	\$50 profit \$0 profit	\$40 profit \$40 profit

- a. Suppose the two airlines play a one-shot game—that is, they interact only once and never again. What will be the Nash (noncooperative) equilibrium in this one-shot game?
- b. Now suppose the two airlines play this game twice. And suppose each airline can play one of two strategies: it can play either always charge the low price or tit for tat—that is, it starts off charging the high price in the first period, and then in the second period it does whatever the other airline did in the previous period. Write down the payoffs to Untied from the following four possibilities:
- Untied plays always charge the low price when Air “R” Us also plays always charge the low price.
  - Untied plays always charge the low price when Air “R” Us plays tit for tat.
  - Untied plays tit for tat when Air “R” Us plays always charge the low price.
  - Untied plays tit for tat when Air “R” Us also plays tit for tat.

## Solution

6. a. This is a prisoners’ dilemma situation. Whatever Air “R” Us does, it is best for Untied to charge the low price; whatever Untied does, it is best for Air “R” Us to charge the low price. So the Nash (noncooperative) equilibrium is for both airlines to charge the low price.
- b. These are Untied’s payoffs:
- Both airlines charge the low price in both periods, so Untied’s payoffs are \$20 in the first period and \$20 in the second period, for a total of  $\$20 + \$20 = \$40$ .
  - In the first period, Untied charges the low price and Air “R” Us charges the high price for a payoff to Untied of \$50. In the second period, Untied and Air “R” Us both charge the low price for a payoff to Untied of \$20. Untied’s payoffs are therefore  $\$50 + \$20 = \$70$ .
  - In the first period, Untied charges the high price and Air “R” Us charges the low price for a payoff to Untied of \$0. In the second period, both airlines charge the low price for a payoff to Untied of \$20. Untied’s total payoff is therefore  $\$0 + \$20 = \$20$ .
  - Both airlines charge the high price in both periods, so Untied’s payoffs are \$40 in both periods, for a total of  $\$40 + \$40 = \$80$ .

- 7.** Suppose that Coke and Pepsi are the only two producers of cola drinks, making them duopolists. Both companies have zero marginal cost and a fixed cost of \$100,000.
- Assume first that consumers regard Coke and Pepsi as perfect substitutes. Currently both are sold for \$0.20 per can, and at that price each company sells 4 million cans per day.
    - How large is Pepsi's profit?
    - If Pepsi were to raise its price to \$0.30 per can, and Coke does not respond, what would happen to Pepsi's profit?
  - Now suppose that each company advertises to differentiate its product from the other company's. As a result of advertising, Pepsi realizes that if it raises or lowers its price, it will sell less or more of its product, as shown by the demand schedule in the accompanying table.

Price of Pepsi (per can)	Quantity of Pepsi demanded (millions of cans)
\$0.10	5
0.20	4
0.30	3
0.40	2
0.50	1

If Pepsi now were to raise its price to \$0.30 per can, what would happen to its profit?

- Comparing your answer to part a(i) and to part b, what is the maximum amount Pepsi would be willing to spend on advertising?

## Solution

- 7. a. i.** Pepsi sells 4 million cans at \$0.20 for total revenue of  $\$0.20 \times 4 \text{ million} = \$800,000$ . Its only cost is the fixed cost of \$100,000, so its profit is  $\$800,000 - \$100,000 = \$700,000$ .
- ii.** If Pepsi were to raise its price, it would lose all its customers. This is because customers regard Coke and Pepsi as identical products and so will buy none of the product that is more expensive. So Pepsi loses money, its fixed cost: its loss will be \$100,000.
- b.** If Pepsi now raises its price to \$0.30, it will lose some customers but not all customers. It will sell 3 million cans at a price of \$0.30 per can and so have total revenue of  $\$0.30 \times 3 \text{ million} = \$900,000$ . Since its only cost is the fixed cost, Pepsi's profit is  $\$900,000 - \$100,000 = \$800,000$ .
- c.** Since Pepsi can raise its revenue by \$100,000 (from \$700,000 without advertising to \$800,000 with advertising), it should be willing to spend at most \$100,000 on an advertising campaign.

8. Philip Morris and R.J. Reynolds spend huge sums of money each year to advertise their tobacco products in an attempt to steal customers from each other. Suppose each year Philip Morris and R.J. Reynolds have to decide whether or not they want to spend money on advertising. If neither firm advertises, each will earn a profit of \$2 million. If they both advertise, each will earn a profit of \$1.5 million. If one firm advertises and the other does not, the firm that advertises will earn a profit of \$2.8 million and the other firm will earn \$1 million.
- Use a payoff matrix to depict this problem.
  - Suppose Philip Morris and R.J. Reynolds can write an enforceable contract about what they will do. What is the cooperative solution to this game?
  - What is the Nash equilibrium without an enforceable contract? Explain why this is the likely outcome.

## Solution

8. a. See the accompanying payoff matrix.

		R.J. Reynolds	
		Advertise	Do not advertise
Philip Morris	Advertise	\$1.5 million profit / \$1.5 million profit	\$2.8 million profit / \$1 million profit
	Do not advertise	\$1 million profit / \$2.8 million profit	\$2 million profit / \$2 million profit

- Each firm should not advertise, since this would maximize joint profits. Each firm then earns a profit of \$2 million.
  - Each firm will consider what its best action is depending on the action of the other firm. If R.J. Reynolds advertises, Philip Morris should as well, since it will earn \$1.5 million instead of \$1 million. If R.J. Reynolds does not advertise, Philip Morris should advertise, since \$2.8 million is better than \$2 million. So no matter what R.J. Reynolds does, the best action for Philip Morris is to advertise. The same logic applies to R.J. Reynolds. As a result, each firm will advertise, yielding profit of \$1.5 million for each firm. This is a prisoners' dilemma situation.
9. Over the last 40 years the Organization of Petroleum Exporting Countries (OPEC) has had varied success in forming and maintaining its cartel agreements. Explain how the following factors may contribute to the difficulty of forming and/or maintaining its price and output agreements.
- New oil fields are discovered and increased drilling is undertaken in the Gulf of Mexico and the North Sea by nonmembers of OPEC.
  - Crude oil is a product that is differentiated by sulfur content: it costs less to refine low-sulfur crude oil into gasoline. Different OPEC countries possess oil reserves of different sulfur content.
  - Cars powered by hydrogen are developed.

## Solution

- 9.**
- With the discovery of new oil by nonmembers of OPEC, there is increased competition. This will lead to a fall in market price and make the cartel agreement harder to maintain.
  - The OPEC countries sell a differentiated and complex product. This complicates the decision about what prices to set for what types of oil and makes enforcement of a cartel agreement more difficult. Much of the conflict within OPEC rests on the price differential that is set between high- and low-quality oils.
  - The development of a hydrogen-powered car would make it more difficult to form or maintain an agreement. Remember that a cartel essentially acts like a monopoly. A cartel's (or a monopoly's) market power is eroded if there is entry of new firms or the development of substitute products.
- 10.** Suppose you are an economist working for the Antitrust Division of the Department of Justice. In each of the following cases you are given the task of determining whether the behavior warrants an antitrust investigation for possible illegal acts or is just an example of undesirable, but not illegal, tacit collusion. Explain your reasoning.
- Two companies dominate the industry for industrial lasers. Several people sit on the boards of directors of both companies.
  - Three banks dominate the market for banking in a given state. Their profits have been going up recently as they add new fees for customer transactions. Advertising among the banks is fierce, and new branches are springing up in many locations.
  - The two oil companies that produce most of the petroleum for the western half of the United States have decided to forgo building their own pipelines and to share a common pipeline, the only means of transporting petroleum products to that market.
  - The two major companies that dominate the market for herbal supplements have each created a subsidiary that sells the same product as the parent company in large quantities but with a generic name.
  - The two largest credit card companies, Passport and OmniCard, have required all retailers who accept their cards to agree to limit their use of rival credit cards.

## Solution

- 10.**
- This warrants an antitrust investigation because it is likely that having the same set of people sit on the two boards will facilitate cartel-like behavior.
  - This does not warrant an antitrust investigation. The intensity of advertising and competition by location indicates that the banks are engaged in nonprice competition.
  - This warrants an antitrust investigation. By using the same pipeline, each company can monitor how much output the other is producing. This facilitates cartel-like behavior.
  - This does not warrant an antitrust investigation. These two companies are actively competing, albeit by using their subsidiaries.
  - This warrants an antitrust investigation. These two companies are acting together to shut out a rival.

- 11.** To preserve the North Atlantic fish stocks, it is decided that only two fishing fleets, one from the United States and the other from the European Union (EU), can fish in those waters. The accompanying table shows the market demand schedule per week for fish from these waters. The only costs are fixed costs, so fishing fleets maximize profit by maximizing revenue.

Price of fish (per pound)	Quantity of fish demanded (pounds)
\$17	1,800
16	2,000
15	2,100
14	2,200
12	2,300

- If both fishing fleets collude, what is the revenue-maximizing output for the North Atlantic fishery? What price will a pound of fish sell for?
- If both fishing fleets collude and share the output equally, what is the revenue to the EU fleet? To the U.S. fleet?
- Suppose the EU fleet cheats by expanding its own catch by 100 pounds per week. The U.S. fleet doesn't change its catch. What is the revenue to the U.S. fleet? To the EU fleet?
- In retaliation for the cheating by the EU fleet, the U.S. fleet also expands its catch by 100 pounds per week. What is the revenue to the U.S. fleet? To the EU fleet?

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**Solution**

- 11. a.** The accompanying table calculates the total revenue for the entire North Atlantic fishery for different output quantities. The revenue-maximizing output is 2,000 pounds per week, which will fetch a price of \$16 per pound.

Price of fish (per pound)	Quantity of fish demanded (pounds)	Total revenue
\$17	1,800	\$30,600
16	2,000	32,000
15	2,100	31,500
14	2,200	30,800
12	2,300	27,600

- If they share the output equally, the U.S. and the EU fleets will each catch 1,000 pounds per week and have revenue of \$16,000 per week.
- If the EU fleet cheats and catches 100 pounds more, the total caught will be 2,100 pounds, which will cause the price to fall to \$15. The EU fleet's revenue will now be  $1,100 \times \$15 = \$16,500$ , and the U.S. fleet's revenue will fall to  $1,000 \times \$15 = \$15,000$ .
- Now the total caught will be 2,200 pounds, which will bring the price down to \$14 per pound. Since each fleet now catches 1,100 pounds, each will have revenue of  $1,100 \times \$14 = \$15,400$ .



# Monopolistic Competition and Product Differentiation

1. Use the three conditions for monopolistic competition discussed in the chapter to decide which of the following firms are likely to be operating as monopolistic competitors. If they are not monopolistically competitive firms, are they monopolists, oligopolists, or perfectly competitive firms?
  - a. A local band that plays for weddings, parties, and so on
  - b. Minute Maid, a producer of individual-serving juice boxes
  - c. Your local dry cleaner
  - d. A farmer who produces soybeans

## Solution

1. The three conditions for monopolistic competition are (1) a large number of producers, (2) differentiated products, and (3) free entry and exit.
  - a. There are many bands that play at weddings, parties, and so on. There are no significant barriers to entry or exit. And products are differentiated by quality (for instance, some bands have better musicians or better electronic equipment) or by style (for instance, different bands play different types of music). All three conditions for monopolistic competition are fulfilled.
  - b. The industry for individual-serving juice boxes is dominated by a few very large firms (for example, Minute Maid, Welch's, and Kool Aid), and there are significant barriers to entry, in part because of the large costs (for example, advertising) involved in gaining any market share of the national market. Products are, however, differentiated—in some cases, the only differences are in the minds of consumers. Because of the small number of competitors, the industry is closer to oligopoly.
  - c. There are a large number of dry cleaners, and each produces a product differentiated by location: customers are likely to prefer to use the dry cleaner closest to their home or workplace. Finally, there are no significant barriers to entry. This is a monopolistically competitive market.
  - d. There are a large number of soybean farmers, and there is free entry and exit in this industry. However, soybeans are not differentiated from each other—they are a standardized product. No individual soybean farmer has market power. This industry is therefore a perfectly competitive industry.
2. You are thinking of setting up a coffee shop. The market structure for coffee shops is monopolistic competition. There are three Starbucks shops and two other coffee shops very much like Starbucks in your town already. In order for you to have some degree of market power, you may want to differentiate your coffee shop. Thinking about the three different ways in which products can be differentiated, explain how you would decide whether you should copy Starbucks or whether you should sell coffee in a completely different way.

## Solution

2. There are three ways in which you can differentiate your product: by style or type, by location, and by quality.

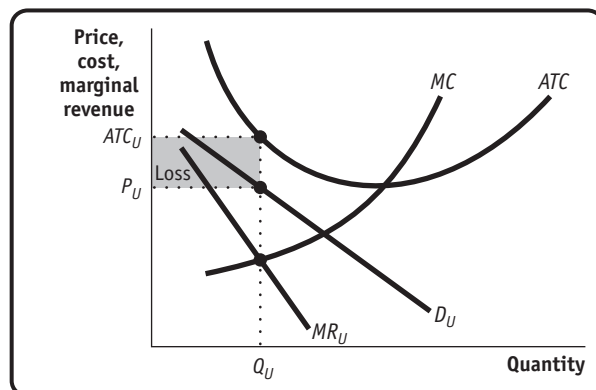
If you decide to copy Starbucks both in style (for example, you copy the décor of the shop and the service) and in quality (for example, you serve coffee made from the same coffee beans, brewed in exactly the same way), you will still most likely differentiate your product by location: your coffee shop will be closer for some people than any of the other shops, and that gives you some degree of market power.

But you could further differentiate your product by style (for example, you could serve coffee in porcelain cups brought to the table by waiters) or by quality (for example, you could serve only organic, shade-grown coffee). All these will help you create a differentiated product that gives you more market power—that is, the power to raise prices. You would, of course, need to determine whether it allows you to raise prices sufficiently to cover the cost of paying for waiters and higher-quality coffee.

3. The market structure of the local gas station industry is monopolistic competition. Suppose that currently each gas station incurs a loss. Draw a diagram for a typical gas station to show this short-run situation. Then, in a separate diagram, show what will happen to the typical gas station in the long run. Explain your reasoning.

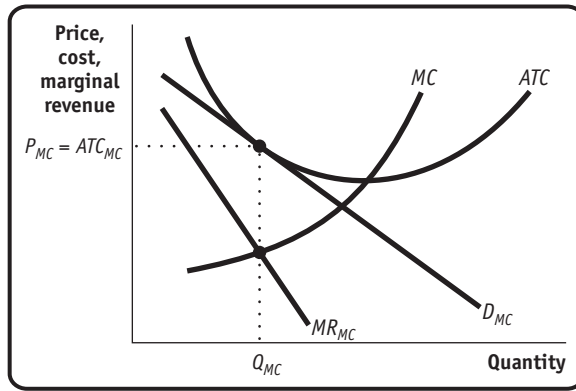
## Solution

3. Each gas station will produce the output, and so charge the price, that maximizes its profit or minimizes its loss. That is, it will produce quantity  $Q_U$ , where marginal cost equals marginal revenue, and so charge price  $P_U$ . Since the price  $P_U$  is lower than average total cost at the quantity  $Q_U$ ,  $ATC_U$ , each gas station incurs a loss. That is, the situation for the typical gas station looks like the accompanying diagram.





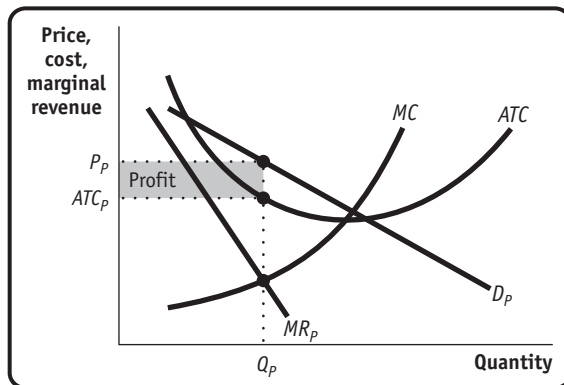
Since gas stations are incurring losses, in the long run some will exit the industry. This shifts the demand and marginal revenue curves for each of the remaining gas stations rightward. Exit continues until each remaining gas station makes zero profit. This is the long-run equilibrium. The situation for the typical gas station in this equilibrium is illustrated in the accompanying diagram. Demand has increased to the level at which this gas station makes zero profit at a price of  $P_{MC}$  and a quantity of  $Q_{MC}$ .



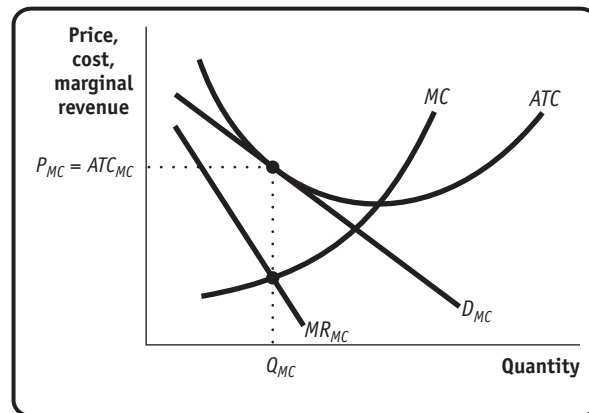
4. The local hairdresser industry has the market structure of monopolistic competition. Your hairdresser boasts that he is making a profit and that if he continues to do so, he will be able to retire in five years. Use a diagram to illustrate your hairdresser's current situation. Do you expect this to last? In a separate diagram, draw what you expect to happen in the long run. Explain your reasoning.

Solution

4. Your hairdresser currently makes a profit. His demand, marginal revenue, marginal cost, and average total cost curves are shown in the accompanying diagram.



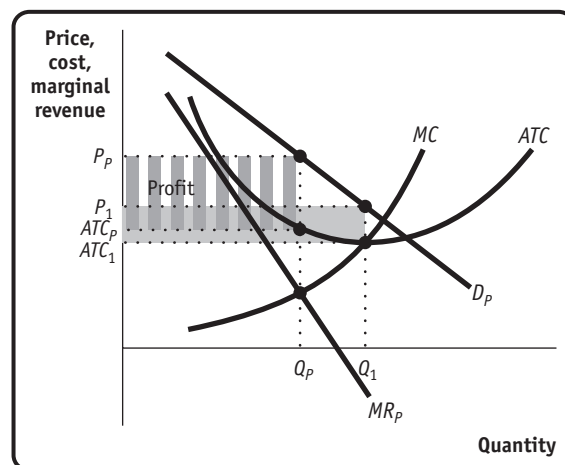
Since this hairdresser (and all other hairdressers) makes a profit equal to the shaded rectangle by producing quantity  $Q_P$  at a price  $P_P$ , there will be entry into this industry. As more hairdressers open shops in town, demand for the typical existing hairdresser will fall—the demand curve and marginal revenue curve shift leftward. This will continue to the point at which no hairdresser makes positive profit. This eliminates the incentive for further entry into the industry, and long-run equilibrium is reached. The situation is illustrated in the accompanying diagram.



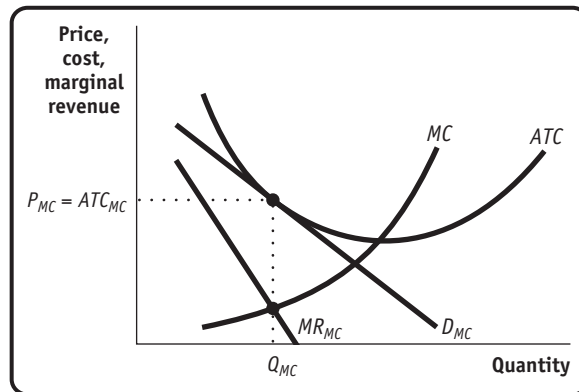
The best the typical hairdresser can do is to produce quantity  $Q_{MC}$  at a price of  $P_{MC}$ . Since price equals average total cost at this quantity, each hairdresser will make exactly zero profit.

5. Magnificent Blooms is a florist in a monopolistically competitive industry. It is a successful operation, producing the quantity that minimizes its average total cost and making a profit. The owner also says that at its current level of output, its marginal cost is above marginal revenue. Illustrate the current situation of Magnificent Blooms in a diagram. Answer the following questions by illustrating with a diagram.
- In the short run, could Magnificent Blooms increase its profit?
  - In the long run, could Magnificent Blooms increase its profit?

- Solution**
5. The current situation of Magnificent Blooms is illustrated in the accompanying diagram. It produces quantity  $Q_1$  at the minimum point of its average total cost curve, and it charges price  $P_1$ , making profit equal to the shaded rectangular area.



- a. Yes, Magnificent Blooms could increase its profit in the short run by producing less. It would maximize its profit by producing quantity  $Q_p$ , the quantity at which marginal revenue equals marginal cost, and selling it at a price  $P_p$ , making a profit equal to the striped area.
- b. No. In the long run, Magnificent Blooms will make zero profit. The fact that it is making profits in the short run induces other firms to enter the industry. In the long run, this shifts its demand curve and marginal revenue curve leftward to the point where it makes zero profit, as shown in the accompanying diagram.



6. “In the long run, there is no difference between monopolistic competition and perfect competition.” Discuss whether this statement is true, false, or ambiguous with respect to the following criteria.
- The price charged to consumers
  - The average total cost of production
  - The efficiency of the market outcome
  - The typical firm’s profit in the long run

## Solution

6. a. According to this criterion, the statement is false. The price charged to consumers is higher in monopolistic competition than it is in perfect competition. All firms in a perfectly competitive market will charge a price equal to marginal cost and equal to minimum average total cost, the lowest point on the average total cost curve. The typical firm in a monopolistically competitive industry will charge a price that is higher than marginal cost and also higher than minimum average total cost.
- b. According to this criterion, the statement is false. The average total cost of production is higher for a monopolistically competitive firm than for a perfectly competitive firm. For a perfectly competitive firm in the long run, there is no way of lowering the average total cost of production: it produces at minimum average total cost. Monopolistically competitive firms, however, have excess capacity: if they were to produce more, they could lower their average total cost, but this would result in a reduction in profit or a loss.
- c. According to this criterion, the statement is ambiguous. The market outcome under perfect competition is clearly efficient: price equals marginal cost, so no firm wants to produce more output at a price at which consumers want to buy more output. That is, no mutually beneficial trades between consumers and producers go unexploited. The efficiency of monopolistic competition, however, is ambiguous. In the market outcome, price exceeds marginal cost, so there are beneficial trades that go unexploited in this case. But consumers also gain from the variety of products that monopolistic competition provides, which is not the case under perfect competition. So it is ambiguous whether consumers are better or worse off when an industry is monopolistically competitive.

- d. According to this criterion, the statement is true. Both perfectly competitive firms and monopolistically competitive firms earn zero profits in the long run, since entry into (or exit from) the industry eliminates all profits (or, in the case of exit, transforms losses to zero profit). In this respect, perfect competition and monopolistic competition are similar.
7. “In both the short run and in the long run, the typical firm in monopolistic competition and a monopolist each make a profit.” Do you agree with this statement? Explain your reasoning.

### Solution

7. In the short run, a monopolist makes positive profit. Whether a firm in monopolistic competition makes a profit depends on how many firms there are in the industry. If there are “too few” firms in the industry (relative to the long-run equilibrium number of firms), then a typical firm in monopolistic competition will make a profit. But if there are “too many” firms in the industry (relative to the long-run equilibrium number of firms), then a typical firm in monopolistic competition will incur a loss in the short run.

In the long run, a monopolist makes positive profit. But in the long-run equilibrium in a monopolistically competitive industry, all firms make zero profit. This is because in the long run in a monopolistically competitive industry, enough firms have entered or exited the market to shift a typical firm’s demand curve so that it is tangent to the firm’s average total cost curve at the firm’s profit-maximizing quantity. The typical firm makes zero profit.

8. The market for clothes has the structure of monopolistic competition. What impact will fewer firms in this industry have on you as a consumer? Address the following issues.
- Variety of clothes
  - Differences in quality of service
  - Price

### Solution

8. a. In monopolistic competition, firms seek to differentiate themselves by, among other things, the type of clothes they sell. And to you, as a customer, there is value in diversity: many consumers value being able to wear clothes that are different from those the people around them wear. If there are fewer firms in this industry, there will also be less variety.
- b. Monopolistically competitive firms also seek to differentiate themselves through the quality of service they offer. There will be stores that take your measurements before making specific recommendations about which clothes to buy. And there will be stores where you help yourself to clothes piled in a heap on a big table. If there are fewer firms in this industry, there will be less diversity in service quality. It will be less likely that each consumer finds a store with just the quality of service he or she prefers.
- c. If there are fewer firms in this industry, each firm will sell a greater quantity and so have lower average total cost of production. As a result, it is likely that prices will also be lower. From this perspective, you might prefer to have fewer firms.

9. For each of the following situations, decide whether advertising is directly informative about the product or simply an indirect signal of its quality. Explain your reasoning.
- Football great Peyton Manning drives a Buick in a TV commercial and claims that he prefers it to any other car.
  - A Craigslist ad states, “For sale: 1999 Honda Civic, 160,000 miles, new transmission.”
  - McDonald’s spends millions of dollars on an advertising campaign that proclaims: “I’m lovin’ it.”
  - Subway advertises one of its sandwiches by claiming that it contains 6 grams of fat and fewer than 300 calories.

## Solution

9. a. This commercial is not directly informative about the product since every car manufacturer can claim that its car is better than any other; this is not a statement that can be easily verified by the purchaser before purchase. However, Peyton Manning commands a very high fee for advertising. What the commercial therefore signals is something like “we can afford to pay Peyton Manning’s fee since we are a company with a superior product.”
- b. This ad is directly informative about the product. It states specific information (that, on inspection of the car, you could easily verify before purchase). Since it can be so easily verified, this information is likely to be true.
- c. This type of advertising provides an indirect signal of the quality of McDonald’s food. By spending millions on advertising, McDonald’s signals that it is confident that once it attracts a buyer to its product, that buyer will buy its products again (creating more profit for McDonald’s in the future).
- d. This type of advertising is directly informative about the product because it contains specific information that could easily be verified. If this claim were false, it would very quickly be discredited. So the claim is likely to be true and informs you directly about the product.
10. In each of the following cases, explain how the advertisement functions as a signal to a potential buyer. Explain what information the buyer lacks that is being supplied by the advertisement and how the information supplied by the advertisement is likely to affect the buyer’s willingness to buy the good.
- “Looking for work. Excellent references from previous employers available.”
  - “Electronic equipment for sale. All merchandise carries a one-year, no-questions-asked warranty.”
  - “Car for sale by original owner. All repair and maintenance records available.”

## Solution

10. a. The seller here is the job-seeker, who is selling his or her labor to a potential employer. The potential employer lacks information on how good an employee the job-seeker is—how dependable, diligent, and so on. By being willing to provide excellent references from previous employers, the job-seeker signals that he or she is a good employee. As a result, the potential employer is more willing to hire that person.
- b. The potential buyer lacks information on how good the merchandise is. By being willing to provide a one-year, no-questions-asked warranty, the seller signals to the potential buyer that the merchandise is of high quality. As a result, the potential buyer is more willing to buy the good.
- c. The potential buyer lacks information on how good the used car is. By being willing to provide the repair and maintenance records, the seller signals to the potential buyer that this is a good-quality used car. As a result, the potential buyer is more willing to buy it.

- 11.** The accompanying table shows the Herfindahl–Hirschman Index (HHI) for the restaurant, cereal, movie, and laundry detergent industries as well as the advertising expenditures of the top 10 firms in each industry. Use the information in the table to answer the following questions.

Industry	HHI	Advertising expenditures (millions)
Restaurants	179	\$1,784
Cereal	2,098	732
Movie studios	918	3,324
Laundry detergent	2,068	132

- a. Which market structure—oligopoly or monopolistic competition—best characterizes each of the industries?
- b. Based on your answer to part a, which type of market structure has higher advertising expenditures? Use the characteristics of each market structure to explain why this relationship might exist.

### Solution

- 11. a.** Recall from Chapter 14 that according to Justice Department guidelines, an HHI below 1,000 indicates a strongly competitive market, an HHI between 1,000 and 1,800 indicates a somewhat competitive market, and an HHI over 1,800 indicates an oligopoly. So you should expect monopolistically competitive industries to have an HHI below 1,000 and oligopolies to have an HHI above 1,800. So the four industries are:

Restaurants: HHI below 1,000—monopolistic competition

Cereal: HHI over 1,800—oligopoly

Movie studios: HHI below 1,000—monopolistic competition

Laundry detergent: HHI over 1,800—oligopoly

- b.** The market structure and advertising expenditures in each of the four industries correlate as follows:

Restaurants: monopolistic competition and high advertising expenditures

Cereal: oligopoly and medium advertising expenditures

Movie studios: monopolistic competition and high advertising expenditures

Laundry detergent: oligopoly and low advertising expenditures

There are higher advertising expenditures in the two monopolistically competitive industries—restaurants and movie studios. Monopolistically competitive firms advertise in order to earn short-run profits through product differentiation. Because there are no barriers to entry in monopolistic competition, firms must advertise and differentiate their products in order to earn short-run profits. There are lower advertising expenditures in the two oligopolistic industries, cereal and laundry detergents. They can advertise less because oligopolistic industries have barriers to entry and therefore do not need to rely on product differentiation to counter entry into the market.

- 12.** McDonald's spends millions of dollars each year on legal protection of its brand name, thereby preventing any unauthorized use of it. Explain what information this conveys to you as a consumer about the quality of McDonald's products.

**12.** The fast-food industry is a monopolistically competitive one, and companies attempt to differentiate their product from that of other firms. McDonald's invests money in maintaining its brand name, which differentiates it from other companies. The amount of money spent on creating and maintaining a brand name does not convey any *specific* information about McDonald's products. But it does convey, indirectly, that McDonald's is in this market for the long haul, that it has a reputation to protect, and that it will interact repeatedly with its customers. In this sense, the amount of money spent on maintaining a brand name signals to you as a consumer that McDonald's will provide products of consistent quality.

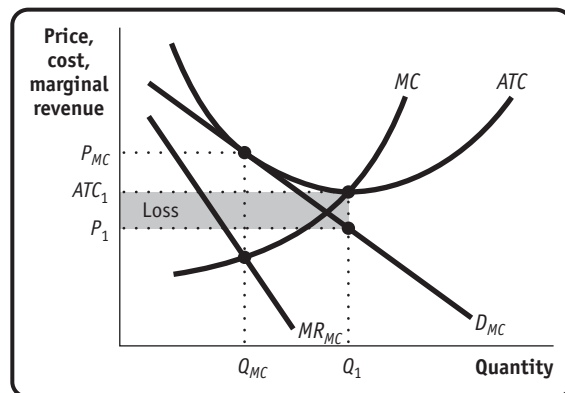
**13.** The restaurant business in town is a monopolistically competitive industry in long-run equilibrium. One restaurant owner asks for your advice. She tells you that, each night, not all tables in her restaurant are full. She also tells you that she would attract more customers if she lowered the prices on her menu and that doing so would lower her average total cost. Should she lower her prices? Draw a diagram showing the demand curve, marginal revenue curve, marginal cost curve, and average total cost curve for this restaurant to explain your advice. Show in your diagram what would happen to the restaurant owner's profit if she were to lower the price so that she sells the minimum-cost output.

**WORK IT OUT**

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**13.** She should not lower her price. Since the industry is in long-run equilibrium, each restaurant makes zero profit. That is, the restaurant's demand, marginal revenue, marginal cost, and average total cost curves are as shown in the accompanying diagram.



The restaurant owner produces output (the number of tables served)  $Q_{MC}$  at a price of  $P_{MC}$ . The price is equal to average total cost, so she makes zero profit. If she were to lower the price to  $P_1$ , she would attract more customers and sell the minimum-cost output  $Q_1$ . That is, there is excess capacity: each restaurant in town could produce more output at a lower average total cost. But lowering the price to  $P_1$  would cause the restaurant owner to incur a loss equal to the shaded rectangle in the diagram, since price is now below average total cost,  $ATC_1$ . In fact, there is no price other than  $P_{MC}$  at which the restaurant owner does not incur a loss. So she should not change the prices on her menu.





1. What type of externality (positive or negative) is present in each of the following examples? Is the marginal social benefit of the activity greater than or equal to the marginal benefit to the individual? Is the marginal social cost of the activity greater than or equal to the marginal cost to the individual? Without intervention, will there be too little or too much (relative to what would be socially optimal) of this activity?
  - a. Mr. Chau plants lots of colorful flowers in his front yard.
  - b. Your next-door neighbor likes to build bonfires in his backyard, and sparks often drift onto your house.
  - c. Maija, who lives next to an apple orchard, decides to keep bees to produce honey.
  - d. Justine buys a large SUV that consumes a lot of gasoline.

## Solution

1.
  - a. This is a positive externality: since other people enjoy looking at Mr. Chau's flowers, the marginal social benefit of looking at the flowers is greater than the marginal benefit to Mr. Chau of looking at them. As a result, fewer flowers will be planted than is socially optimal.
  - b. This is a negative externality: an external cost, the risk that your house will catch fire from the sparks from your neighbor's bonfire, is imposed on you. That is, the marginal social cost is greater than the marginal cost incurred by your neighbor. Since your neighbor does not take this external cost into account, there will be more bonfires in your neighbor's yard than is socially optimal.
  - c. This is a positive externality: since bees pollinate her neighbor's apple trees and therefore confer an external benefit on the owner of the apple orchard, the marginal social benefit is greater than the marginal benefit to Maija. Since Maija does not take the external benefit into account, she will keep fewer bees than is socially optimal.
  - d. This is a negative externality: the burning of gasoline produces toxic gases that impose an external cost on others. The marginal social cost is greater than the marginal cost incurred by Justine. As a result, more people will purchase SUVs than is socially optimal.

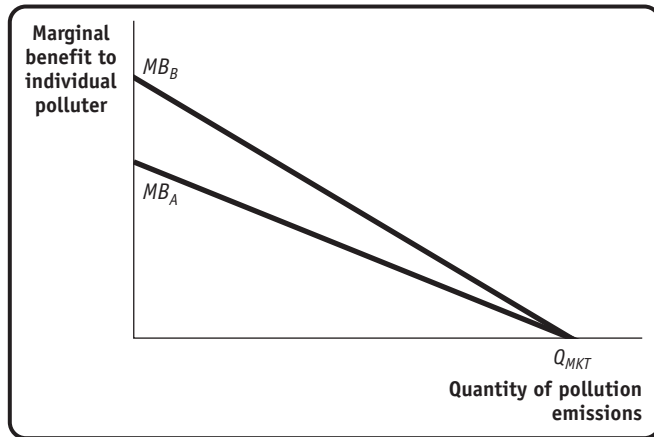
2. Many dairy farmers in California are adopting a new technology that allows them to produce their own electricity from methane gas captured from animal waste. (One cow can produce up to 2 kilowatts a day.) This practice reduces the amount of methane gas released into the atmosphere. In addition to reducing their own utility bills, the farmers are allowed to sell any electricity they produce at favorable rates.
- Explain how the ability to earn money from capturing and transforming methane gas behaves like a Pigouvian tax on methane gas pollution and can lead dairy farmers to emit the efficient amount of methane gas pollution.
  - Suppose some dairy farmers have lower costs of transforming methane into electricity than others. Explain how this system of capturing and selling methane gas leads to an efficient allocation of emissions reduction among farmers.

## Solution

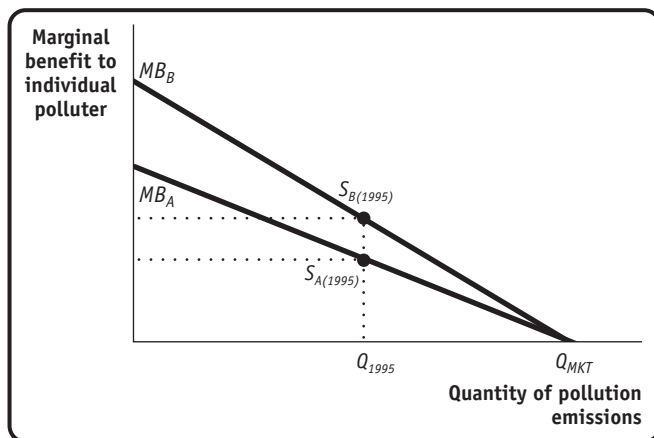
2. a. Without the new technology, dairy farmers will release methane gas until the marginal social benefit of emissions is zero. With the new technology, there is now an opportunity cost to the farmer from releasing methane gas because there now exists a profitable alternative—turning it into electricity. The financial reward forgone if a farmer emits the methane gas acts like a Pigouvian tax on emissions. If the financial reward is set at the right level—equal to the marginal social cost of a unit of methane gas pollution—it will lead dairy farmers to emit the efficient amount of methane gas pollution.
- b. Farmers who have a lower cost of capturing methane will generate more profit from transformation of their methane than farmers who have a higher cost. So farmers with lower costs will transform more units of methane gas into electricity than will farmers with higher costs. As a result, emissions reduction will be allocated efficiently among dairy farmers.
3. Voluntary environmental programs were extremely popular in the United States, Europe, and Japan in the 1990s. Part of their popularity stems from the fact that these programs do not require legislative authority, which is often hard to obtain. The 33/50 program started by the Environmental Protection Agency (EPA) is an example of such a program. With this program, the EPA attempted to reduce industrial emissions of 17 toxic chemicals by providing information on relatively inexpensive methods of pollution control. Companies were asked to voluntarily commit to reducing emissions from their 1988 levels by 33% by 1992 and by 50% by 1995. The program actually met its second target by 1994.
- As in Figure 16-3, draw marginal benefit curves for pollution generated by two plants, A and B, in 1988. Assume that without government intervention, each plant emits the same amount of pollution, but that at all levels of pollution less than this amount, plant A's marginal benefit of polluting is less than that of plant B. Label the vertical axis "Marginal benefit to individual polluter" and the horizontal axis "Quantity of pollution emissions." Mark the quantity of pollution each plant produces without government action.
  - Do you expect the total quantity of pollution before the program was put in place to have been less than or more than the optimal quantity of pollution? Why?
  - Suppose the plants whose marginal benefit curves you depicted in part a were participants in the 33/50 program. In a replica of your graph from part a, mark targeted levels of pollution in 1995 for the two plants. Which plant was required to reduce emissions more? Was this solution necessarily efficient?
  - What kind of environmental policy does the 33/50 program most closely resemble? What is the main shortcoming of such a policy? Compare it to two other types of environmental policies discussed in this chapter.

### Solution

3. a. The accompanying diagram shows the marginal benefit curve for plant A,  $MB_A$ , and the marginal benefit curve for plant B,  $MB_B$ . Without government intervention, both plants produce  $Q_{MKT}$  pollution.



- b. We should expect that the total quantity of pollution before the plan was adopted was above the optimal quantity because pollution generates a negative externality. When the negative externality is not internalized or regulated, it results in higher market activity than is optimal.
- c. The accompanying diagram shows the targeted level of emissions in 1995,  $Q_{1995}$ . Both firms had to reduce their emissions by the same amount. This was not necessarily efficient: since at the quantity  $Q_{1995}$ , plant B had a higher marginal benefit of pollution, the situation could have been more efficient by allowing plant B to pollute a little more and asking plant A to reduce its emissions more.



- d. The 33/50 program set an environmental standard. The main shortcoming of this type of policy is that its inflexibility often prevents pollution reductions from being achieved at the lowest cost. Tradable permits and emissions taxes are more flexible policies than an environmental standard. These policies help to achieve reductions in emissions at the lowest possible cost.

4. According to a report from the U.S. Census Bureau, “the average [lifetime] earnings of a full-time, year round worker with a high school education are about \$1.2 million compared with \$2.1 million for a college graduate.” This indicates that there is a considerable benefit to a graduate from investing in his or her own education. Tuition at most state universities covers only about two-thirds to three-quarters of the cost, so the state applies a Pigouvian subsidy to college education.

If a Pigouvian subsidy is appropriate, is the externality created by a college education a positive or a negative externality? What does this imply about the differences between the costs and benefits to students compared to social costs and benefits? What are some reasons for the differences?

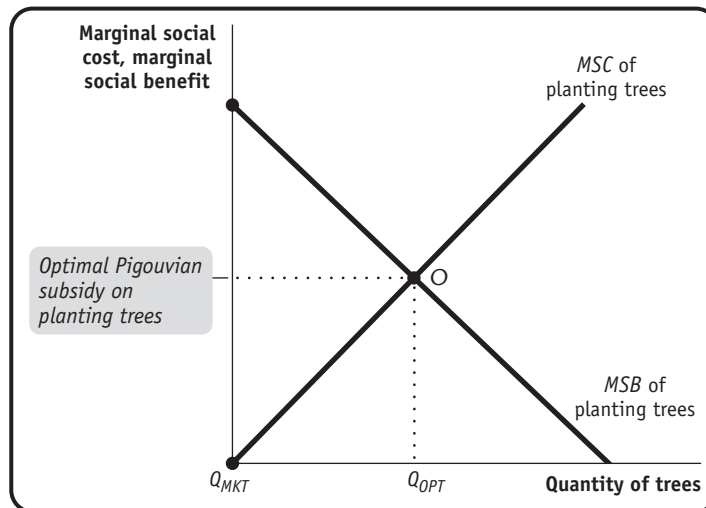
### Solution

4. If a Pigouvian subsidy is appropriate, the externality is a positive one. This means that the marginal social benefit of education is higher than the marginal benefit going to graduates. (It is likely that marginal social cost and marginal cost to graduates do not differ.) One reason the marginal social benefit of education is higher than the marginal benefit to graduates is that their increased human capital makes other people in the economy more productive, even those who do not have a college education. Also, they are more likely to realize cultural and social achievements from which all of society benefits.
5. The city of Falls Church, Virginia, subsidizes the planting of trees in homeowners’ front yards when they are within 15 feet of the street.
- Using concepts in the chapter, explain why a municipality would subsidize planting trees on private property, but near the street.
  - Draw a diagram similar to Figure 16-4 that shows the marginal social benefit, the marginal social cost, and the optimal Pigouvian subsidy on planting trees.

### Solution

5. a. Trees planted near the street provide external benefits. They provide shade and so keep streets and sidewalks cooler, which makes activities such as walking and bicycling more pleasant for all citizens. They also beautify neighborhoods and can raise property values. And they provide habitat for wildlife which helps to preserve biodiversity. Without the subsidy, the market equilibrium quantity would be below the socially optimal quantity. An optimal Pigouvian subsidy will lead homeowners to plant the socially optimal quantity of trees.

- b. The accompanying diagram shows the marginal social benefit (*MSB*) and the marginal social cost (*MSC*) of planting trees. The marginal social benefit is decreasing: the first trees are planted in the most ideal locations (close to frequently traveled streets, etc.), but subsequent trees must increasingly be planted in less ideal locations. The marginal social cost is increasing: as homeowners have more trees planted, arborists are likely to raise their rates in response to the increased demand for their services. The diagram shows the market equilibrium quantity,  $Q_{MKT}$ , the socially optimal quantity,  $Q_{OPT}$ , and the optimal Pigouvian subsidy.



6. Fishing for sablefish has been so intensive that sablefish were threatened with extinction. After several years of banning such fishing, the government is now proposing to introduce tradable vouchers, each of which entitles its holder to a catch of a certain size. Explain how uncontrolled fishing generates a negative externality and how the voucher scheme may overcome the inefficiency created by this externality.

## Solution

6. An individual fisherman makes decisions about how many fish to catch based on his or her marginal benefit and marginal cost. However, the marginal social cost of fishing is greater than the fishing industry's marginal cost, since catching fish reduces the number of fish that can reproduce and so imposes an external cost on other fishermen. Since an individual fisherman does not take this external cost into account in deciding how much to fish, there will be too much fishing compared to what would be socially optimal. Assuming that the number of vouchers allocated to all fishermen corresponds to the socially optimal quantity of fish caught, the voucher scheme could achieve efficiency: it will limit the size of the total catch to the socially optimal quantity. And since the vouchers are tradable, fishermen who are more efficient (can operate at a lower cost) will buy vouchers from less efficient ones, so only the most efficient fishermen will operate.

7. The two dry-cleaning companies in Collegetown, College Cleaners and Big Green Cleaners, are a major source of air pollution. Together they currently produce 350 units of air pollution, which the town wants to reduce to 200 units. The accompanying table shows the current pollution level produced by each company and each company's marginal cost of reducing its pollution. The marginal cost is constant.

Companies	Initial pollution level (units)	Marginal cost of reducing pollution (per unit)
College Cleaners	230	\$5
Big Green Cleaners	120	\$2

- a. Suppose that Collegetown passes an environmental standards law that limits each company to 100 units of pollution. What would be the total cost to the two companies of each reducing its pollution emissions to 100 units?

Suppose instead that Collegetown issues 100 pollution vouchers to each company, each entitling the company to one unit of pollution, and that these vouchers can be traded.

- b. How much is each pollution voucher worth to College Cleaners? To Big Green Cleaners? (That is, how much would each company, at most, be willing to pay for one more voucher?)
- c. Who will sell vouchers and who will buy them? How many vouchers will be traded?
- d. What is the total cost to the two companies of the pollution controls under this voucher system?

## Solution

7. a. College Cleaners would have to reduce its pollution level by 130 units, costing it  $130 \times \$5 = \$650$ . Big Green Cleaners would have to reduce its pollution level by 20 units, costing it  $20 \times \$2 = \$40$ . So the total cost of reducing pollution to a total of 200 units would be  $\$650 + \$40 = \$690$ .
- b. One pollution voucher is worth \$5 to College Cleaners and \$2 to Big Green Cleaners. To see why, consider this: if College Cleaners can obtain one more voucher entitling it to one more unit of pollution, it saves \$5 (the cost it would have had to incur to reduce pollution by one unit).
- c. Each voucher is worth more to College Cleaners than to Big Green Cleaners, so Big Green Cleaners will sell all of its 100 vouchers to College Cleaners (for a price between \$2 and \$5).
- d. Big Green Cleaners will reduce its output of pollution to zero, which will cost it  $120 \times \$2 = \$240$ . College Cleaners will now have 200 vouchers and can emit 200 units of pollution, 30 fewer than before. This will cost College Cleaners  $30 \times \$5 = \$150$ . So the total cost of pollution control under this system is  $\$240 + \$150 = \$390$ . The prices paid by College Cleaners and received by Big Green Cleaners in trading vouchers cancel each other out—they are pure “transfers” between the two companies.

8. a. EAuction and EMarketplace are two competing internet auction sites, where buyers and sellers transact goods. Each auction site earns money by charging sellers for listing their goods. EAuction has decided to eliminate fees for the first transaction for sellers that are new to its site. Explain why this is likely to be a good strategy for EAuction in its competition with EMarketplace.
- b. EMarketplace complained to the Justice Department that EAuction's practice of eliminating fees for new sellers was anti-competitive and would lead to monopolization of the internet auction industry. Is EMarketplace correct? How should the Justice Department respond?
- c. EAuction stopped its practice of eliminating fees for new sellers. But since it provided much better technical service than its rival, EMarketplace, buyers and sellers came to prefer EAuction. Eventually, EMarketplace closed down, leaving EAuction as a monopolist. Should the Justice Department intervene to break EAuction into two companies? Explain.
- d. EAuction is now a monopolist in the internet auction industry. It also owns a site that handles payments over the internet, called PayForIt. It is competing with another internet payment site, called PayBuddy. EAuction has now stipulated that any transaction on its auction site must use PayForIt, rather than PayBuddy, for the payment. Should the Justice Department intervene? Explain.

## Solution

8. a. Internet auction sites are characterized by network externalities: more sellers will want to list their items on the site that more buyers visit, and more buyers will visit a site on which more sellers list items for sale. So it is a good strategy for EAuction to eliminate its fees to first-time sellers. As a result, more sellers will come to EAuction than to EMarketplace, also drawing more buyers to EAuction than to EMarketplace.
- b. EMarketplace is correct: due to the network externality, EAuction's practice is anti-competitive and likely to eventually drive EMarketplace out of business. Because actions taken to gain a monopoly advantage are illegal, the Justice Department should intervene and stop EAuction's practice of eliminating fees for new sellers.
- c. No, the Justice Department should not intervene. Due to the network externality, the internet auction industry has naturally become a monopoly: buyers and sellers are both better served by an industry with one large auction site than two smaller sites. EAuction did nothing illegal because it became a monopolist through providing better service, rather than by taking anti-competitive actions to gain a monopoly advantage.
- d. Yes, the Justice Department should intervene. As in the case of Microsoft, EAuction is using its monopoly position in one industry (the internet auction industry) to gain a monopoly in the internet payment industry. It should stop EAuction from requiring that buyers and sellers on its site use PayForIt.
9. Which of the following are characterized by network externalities? Which are not? Explain.
- a. The choice between installing 110-volt electrical current in structures rather than 220-volt
- b. The choice between purchasing a Toyota versus a Ford
- c. The choice of a printer, where each printer requires its own specific type of ink cartridge
- d. The choice of whether to purchase an iPod or an iPod Nano.

## Solution

9. a. This choice is characterized by a network externality: you want to use the standard that is more widely adopted by other people. That's because the greater the use of a given electricity standard, the greater the availability of appliances and other electrical items using that standard.
- b. This choice is not characterized by a network externality because there are millions of Fords and Toyotas already on the road. Consequently, you will easily find a Toyota or Ford repair shop whenever you need one. There would be a network externality present in the choice of buying a new make of car in which you could not be assured of finding a mechanic for it.
- c. This choice is characterized by a network externality because you want to be assured of finding a cartridge for your printer in the future. If few people use your type of printer, you may be unable to find a cartridge; if many people use the printer, you are much more likely to find a cartridge for it.
- d. This choice is not characterized by a network externality because an iPod Touch and an iPod Nano use the same operating system. Any song that you could download using an iPod Touch you could also download using an iPod Nano. Any repair shop that can repair an iPod Touch can also repair an iPod Nano.

### WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



10. The loud music coming from the sorority next to your dorm is a negative externality that can be directly quantified. The accompanying table shows the marginal social benefit and the marginal social cost per decibel (dB, a measure of volume) of music.

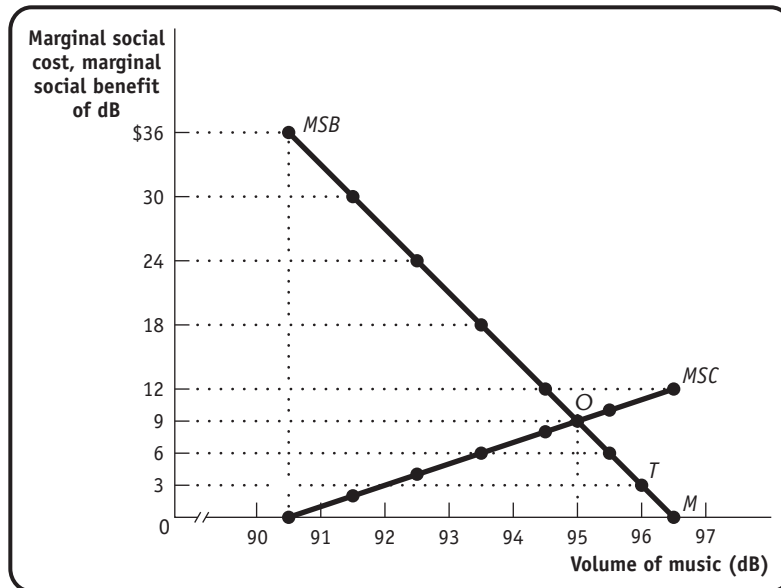
Volume of music (dB)	Marginal social benefit of dB	Marginal social cost of dB
90	\$36	\$0
91	30	2
92	24	4
93	18	6
94	12	8
95	6	10
96	0	12
97		

- a. Draw the marginal social benefit curve and the marginal social cost curve. Use your diagram to determine the socially optimal volume of music.
- b. Only the members of the sorority benefit from the music, and they bear none of the cost. Which volume of music will they choose?
- c. The college imposes a Pigouvian tax of \$3 per decibel of music played. From your diagram, determine the volume of music the sorority will now choose.



## Solution

10. a. The accompanying diagram shows the marginal social cost curve and the marginal social benefit curve of music. The socially optimal volume of music is the volume at which marginal social benefit and marginal social cost are equal (point *O* in the diagram). This is the case at a volume of 95 dB.



- b. Since the members of the sorority do not bear any of the social cost of playing loud music, they will play music up to the volume where the marginal social benefit is zero (point *M* in the diagram). This is at a volume of 96.5 dB.
- c. If the college imposes a Pigouvian tax of \$3 per decibel, the sorority now faces a marginal cost of playing music of \$3. So they will play music up to the volume where the marginal social benefit is just equal to \$3 (point *T* in the diagram). This is at a volume of 96 dB. This is not the optimal quantity of music, so this is not an *optimal* Pigouvian tax.



# Public Goods and Common Resources

1. The government is involved in providing many goods and services. For each of the goods or services listed, determine whether it is rival or nonrival in consumption and whether it is excludable or nonexcludable. What type of good is it? Without government involvement, would the quantity provided be efficient, inefficiently low, or inefficiently high?
  - a. Street signs
  - b. Amtrak rail service
  - c. Regulations limiting pollution
  - d. A congested interstate highway without tolls
  - e. A lighthouse on the coast

## Solution

1.
  - a. Street signs are nonrival in consumption (if I make use of a street sign, that does not reduce your opportunity to use it) and nonexcludable (no one can prevent another person from making use of a street sign). So street signs are a public good. Because of the free-rider problem, the quantity provided privately would be inefficiently low.
  - b. Amtrak rail service is rival in consumption (if I consume a seat, you cannot) and excludable (you cannot consume the service if you do not have a ticket). Although Amtrak rail service is a private good, it creates a positive externality in the form of reduced road and air traffic congestion. The market would provide an inefficiently low level of passenger rail service, so there is a justification for government intervention to support Amtrak.
  - c. Regulations limiting pollution are nonrival in consumption (my benefit from these regulations is not diminished by your benefit) and nonexcludable (people cannot be selectively excluded from benefiting from these regulations—that is, excluded from breathing clean air or drinking clean water). So these regulations are a public good. Because of the free-rider problem, the privately provided quantity of these regulations would be inefficiently low.
  - d. A congested interstate highway without tolls is rival in consumption (if I use the highway, I create a negative externality for you—more congestion; that is, I reduce your benefit from the highway) but nonexcludable (drivers can use the highway without paying for access). So the highway is a common resource. Because of nonexcludability, a free-rider problem exists, and the privately provided quantity of highways would be inefficiently low.
  - e. A lighthouse is nonrival in consumption (if I use the lighthouse to steer my boat away from rocks, you can still use the same lighthouse) and nonexcludable (boats cannot selectively be made to pay for the services provided by the lighthouse). So the lighthouse is a public good. Because of the free-rider problem, the privately provided quantity would be inefficiently low.

2. An economist gives the following advice to a museum director: “You should introduce ‘peak pricing.’ At times when the museum has few visitors, you should admit visitors for free. And at times when the museum has many visitors, you should charge a higher admission fee.”
- When the museum is quiet, is it rival or nonrival in consumption? Is it excludable or nonexcludable? What type of good is the museum at those times? What would be the efficient price to charge visitors during that time, and why?
  - When the museum is busy, is it rival or nonrival in consumption? Is it excludable or nonexcludable? What type of good is the museum at those times? What would be the efficient price to charge visitors during that time, and why?

### Solution

2. a. When the museum is quiet, it is nonrival in consumption: one additional visitor does not diminish any other visitor’s ability to enjoy the museum. Furthermore, the museum is excludable (if you don’t pay the entrance fee, you are not admitted). So the museum is an artificially scarce good. The marginal cost of admitting one more visitor is zero (the museum is already staffed, lighted, and heated or air-conditioned), and so the efficient admission fee would be zero.
- b. When the museum is busy, it is rival in consumption: one additional visitor in the museum diminishes any other visitor’s ability to enjoy the museum because of overcrowding. The museum is still excludable (if you don’t pay the entrance fee, you are not admitted). So the museum is a private good. There is now a marginal external cost to admitting one more visitor (the cost imposed on other visitors from a more crowded museum). So the efficient admission fee would be equal to the marginal external cost at the efficient number of visitors.
3. In many planned communities, various aspects of community living are subject to regulation by a homeowners’ association. These rules can regulate house architecture; require snow removal from sidewalks; exclude outdoor equipment, such as backyard swimming pools; require appropriate conduct in shared spaces such as the community clubhouse; and so on. Suppose there has been some conflict in one such community because some homeowners feel that some of the regulations mentioned above are overly intrusive. You have been called in to mediate. Using what you have learned about public goods and common resources, how would you decide what types of regulations are warranted and what types are not?

### Solution

3. Using efficiency as the goal, a regulation is warranted if it provides a public good or if it conserves a common resource. The enjoyment of pleasing and harmonious architecture and snow removal from sidewalks are examples of public goods: they are nonexcludable and nonrival in consumption. A clubhouse is a common resource: it is nonexcludable but rival in consumption. So it promotes efficiency if these aspects of the community are regulated for the benefit for all. But it is questionable whether or not aspects such as backyard swimming pools should be regulated: their presence in someone’s yard does not benefit or hurt neighbors (so they are rival in consumption) and they are solely for the benefit of the homeowner who owns them (they are excludable). So they are private goods and should not be subject to regulation by the homeowners’ association. The regulation of private goods in the community is unwarranted.

4. The accompanying table shows Tanisha's and Ari's individual marginal benefit of different amounts of street cleanings per month. Suppose that the marginal cost of street cleanings is constant at \$9 each.

Quantity of street cleanings per month	Tanisha's individual marginal benefit	Ari's individual marginal benefit
0		
1	\$10	\$8
2	6	4
3	2	1

- If Tanisha had to pay for street cleaning on her own, how many street cleanings would there be?
- Calculate the marginal social benefit of street cleaning. What is the optimal number of street cleanings?
- Consider the optimal number of street cleanings. The last street cleaning of that number costs \$9. Is Tanisha willing to pay for that last cleaning on her own? Is Ari willing to pay for that last cleaning on his own?

### Solution

- If Tanisha had to pay for street cleaning on her own, she would pay for the street to be cleaned once: her individual marginal benefit of the first cleaning, \$10, exceeds the marginal cost of \$9. However, she would not pay for more than one: her marginal benefit of the second cleaning is \$6, less than the marginal cost of \$9.
- The accompanying table shows the marginal social benefit of street cleaning. The optimal number of street cleanings is 2: the marginal social benefit of the second cleaning is \$10, which exceeds the marginal cost of \$9. A third cleaning would be inefficient because its marginal social benefit is \$3, less than the marginal cost of \$9.

Quantity of street cleanings per month	Tanisha's individual marginal benefit	Ari's individual marginal benefit	Marginal social benefit
0			
1	\$10	\$8	\$18
2	6	4	10
3	2	1	3

- Tanisha on her own would be willing to pay only \$6 (her individual marginal benefit) for the second cleaning. Ari on his own would be willing to pay only \$4 (his individual marginal benefit) for the second cleaning. So neither would be individually willing to pay for the second cleaning.

5. Anyone with a radio receiver can listen to public radio, which is funded largely by donations.
- Is public radio excludable or nonexcludable? Is it rival in consumption or nonrival? What type of good is it?
  - Should the government support public radio? Explain your reasoning.
  - In order to finance itself, public radio decides to transmit only to satellite radios, for which users have to pay a fee. What type of good is public radio then? Will the quantity of radio listening be efficient? Why or why not?

### Solution

5. a. Public radio is nonexcludable: anyone with a radio receiver can pick up the radio waves. It is nonrival: if I listen to public radio, that does not diminish your opportunity to listen to it also. So public radio is a public good.
- b. As with all public goods, private markets lead to an inefficient quantity of the good being supplied. The individual marginal benefit from a certain amount of public radio programming is less than the marginal social benefit from that amount of public radio programming. So individuals are not willing to pay for the efficient level of public radio programming, and as a result the privately provided quantity of programming would be inefficiently low. There is a case for government support of public radio.
- c. Transmitting only to satellite radios, where a fee is charged for the service, makes public radio excludable. So public radio is now an artificially scarce good. The efficient price for receiving the satellite radio signal would be zero, since the marginal cost is zero. But since a positive price is charged, only consumers with a marginal benefit greater than or equal to that price will choose to purchase the good. As a result, there are many consumers with individual marginal benefits that exceed the marginal cost but who do not get access to public radio because the price exceeds their individual marginal benefit. The quantity of radio listening is therefore inefficiently low.
6. Your economics professor assigns a group project for the course. Describe the free-rider problem that can lead to a suboptimal outcome for your group. To combat this problem, the instructor asks you to evaluate the contribution of your peers in a confidential report. Will this evaluation have the desired effects?

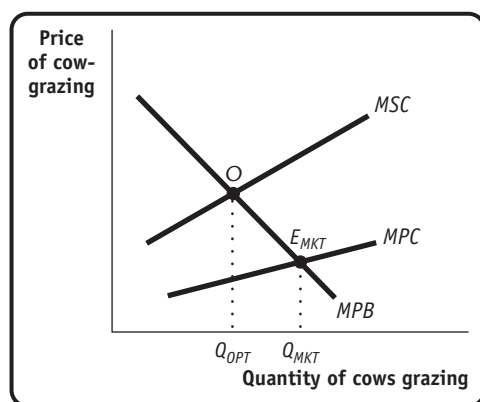
### Solution

6. Without the confidential evaluation, the grade a member of a group receives on the assignment depends only on the project as a whole, not on the contributions of individual members. Since each member of the group is aware of this, they realize that it is possible to shirk undetected and free-ride on the efforts of others. Consequently, everyone in the group is likely to underperform. The confidential peer evaluation provides an incentive to a potential free-rider to work harder. Since shirkers may be discovered through this evaluation and receive a lower grade as a result, the free-rider problem is mitigated.

7. The village of Upper Bigglesworth has a village “commons,” a piece of land on which each villager, by law, is free to graze his or her cows. Use of the commons is measured in units of the number of cows grazing on it. Assume that the marginal private cost curve of cow-grazing on the commons is upward sloping (say due to more time spent herding). There is also a marginal social cost curve of cow-grazing on the commons: each additional cow grazed means less grass available for others, and the damage done by overgrazing of the commons increases as the number of cows grazing increases. Finally, assume that the private benefit to the villagers of each additional cow grazing on the commons declines as more cows graze, since each additional cow has less grass to eat than the previous one.
- Is the commons excludable or nonexcludable? Is it rival in consumption or nonrival? What kind of good is the commons?
  - Draw a diagram showing the marginal social cost, marginal private cost, and the marginal private benefit of cow-grazing on the commons, with the quantity of cows that graze on the commons on the horizontal axis. How does the quantity of cows grazing in the absence of government intervention compare to the efficient quantity? Show both in your diagram.
  - The villagers hire you to tell them how to achieve an efficient use of the commons. You tell them that there are three possibilities: a Pigouvian tax, the assignment of property rights over the commons, and a system of tradable licenses for the right to graze a cow. Explain how each one of these options would lead to an efficient use of the commons. In the assignment of property rights, assume that one person is assigned the rights to the commons and the rights to all the cows. Draw a diagram that shows the Pigouvian tax.

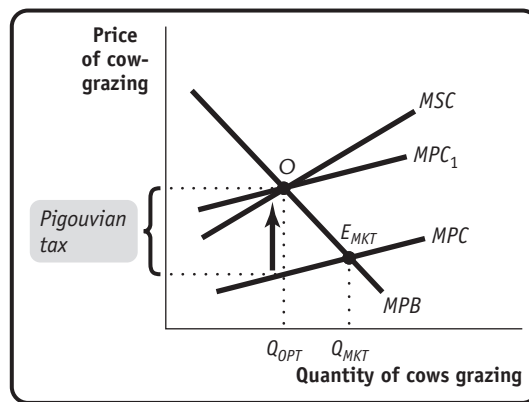
## Solution

7. a. The commons is nonexcludable since, by law, each villager is free to send his or her cows there. It is also rival in consumption, since the grass that one villager’s cow eats is no longer available for another villager’s cow. So the commons is a common resource.
- b. The accompanying diagram shows the marginal private cost to villagers of cow-grazing on the commons,  $MPC$ . It is also the supply curve of cows for grazing. It lies below the marginal social cost curve,  $MSC$ .  $MSC$  is higher than  $MPC$  because each villager who sends his or her cow to graze inflicts a cost on every other villager, a cost that increases as the number of cows grazing increases. The marginal private benefit curve,  $MPB$ , shows the marginal benefit that accrues to villagers according to the number of cows grazing.



The outcome without government intervention is indicated by  $Q_{MKT}$ , the quantity at which the marginal private benefit equals marginal private cost. It is greater than the optimal, or efficient, equilibrium quantity,  $Q_{OPT}$ . That is, the villagers will send too many cows to the commons to graze. This problem is known as the “tragedy of the commons” [G. Hardin, “The Tragedy of the Commons,” *Science*, pp. 1243–1248, 1968].

- c. A Pigouvian tax on grazing would increase the villagers’ marginal cost and shift the  $MPC$  upward until it intersects  $MPB$  at the efficient quantity,  $Q_{OPT}$ . This is shown in the diagram as the movement of  $MPC$  to its new position at  $MPC_1$ . Each individual villager would now make the socially optimal, or efficient, decision. Alternatively, ownership of the commons and the cows could be assigned to one person. He or she would set the amount of grazing to the efficient quantity. Last, villagers could create a system of tradable licenses for grazing one cow, where the number of licenses issued is equal to the efficient quantity of grazing.

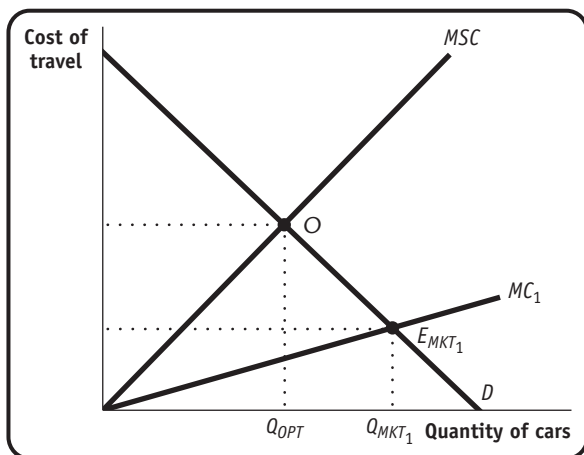


8. Prior to 2003, the city of London was often one big parking lot. Traffic jams were common, and it could take hours to travel a couple of miles. Each additional commuter contributed to the congestion, which can be measured by the total number of cars on London roads. Although each commuter suffered by spending valuable time in traffic, none of them paid for the inconvenience they caused others. The total cost of travel includes the opportunity cost of time spent in traffic and any fees levied by London authorities.
- Draw a graph illustrating the overuse of London roads, assuming that there is no fee to enter London in a vehicle and that roads are a common resource. Put the cost of travel on the vertical axis and the quantity of cars on the horizontal axis. Draw typical demand, individual marginal cost ( $MC$ ), and marginal social cost ( $MSC$ ) curves and label the equilibrium point. (*Hint:* The marginal cost takes into account the opportunity cost of spending time on the road for individual drivers but not the inconvenience they cause to others.)
  - In February 2003, the city of London began charging a £5 congestion fee on all vehicles traveling in central London. Illustrate the effects of this congestion charge on your graph and label the new equilibrium point. Assume the new equilibrium point is not optimally set (that is, assume that the £5 charge is too low relative to what would be efficient).
  - The congestion fee was raised to £9 in January 2011. Illustrate the new equilibrium point on your graph, assuming the new charge is now optimally set.

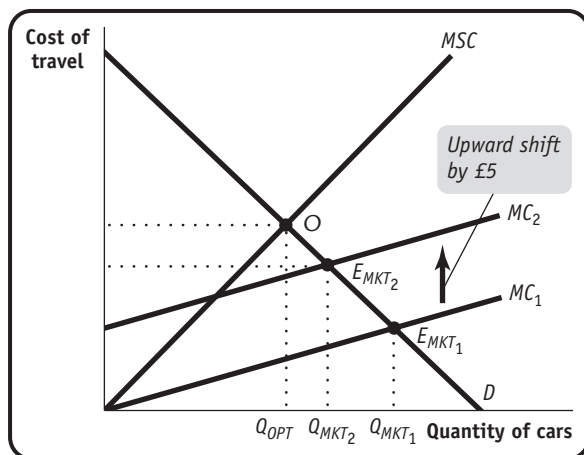


**Solution**

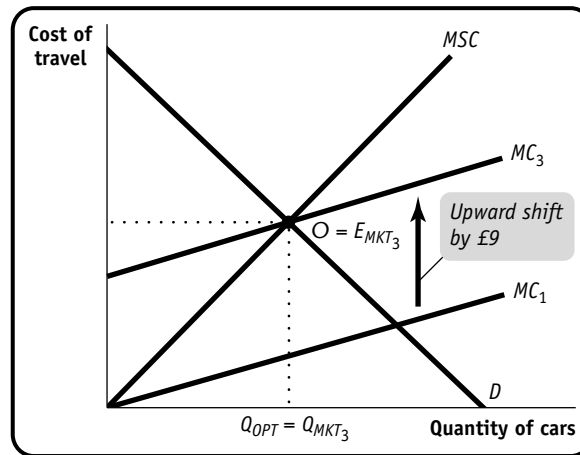
8. a. The accompanying diagram depicts the demand and individual marginal cost ( $MC_1$ ) for using London roads. When no fees are levied for using the roads, the equilibrium point is  $E_{MKT_1}$ . This is the usual market equilibrium when market externalities are not corrected.



- b. After the £5 fee is imposed, the market equilibrium moves as shown in the accompanying diagram. The congestion charge effectively increases the cost of traveling by car in central London, and the marginal cost curve shifts upward, from  $MC_1$  to  $MC_2$ . The commuters who are easily able to switch to public transport stop driving, causing the quantity of cars to fall. However, the charge is too low: although the quantity of cars falls relative to the situation in part a, it is still greater than the efficient quantity,  $Q_{OPT}$ .



- c. When the fee is raised to £9, the marginal cost curve moves farther up, to  $MC_3$ , and more people refrain from using central London roads as the equilibrium quantity falls to the efficient quantity,  $Q_{OPT}$ . The charge of £9 is the optimal Pigouvian tax in this case: it moves the equilibrium to the efficient outcome,  $O$ .



9. The accompanying table shows six consumers' willingness to pay (his or her individual marginal benefit) for one MP3 file copy of a Jay-Z album. The marginal cost of making the file accessible to one additional consumer is constant, at zero.

Consumer	Individual marginal benefit
Adriana	\$2
Bhagesh	15
Chizuko	1
Denzel	10
Emma	5
Frank	4

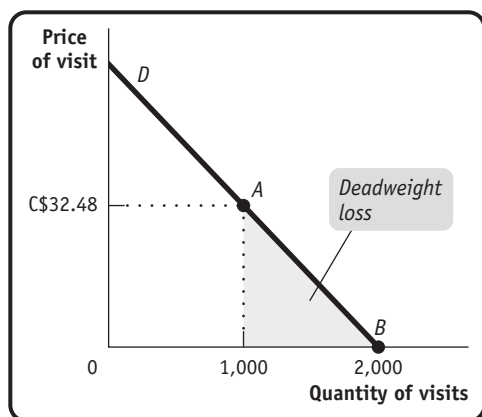
- What would be the efficient price to charge for a download of the file?
- All six consumers are able to download the file for free from a file-sharing service, Pantster. Which consumers will download the file? What will be the total consumer surplus to those consumers?
- Pantster is shut down for copyright law infringement. In order to download the file, consumers now have to pay \$4.99 at a commercial music site. Which consumers will download the file? What will be the total consumer surplus to those consumers? How much producer surplus accrues to the commercial music site? What is the total surplus? What is the deadweight loss from the new pricing policy?

## Solution

9. a. Since the marginal cost of delivering the good to one additional consumer is zero, the efficient price would be zero.
- b. Since each of the six consumers has a marginal benefit greater than zero, all six will download the file. Adriana's individual consumer surplus will be \$2, Bhagesh's \$15, Chizuko's \$1, Denzel's \$10, Emma's \$5, and Frank's \$4. The total consumer surplus is therefore  $\$2 + \$15 + \$1 + \$10 + \$5 + \$4 = \$37$ .

- c. At a price of \$4.99, Bhagesh, Denzel, and Emma will download the file. Bhagesh's individual consumer surplus will be \$10.01, Denzel's \$5.01, and Emma's \$0.01. So total consumer surplus is  $\$10.01 + \$5.01 + \$0.01 = \$15.03$ . Producer surplus is  $3 \times \$4.99 = \$14.97$ . So total surplus is  $\$15.03 + \$14.97 = \$30$ . This is \$7 less than in part b. So the deadweight loss from making the good artificially scarce is \$7.
10. Butchart Gardens is a very large garden in Victoria, British Columbia, renowned for its beautiful plants. It is so large that it could hold many times more visitors than currently visit it. The garden charges an admission fee of \$30. At this price, 1,000 people visit the garden each day. If admission were free, 2,000 people would visit each day.
- Are visits to Butchart Gardens excludable or nonexcludable? Are they rival in consumption or nonrival? What type of good is it?
  - In a diagram, illustrate the demand curve for visits to Butchart Gardens. Indicate the situation when Butchart Gardens charges an admission fee of \$30. Also indicate the situation when Butchart Gardens charges no admission fee.
  - Illustrate the deadweight loss from charging a \$30 admission fee. Explain why charging this admission fee is inefficient.

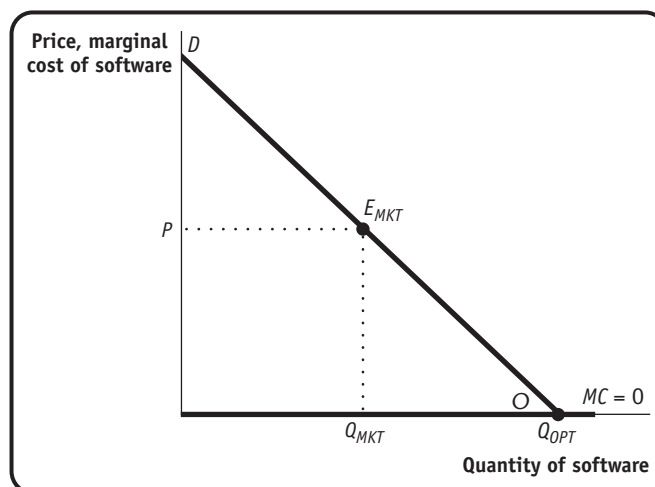
10. a. Visits to Butchart Gardens are excludable (there is an entrance fee) and nonrival (the garden could hold many more visitors than it currently hosts, so one visitor's enjoyment of the park does not diminish another visitor's enjoyment). So visits to Butchart Gardens are an artificially scarce good.
- b. The demand curve is illustrated in the accompanying diagram. The situation when Butchart Gardens charges a \$30 admission fee is indicated by point A on the demand curve. The situation when Butchart Gardens charges no admission fee is indicated by point B on the demand curve.



- c. The deadweight loss from charging a \$30 admission fee rather than no fee is indicated by the shaded area in the diagram. Since the marginal cost of admitting one more visitor is zero, it would be efficient to charge no admission. However, since the good is artificially scarce and an admission fee of \$30 is charged, only those consumers with a marginal benefit greater than \$30 will visit the gardens. There are 1,000 consumers who have marginal benefits that exceed the marginal cost of allowing them access, but they are prevented from visiting the gardens by the \$30 admission fee.

- 11.** Software has historically been an artificially scarce good—it is nonrival because the cost of replication is negligible once the investment to write the code is made, but software companies make it excludable by charging for user licenses. But then open-source software emerged, most of which is free to download and can be modified and maintained by anyone.
- Discuss the free-rider problem that might exist in the development of open-source software. What effect might this have on quality? Why does this problem not exist for proprietary software, such as the products of a company like Microsoft or Adobe?
  - Some argue that open-source software serves an unsatisfied market demand that proprietary software ignores. Draw a typical diagram that illustrates how proprietary software may be underproduced. Put the price and marginal cost of software on the vertical axis and the quantity of software on the horizontal axis. Draw a typical demand curve and a marginal cost curve ( $MC$ ) that is always equal to zero. Assume that the software company charges a positive price,  $P$ , for the software. Label the equilibrium point and the efficient point.

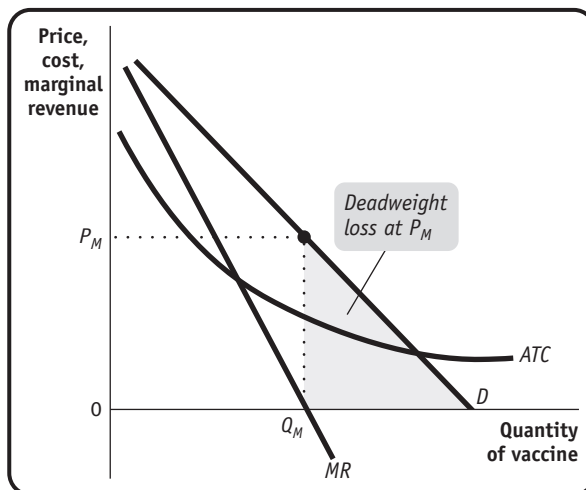
- 11. a.** In principle, the developers of open-source software are not strictly monitored. Some developers may shirk and write poor code in the hope that others in the development community will correct their mistakes. A free-rider problem is created because individual developers are not held responsible for their code, potentially resulting in poor quality.
- Microsoft and Adobe, however, are responsible for the quality of their software; they risk losing business and profits if their product is substandard. So company management enforces quality-control measures that mitigate the free-rider problem.
- b.** The accompanying diagram shows a demand curve,  $D$ , and a marginal cost curve that is constant and always equal to zero,  $MC$ . The equilibrium is at point  $E_{MKT}$ , with a quantity,  $Q_{MKT}$ , that is lower than the efficient quantity,  $Q_{OPT}$ .



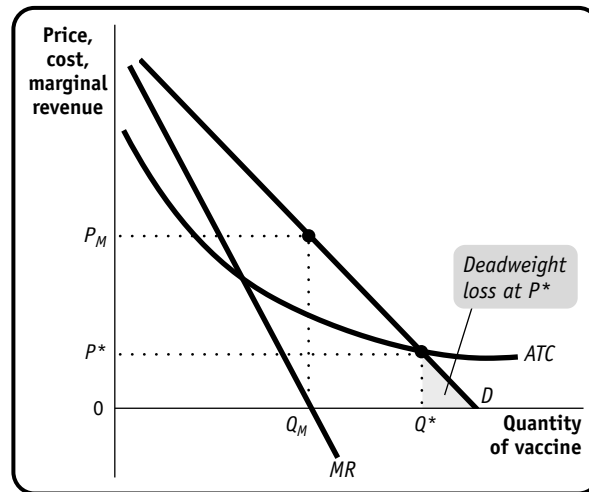
12. In developing a vaccine for the SARS virus, a pharmaceutical company incurs a very high fixed cost. The marginal cost of delivering the vaccine to patients, however, is negligible (consider it to be equal to zero). The pharmaceutical company holds the exclusive patent to the vaccine. You are a regulator who must decide what price the pharmaceutical company is allowed to charge.
- Draw a diagram that shows the price for the vaccine that would arise if the company is unregulated, and label it  $P_M$ . What is the efficient price for the vaccine? Show the deadweight loss that arises from the price  $P_M$ .
  - On another diagram, show the lowest price that the regulator can enforce that would still induce the pharmaceutical company to develop the vaccine. Label it  $P^*$ . Show the deadweight loss that arises from this price. How does it compare to the deadweight loss that arises from the price  $P_M$ ?
  - Suppose you have accurate information about the pharmaceutical company's fixed cost. How could you use price regulation of the pharmaceutical company, combined with a subsidy to the company, to have the efficient quantity of the vaccine provided at the lowest cost to the government?

## Solution

12. a. If the company is unregulated, it will behave like a monopolist and choose a quantity,  $Q_M$ , at which marginal revenue is equal to marginal cost, which is equal to zero. This leads to the price  $P_M$ . The efficient price, however, is zero. There is a deadweight loss equal to the shaded area in the accompanying diagram.



- b. The lowest price that still induces the company to develop the vaccine is the price at which the demand curve crosses the average total cost curve. At this price, the company just breaks even. There is a smaller deadweight loss than under the price  $P_M$ . The deadweight loss is indicated by the shaded area in the accompanying diagram.



- c. You could regulate the company's price to be equal to zero. That way, all consumers with a positive willingness to pay will get the vaccine. To guarantee that the company will develop the vaccine, the government will pay the company a subsidy equal to its fixed cost.

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13. A residential community has 100 residents who are concerned about security. The accompanying table gives the total cost of hiring a 24-hour security service as well as each individual resident's total benefit.

Quantity of security guards	Total cost	Total individual benefit to each resident
0	\$0	\$0
1	150	10
2	300	16
3	450	18
4	600	19

- Explain why the security service is a public good for the residents of the community.
- Calculate the marginal cost, the individual marginal benefit for each resident, and the marginal social benefit.
- If an individual resident were to decide about hiring and paying for security guards on his or her own, how many guards would that resident hire?
- If the residents act together, how many security guards will they hire?

### Solution

13. a. Security services are nonexcludable: as soon as security is provided to the community, every resident benefits from it. Security services are nonrival: if one resident enjoys protection, this does not diminish any other resident's ability to enjoy the service.
- b. The accompanying table calculates the marginal cost, the individual marginal benefit, and the marginal social benefit. The marginal social benefit is just the individual marginal benefit times 100, since there are 100 residents.

Quantity of security guards	Total cost	Marginal cost	Total individual benefit to each resident	Individual marginal benefit	Marginal social benefit
0	\$0		\$0		
1	150	\$150	10	\$10	\$1,000
2	300	150	16	6	600
3	450	150	18	2	200
4	600	150	19	1	100

- c. An individual resident would compare the marginal cost of hiring an additional security guard against his or her individual marginal benefit. Since the marginal cost of hiring even the first security guard exceeds the individual marginal benefit to the resident, the resident would decide to hire no security guards on his or her own.
- d. If the residents act together, they will compare the marginal cost of hiring an additional security guard against the marginal social benefit. They will therefore decide to hire 3 security guards. For the third security guard, the marginal social benefit of \$200 exceeds the marginal cost of \$150. But for the fourth security guard, the marginal cost of \$150 would exceed the marginal social benefit of \$100.





# The Economics of the Welfare State

1. The accompanying table contains data on the U.S. economy for the years 1983 and 2013. The second column shows the poverty threshold. The third column shows the consumer price index (CPI), a measure of the overall level of prices. And the fourth column shows U.S. gross domestic product (GDP) per capita, a measure of the standard of living.

Year	Poverty threshold	CPI (1982–1984 = 100)	GDP per capita
1983	\$5,180	99.6	\$15,525
2013	11,490	233.0	53,086

Source: U.S. Census Bureau; Bureau of Labor Statistics; Bureau of Economic Analysis.  
\*Denotes estimate.

- By what factor has the poverty threshold increased from 1983 to 2013? That is, has it doubled, tripled, and so on?
- By what factor has the CPI (a measure of the overall price level) increased from 1983 to 2013? That is, has it doubled, tripled, and so on?
- By what factor has GDP per capita (a measure of the standard of living) increased from 1983 to 2013? That is, has it doubled, tripled, and so on?
- What do your results tell you about how those people officially classified as “poor” have done economically relative to other U.S. citizens?

## Solution

- The poverty threshold has increased by a factor of  $\$11,490/\$5,180 = 2.2$  from 1983 to 2013. That is, it has roughly doubled.
  - The CPI has increased by a factor of  $233.0/99.6 = 2.3$  from 1983 to 2013. That is, it also has roughly doubled. This, of course, is unsurprising: the poverty threshold each year is adjusted upward nearly by the increase in the overall price level.
  - GDP per capita has increased by a factor of  $\$53,086/\$15,525 = 3.4$  from 1983 to 2013. That is, it has roughly tripled.
  - Since the standard of living has grown more rapidly than the poverty threshold, those officially classified as “poor” have done increasingly worse relative to other U.S. citizens: if you are classified as “poor” (that is, below the poverty threshold) today, you are doing dramatically worse relative to the rest of the population than someone who was classified as “poor” in 1983.
- In the city of Metropolis, there are 100 residents, each of whom lives until age 75. Residents of Metropolis have the following incomes over their lifetime: Through age 14, they earn nothing. From age 15 until age 29, they earn 200 metros (the currency of Metropolis) per year. From age 30 to age 49, they earn 400 metros. From age 50 to age 64, they earn 300 metros. Finally, at age 65 they retire and are paid a pension of 100 metros per year until they die at age 75. Each year, everyone consumes whatever their income is that year (that is, there is no saving and no borrowing). Currently, 20 residents are 10 years old, 20 residents are 20 years old, 20 residents are 40 years old, 20 residents are 60 years old, and 20 residents are 70 years old.

- a. Study the income distribution among all residents of Metropolis. Split the population into quintiles according to their income. How much income does a resident in the lowest quintile have? In the second, third, fourth, and top quintiles? What share of total income of all residents goes to the residents in each quintile? Construct a table showing the share of total income that goes to each quintile. Does this income distribution show inequality?
- b. Now look only at the 20 residents of Metropolis who are currently 40 years old, and study the income distribution among only those residents. Split those 20 residents into quintiles according to their income. How much income does a resident in the lowest quintile have? In the second, third, fourth, and top quintiles? What share of total income of all 40-year-olds goes to the residents in each quintile? Does this income distribution show inequality?
- c. What is the relevance of these examples for assessing data on the distribution of income in any country?

## Solution

2. a. Each quintile will contain  $100/5 = 20$  citizens. Total income in Metropolis among all citizens is  $(20 \times 0) + (20 \times 200) + (20 \times 400) + (20 \times 300) + (20 \times 100) = 20,000$ . The citizens in the lowest quintile are the 10-year-olds, with income of 0 metros each, for a total income in that quintile of 0 metros, which is 0% of the total income. The citizens in the second quintile are the 70-year-olds, with income of 100 metros each, for a total income in that quintile of  $20 \times 100 = 2,000$  metros, which is  $2,000/20,000 = 10\%$  of the total income. The citizens in the third quintile are the 20-year-olds, with income of 200 metros each, for a total income in that quintile of  $20 \times 200 = 4,000$  metros, which is  $4,000/20,000 = 20\%$  of the total income. The citizens in the fourth quintile are the 60-year-olds, with income of 300 metros each, for a total income in that quintile of  $20 \times 300 = 6,000$  metros, which is  $6,000/20,000 = 30\%$  of the total income. The citizens in the top quintile are the 40-year-olds, with income of 400 metros each, for a total income in that quintile of  $20 \times 400 = 8,000$  metros, which is  $8,000/20,000 = 40\%$  of the total income. The accompanying table shows the income distribution. This income distribution exhibits considerable inequality.

Quintile	Share of total income
Lowest	0%
Second	10
Third	20
Fourth	30
Top	40

- b. All 40-year-olds have the same income: 400 metros. Each quintile will contain  $20/5 = 4$  citizens. That is, the citizens in the lowest quintile (the lowest four earners) have income of 400 metros. The citizens in the second quintile (the next higher four earners) also have income of 400 metros, and so on. Since total income of all 40-year-olds is  $20 \times 400 = 8,000$  metros, the share of total income earned by citizens in the lowest quintile is  $(4 \times 400)/8,000 = 20\%$ . This is the same for all quintiles. The income distribution exhibits complete equality: the share of total income earned by citizens in each quintile is exactly equal.
- c. These examples show how looking at the overall income distribution can overstate the true degree of inequality. Since incomes tend to vary over the life cycle, studying the income distribution across all citizens shows greater inequality than when studying the income distribution across citizens of the same age.

3. The accompanying table presents data from the U.S. Census Bureau on median and mean income of male workers for the years 1972 and 2012. The income figures are adjusted to eliminate the effect of inflation.

Year	Median income	Mean income
	(in 2012 dollars)	
1972	\$36,547	\$42,383
2012	33,904	49,915

Source: U.S. Census Bureau.

- a. By what percentage has median income changed over this period? By what percentage has mean income changed over this period?
- b. Between 1972 and 2012, has the income distribution become less or more unequal? Explain.

### Solution

3. a. Median income, the income of the typical worker, has actually fallen, by \$2,643. In percentage terms this is a fall of  $\$2,643/\$36,547 \times 100 = 7.2\%$ . However, mean (or average) income has increased by \$7,532; in percentage terms this is an increase of  $\$7,532/\$42,383 \times 100 = 17.7\%$ .
- b. Since median income has fallen, but mean income has grown significantly, this means that most of the growth in incomes has been at the top of the income distribution. If the incomes of the highest earners increase, this will raise the average income but leave the median income unchanged. So the income distribution has become more unequal from 1972 to 2012.

4. There are 100 households in the economy of Equalor. Initially, 99 of them have an income of \$10,000 each, and one household has an income of \$1,010,000.
- a. What is the median income in this economy? What is the mean income?
- Through its poverty programs, the government of Equalor now redistributes income: it takes \$990,000 away from the richest household and distributes it equally among the remaining 99 households.
- b. What is the median income in this economy now? What is the mean income? Has the median income changed? Has the mean income changed? Which indicator (mean or median household income) is a better indicator of the typical Equalorian household's income? Explain.

### Solution

4. a. The median income is the income of the household in the exact middle of the income distribution. The exact middle of 100 households is in between the 49th and the 50th household; but since both of those households have income of \$10,000, we can say that the median household income is exactly \$10,000. The mean (or average) household income is the total income of all households, divided by the number of households. In Equalor, the mean household income is therefore  $(99 \times \$10,000 + \$1,010,000)/100 = \$20,000$ .
- b. After this redistribution, all households now have income of \$20,000. So the median household income is \$20,000. The mean (or average) household income is  $(100 \times \$20,000)/100 = \$20,000$ . Note that although the median household income has increased, the mean household income has remained the same. This is one reason why economists generally think of median household income as a better indicator of the typical household's income than mean income: it is obvious that as a result of the redistribution, the typical Equalorian household has been made better off. This is reflected by the increased median household income. However, this increase in the typical household's income is not captured by mean (or average) household income at all.

5. The country of Marxland has the following income tax and social insurance system. Each citizen's income is taxed at an average tax rate of 100%. A social insurance system then provides transfers to each citizen such that each citizen's after-tax income is exactly equal. That is, each citizen gets (through a government transfer payment) an equal share of the income tax revenue. What is the incentive for one individual citizen to work and earn income? What will the total tax revenue in Marxland be? What will be the after-tax income (including the transfer payment) for each citizen? Do you think such a tax system that creates perfect equality will work?

### Solution

5. If each citizen is taxed at an average tax rate of 100%, his or her income is entirely taxed away. Each citizen then receives an equal share of the total tax revenue. So the incentive for an individual citizen is not to work at all, to pay no taxes, but still to receive an equal share of the income (the tax revenue) generated by everyone else. As a result, no one will work, there will be no pre-tax income or tax revenue, and each citizen's after-tax income will also be zero. A tax system that creates perfect equality in this way will destroy any incentive to earn income and so be impossible to implement.
6. The tax system in Taxilvania includes a negative income tax. For all incomes below \$10,000, individuals pay an income tax of  $-40\%$  (that is, they receive a payment of 40% of their income). For any income above the \$10,000 threshold, the tax rate on that additional income is 10%. For the first three scenarios below, calculate the amount of income tax to be paid and after-tax income.
- Lowani earns income of \$8,000.
  - Midram earns income of \$40,000.
  - Hi-Wan earns income of \$100,000.
  - Can you find a notch in this tax system? That is, can you find a situation where earning more pre-tax income actually results in *less* after-tax income?

### Solution

6. a. The income tax on the first \$10,000 is  $-40\%$ , and since Lowani does not earn more than \$10,000, this determines her income tax: she pays income tax of  $-0.4 \times \$8,000 = -\$3,200$ . That is, she receives a payment of \$3,200 from the government. So her total after-tax income is  $\$8,000 + \$3,200 = \$11,200$ .
- b. The income tax on the first \$10,000 is  $-40\%$ , so on that income Midram pays  $-0.4 \times \$10,000 = -\$4,000$ . On the next \$30,000 of his income, Midram pays 10% taxes, so his tax payment on that portion of his income is  $0.10 \times \$30,000 = \$3,000$ . Overall, Midram pays income tax of  $-\$4,000 + \$3,000 = -\$1,000$ . That is, he still receives a payment of \$1,000 from the government. So his total after-tax income is  $\$40,000 + \$1,000 = \$41,000$ .
- c. The income tax on the first \$10,000 is  $-40\%$ , so on that income Hi-Wan pays  $-0.4 \times \$10,000 = -\$4,000$ . On the next \$90,000 of his income, Hi-Wan pays 10% taxes, so his tax payment on that portion of his income is  $0.10 \times \$90,000 = \$9,000$ . Overall, Hi-Wan pays income tax of  $-\$4,000 + \$9,000 = \$5,000$ . So his total after-tax income is  $\$100,000 - \$5,000 = \$95,000$ .
- d. There is no notch in this tax system. Whenever you earn more pre-tax income, your after-tax income increases as well. This is certainly true for the first \$10,000 earned: for each additional dollar earned below \$10,000, your after-tax income actually increases by \$1.40. And it is still true for any amount earned above \$10,000: for each additional dollar earned above \$10,000, your after-tax income increases by \$0.90. So there is no situation where earning more pre-tax income actually reduces your after-tax income.

7. In the city of Nottingham, each worker is paid a wage rate of \$10 per hour. Nottingham administers its own unemployment benefit, which is structured as follows: If you are unemployed (that is, if you do not work at all), you get unemployment benefits (a transfer from the government) of \$50 per day. As soon as you work for only one hour, the unemployment benefit is completely withdrawn. That is, there is a notch in the benefit system.
- How much income does an unemployed person have per day? How much daily income does an individual who works four hours per day have? How many hours do you need to work to earn just the same as if you were unemployed?
  - Will anyone ever accept a part-time job that requires working four hours per day, rather than being unemployed?
  - Suppose that Nottingham now changes the way in which the unemployment benefit is withdrawn. For each additional dollar an individual earns, \$0.50 of the unemployment benefit is withdrawn. How much daily income does an individual who works four hours per day now have? Is there an incentive now to work four hours per day rather than being unemployed?

**Solution**

7. a. An unemployed person has \$50 income per day. An individual who works four hours per day has daily income of \$40. If you worked five hours per day, you would earn equally as much as if you were unemployed.
- b. Since leisure is presumably preferable to work, no one would want to take a job that requires less than five hours work per day, since such a job would generate less income than the unemployment benefit and would require giving up leisure time.
- c. If \$0.50 of the unemployment benefit is withdrawn for every earned dollar of income, for an individual who works four hours per day and so has earned income of \$40, the unemployment benefit is cut by  $40 \times 0.50 = 20$ . That is, an individual who works for four hours per day has total income of  $40 + 50 - 20 = 70$  (income from work plus unemployment benefit minus cut in unemployment benefit). Now there is a financial incentive to working four hours per day: the individual makes \$20 more than by being unemployed.
8. The accompanying table shows data on the total number of people in the United States and the number of all people who were uninsured, for selected years from 1999 to 2011. It also shows data on the total number of poor children in the United States—those under 18 and below the poverty threshold—and the number of poor children who were uninsured.

Year	Total people	Uninsured people	Total poor children	Uninsured poor children
(millions)				
1999	276.8	38.8	12.3	3.8
2001	282.1	39.8	11.7	3.3
2003	288.3	43.4	12.9	3.3
2005	293.8	44.8	12.9	3.1
2007	299.1	45.7	13.3	3.1
2009	304.3	50.7	15.5	3.1
2011	308.3	48.6	16.1	3.0

Source: U.S. Census Bureau.

For each year, calculate the percentage of all people who were uninsured and the percentage of poor children who were uninsured. How have these percentages changed over time? What is a possible explanation for the change in the percentage of uninsured poor children?

### Solution

8. The accompanying table calculates the percentages of all uninsured people and the percentages of uninsured poor children.

Year	Uninsured people	Uninsured poor children
1999	14%	31%
2001	14	28
2003	15	26
2005	15	24
2007	15	23
2009	17	20
2011	16	19

The percentage of all uninsured people has been relatively steady since 1997. However, the percentage of uninsured poor children has fallen dramatically, even in 2009, when the percentage of uninsured people overall increased. As the chapter explained, SCHIP, created in 1997, gives health insurance benefits to certain children. This has almost certainly helped to lower the percentage of uninsured children, especially among children in poverty.

9. The American National Election Studies conducts periodic research on the opinions of U.S. voters. The accompanying table shows the percentage of people, in selected years from 1952 to 2008, who agreed with the statement “There are important differences in what the Republicans and Democrats stand for.”

Year	Agree with statement
1952	50%
1972	46
1992	60
2004	76
2008	78

Source: American National Election Studies.

What do these data say about the degree of partisanship in U.S. politics over time?

### Solution

9. Clearly, voters increasingly feel that the degree of partisanship in U.S. politics has increased over time, as political parties are perceived to be increasingly different in their platforms.

- 10.** In a private insurance market, there are two different kinds of people: some who are more likely to require expensive medical treatment and some who are less likely to require medical treatment and who, if they do, require less expensive treatment. One health insurance policy is offered, tailored to the average person's health care needs: the premium is equal to the average person's medical expenses (plus the insurer's expenses and normal profit).
- Explain why such an insurance policy is unlikely to be feasible.
- In an effort to avoid the adverse selection death spiral, a private health insurer offers two health insurance policies: one that is intended for those who are more likely to require expensive treatment (and therefore charges a higher premium) and one that is intended for those who are less likely to require treatment (and therefore charges a lower premium).
- Could this system overcome the problem created by adverse selection?
  - How does the British National Health Service (NHS) avoid these problems?

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- 10.** **a.** This insurance policy is unlikely to be feasible because those people who are less likely to require expensive treatment generally know that they are less likely to need health insurance. And since the insurance premium is based on the average person's medical expenses, those who are less likely to require treatment will find this policy too expensive. So many of these individuals will not purchase this one-size-fits-all policy. However, the policy is generally a good deal for those who know they are likely to require a lot of—and very expensive—medical treatment, and those individuals will want to buy the policy. So the insurer will be left with an *adverse selection* of mostly high-risk individuals and, in order to avoid losing money on selling the policy, will have to increase the premium. These are the first steps in what is known as the adverse selection death spiral.
- b.** Even offering two different insurance policies will likely not work, because the insurer generally knows less well than the individual whether any given individual has a high or low risk of requiring treatment. As a result, everyone would want to buy the cheaper (lower-premium) policy. If the insurer is unable to tell whether some high-risk individuals are purchasing the insurance policy not intended for them, it will lose money on this policy and will have to increase the premium. This, again, is the first step in the adverse selection death spiral.
- c.** As you learned in the chapter, the British National Health Service is a government agency that extends health care to everyone in Britain (this includes you as an American if you are in Britain on vacation!). And it pays for the cost out of general taxation. That is, no one has the option to opt out of paying for this government-provided health insurance policy.





# Factor Markets and the Distribution of Income

1. In 2013, national income in the United States was \$14,542.4 billion. In the same year, 137 million workers were employed, at an average wage, including benefits, of \$64,667 per worker per year.
  - a. How much compensation of employees was paid in the United States in 2013?
  - b. Analyze the factor distribution of income. What percentage of national income was received in the form of compensation to employees in 2013?
  - c. Suppose that a huge wave of corporate downsizing leads many terminated employees to open their own businesses. What is the effect on the factor distribution of income?
  - d. Suppose the supply of labor rises due to an increase in the retirement age. What happens to the percentage of national income received in the form of compensation of employees?

## Solution

1.
  - a. Since 137 million workers were employed at an average yearly wage of \$64,667, the total amount of compensation of employees was  $137 \text{ million} \times \$64,667 = \$8,859.4 \text{ billion}$ .
  - b. Of a total of \$14,542.4 billion, the amount received by workers was \$8,859.4 billion. In percentage terms, this is  $(\$8,859.4 \text{ billion} / \$14,542.4 \text{ billion}) \times 100 = 61.0\%$ .
  - c. The effect of this change is to diminish the share of income going to compensate employees and increase the share going to proprietors' income.
  - d. As the supply of labor increases, the equilibrium wage rate falls, but the equilibrium number of workers employed rises. So it is not clear whether more or less of national income is paid to workers in the form of compensation.
2. Marty's Frozen Yogurt has the production function per day shown in the accompanying table. The equilibrium wage rate for a worker is \$80 per day. Each cup of frozen yogurt sells for \$2.

Quantity of labor (workers)	Quantity of frozen yogurt (cups)
0	0
1	110
2	200
3	270
4	300
5	320
6	330

- a. Calculate the marginal product of labor for each worker and the value of the marginal product of labor per worker.
- b. How many workers should Marty employ?

## Solution

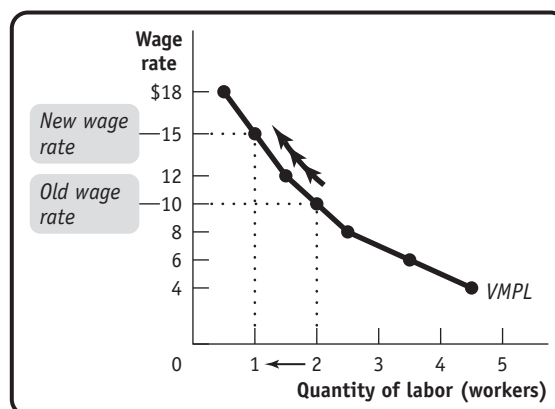
2. a. The accompanying table shows the marginal product of labor ( $MPL$ ) and the value of the marginal product of labor ( $VMPL$ ) of each worker. Remember that  $VMPL = P \times MPL$ . Here that means that  $VMPL = \$2 \times MPL$ .

Quantity of labor (workers)	Quantity of frozen yogurt (cups)	$MPL$ (cups per worker)	$VMPL$ (per worker)
0	0		
1	110	110	\$220
2	200	90	180
3	270	70	140
4	300	30	60
5	320	20	40
6	330	10	20

- b. Marty should employ 3 workers. The value of the marginal product of the third worker (\$140) is above the wage rate of \$80: Marty should hire the third worker. But the fourth worker's value of the marginal product is only \$60. This is less than Marty would have to pay this worker, so Marty should not hire a fourth worker.
3. The production function for Patty's Pizza Parlor is given in the table in Problem 14. The price of pizza is \$2, but the hourly wage rate rises from \$10 to \$15. Use a diagram to determine how Patty's demand for workers responds as a result of this wage rate increase.

## Solution

3. The accompanying diagram shows the value of the marginal product of labor curve and the wage rates of \$10 and \$15. As the wage rate increases from \$10 to \$15, Patty's demand for workers decreases from 2 workers to 1 worker. So, as the wage rate increases, Patty should hire fewer workers.



4. Jameel runs a driver education school. The more driving instructors he hires, the more driving lessons he can sell. But because he owns a limited number of training automobiles, each additional driving instructor adds less to Jameel's output of driving lessons. The accompanying table shows Jameel's production function per day. Each driving lesson can be sold at \$35 per hour.

Quantity of labor (driving instructors)	Quantity of driving lessons (hours)
0	0
1	8
2	15
3	21
4	26
5	30
6	33

Determine Jameel's labor demand schedule (his demand schedule for driving instructors) for each of the following daily wage rates for driving instructors: \$160, \$180, \$200, \$220, \$240, and \$260.

### Solution

4. The accompanying table calculates the marginal product of labor (*MPL*) and the value of the marginal product of labor (*VMPL*).

Quantity of labor (driving instructors)	Quantity of driving lessons (hours)	<i>MPL</i> (hours per driving instructor)	<i>VMPL</i> (per driving instructor)
0	0		
1	8	8	\$280
2	15	7	245
3	21	6	210
4	26	5	175
5	30	4	140
6	33	3	105

If the daily wage rate of driving instructors is \$160, Jameel should hire 4 instructors: the fourth instructor has a value of the marginal product of \$175, which is greater than the wage rate; but the fifth instructor would have a value of the marginal product of only \$140, which is less than the wage rate. By similar reasoning for the other wage rates, Jameel's demand schedule for labor is as shown in the accompanying table.

Daily wage rate	Quantity of labor demanded (driving instructors)
\$160	4
180	3
200	3
220	2
240	2
260	1

5. Dale and Dana work at a self-service gas station and convenience store. Dale opens up every day, and Dana arrives later to help stock the store. They are both paid the current market wage of \$9.50 per hour. But Dale feels he should be paid much more because the revenue generated from the gas pumps he turns on every morning is much higher than the revenue generated by the items that Dana stocks. Assess this argument.

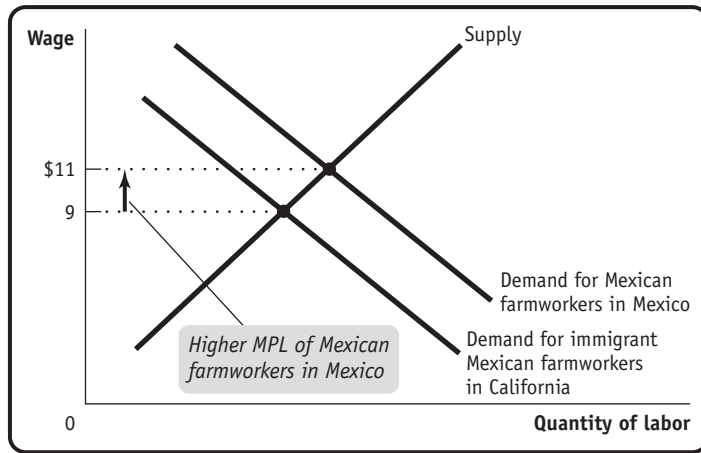
### Solution

5. Dale's argument is incorrect because the owner of the business will hire workers until the hourly value of the marginal product of the last person hired equals \$9.50. This implies that all other workers hired will have an hourly value of the marginal product higher than \$9.50 but will be paid a wage of \$9.50. Or to put it a slightly different way, any worker who opens the station, regardless of whether it is Dale or Dana, will have a higher value of the marginal product than the second person to report for work.
6. A *New York Times* article observed that the wage of farmworkers in Mexico was \$11 an hour but the wage of immigrant Mexican farmworkers in California was \$9 an hour.
- Assume that the output sells for the same price in the two countries. Does this imply that the marginal product of labor of farmworkers is higher in Mexico or in California? Explain your answer, and illustrate with a diagram that shows the demand and supply curves for labor in the respective markets. In your diagram, assume that the quantity supplied of labor for any given wage rate is the same for Mexican farmworkers as it is for immigrant Mexican farmworkers in California.
  - Now suppose that farmwork in Mexico is more arduous and more dangerous than farmwork in California. As a result, the quantity supplied of labor for any given wage rate is not the same for Mexican farmworkers as it is for immigrant Mexican farmworkers in California. How does this change your answer to part a? What concept best accounts for the difference between wage rates for Mexican farmworkers and immigrant Mexican farmworkers in California?
  - Illustrate your answer to part b with a diagram. In this diagram, assume that the quantity of labor demanded for any given wage rate is the same for Mexican employers as it is for Californian employers.

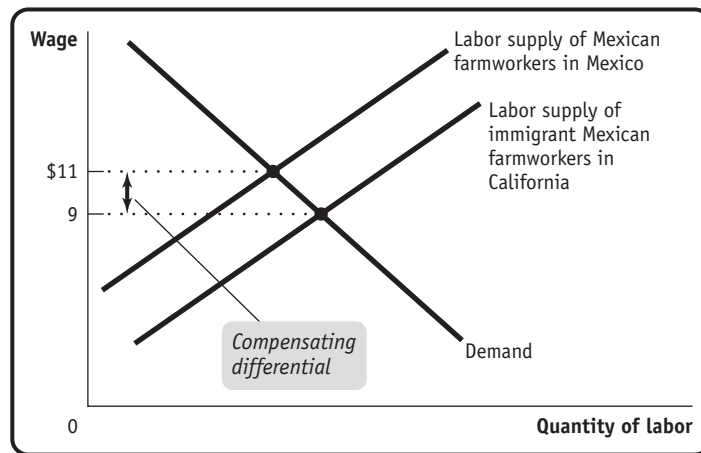
### Solution

6. a. We know that farmworkers are employed up to the point where the value of the marginal product of labor is just equal to the wage:  $VMPL = P \times MPL = W$ . In Mexico, this means that  $P \times MPL_{Mexico} = \$11$  and in California  $P \times MPL_{California} = \$9$ . Since the price,  $P$ , is the same in Mexico and in California, this means that the marginal product of labor in Mexico has to be higher than in California. Assuming that the quantity supplied for any given wage rate is the same for Mexican farmworkers as it is for immigrant Mexican farmworkers in California implies that the two groups have equivalent supply curves. Therefore, one supply curve can be drawn to illustrate the supply responses of both types of workers. The different wage rates received by the two groups of workers is a result of differences

in the demand curves for labor. Because Mexican farmworkers have a higher marginal product of labor, the demand curve for their labor lies above and to the right of the demand curve for their peers in California, as shown in the accompanying diagram.



- b. Because farmwork in Mexico is more arduous and dangerous than farmwork in California, we can no longer infer that the higher wages paid to Mexican farmworkers is evidence that they have a higher marginal product of labor than their peers in California. Rather, the difference in wages is a compensating differential that compensates Mexican farmworkers for the greater difficulty and danger they face.
- c. Assuming that the quantity of labor demanded for any given wage rate is the same for the two groups means that one demand curve can be drawn to represent employers' demand responses in both markets. The compensating differential that Mexican farmworkers demand relative to their peers in California is illustrated by their supply curve of labor in the accompanying diagram, which lies above and to the left of the supply curve of their Californian peers.



- 7.** Kendra is the owner of Wholesome Farms, a commercial dairy. Kendra employs labor, land, and capital. In her operations, Kendra can substitute between the amount of labor she employs and the amount of capital she employs. That is, to produce the same quantity of output she can use more labor and less capital; similarly, to produce the same quantity of output she can use less labor and more capital. Let  $w^*$  represent the annual cost of labor in the market, let  $r_L^*$  represent the annual cost of a unit of land in the market, and let  $r_K^*$  represent the annual cost of a unit of capital in the market.
- Suppose that Kendra can maximize her profits by employing less labor and more capital than she is currently using but the same amount of land. What three conditions must now hold for Kendra's operations (involving her value of the marginal product of labor, land, and capital) for this to be true?
  - Kendra believes that she can increase her profits by renting and using more land. However, if she uses more land she must use more of both labor and capital; if she uses less land, she can use less of both labor and capital. What three conditions must hold (involving her value of the marginal product of labor, land, and capital) for this to be true?

### Solution

- 7. a.** The three conditions are: (1) Kendra's current value of the marginal product of land  $= r_L^*$ . Only if this is satisfied should Kendra leave the amount of land she employs unchanged. (2) Kendra's current value of the marginal product of labor  $< w^*$ . Only if this is satisfied should Kendra reduce the amount of labor she employs. (3) Kendra's current value of the marginal product of capital  $> r_K^*$ . Only if this is satisfied should Kendra increase the amount of capital she uses.
- b.** The three conditions are: (1) Kendra's current value of the marginal product of land  $> r_L^*$ . Only if this is satisfied should Kendra increase the amount of land she employs. (2) Kendra's current value of the marginal product of labor  $> w^*$ . Kendra must hire more labor if she employs more land. Thus, only if this condition is satisfied should Kendra increase the amount of labor she employs along with the amount of land. (3) Kendra's current value of the marginal product of capital  $> r_K^*$ . Kendra must use more capital if she employs more land. Thus, only if this condition is satisfied should Kendra increase the amount of capital she uses along with the amount of land.
- 8.** For each of the following situations in which similar workers are paid different wages, give the most likely explanation for these wage differences.
- Test pilots for new jet aircraft earn higher wages than airline pilots.
  - College graduates usually have higher earnings in their first year on the job than workers without college degrees have in their first year on the job.
  - Full professors command higher salaries than assistant professors for teaching the same class.
  - Unionized workers are generally better paid than non-unionized workers.

## Solution

8. a. This is most likely because being a test pilot for a new aircraft design is more dangerous than flying a commercial airliner. So the most likely explanation is that of compensating differentials.
- b. This is probably due to differences in human capital. More education gives a worker greater amounts of human capital. So more education usually translates into greater earnings.
- c. This is also probably due to differences in human capital. Because full professors have been teaching longer than assistant professors, their greater on-the-job experience has given them greater human capital. And greater human capital translates into higher salaries.
- d. Unions exercise considerable bargaining power in negotiating wages for their members. This results in higher wages and therefore wage differences that are not explained by marginal productivity theory.
9. Research consistently finds that despite nondiscrimination policies, African-American workers on average receive lower wages than White workers do. What are the possible reasons for this? Are these reasons consistent with marginal productivity theory?

## Solution

9. One possible reason is that this is the result of discrimination in the workplace. And, as you know, discrimination is not consistent with marginal productivity theory. But another possible reason for this income disparity is that it may be a result of *past* discrimination, which is consistent with marginal productivity theory. In the past, because of overt discrimination, the educational opportunities for African-American children were severely limited. These children are today's workers, and if their educational attainment is lower, they embody less human capital and are therefore paid a lower wage. So the current income disparity may imply past discrimination but be consistent with marginal productivity theory. But even if this is true, keep in mind that marginal productivity theory does not give *moral* justification to the current distribution of income.
10. Greta is an enthusiastic amateur gardener and spends a lot of her free time working in her yard. She also has a demanding and well-paid job as a freelance advertising consultant. Because the advertising business is going through a difficult time, the hourly consulting fee Greta can charge falls. Greta decides to spend more time gardening and less time consulting. Explain her decision in terms of income and substitution effects.

## Solution

10. As Greta's hourly consulting fee falls, the opportunity cost of leisure—time spent working in her yard—also falls. So the substitution effect will push Greta toward spending more time gardening and less time consulting. However, the income effect of a fall in the consulting fee makes Greta poorer and—since leisure is a normal good—less inclined to consume leisure. That is, the income effect will push Greta toward working more. If, overall, Greta decides to work less, the substitution effect must have dominated the income effect.

- 11.** You are the governor's economic policy adviser. The governor wants to put in place policies that encourage employed people to work more hours at their jobs and that encourage unemployed people to find and take jobs. Assess each of the following policies in terms of reaching that goal. Explain your reasoning in terms of income and substitution effects, and indicate when the impact of the policy may be ambiguous.
- The state income tax rate is lowered, which has the effect of increasing workers' after-tax wage rate.
  - The state income tax rate is increased, which has the effect of decreasing workers' after-tax wage rate.
  - The state property tax rate is increased, which reduces workers' after-tax income.

### Solution

- 11.**
- The effect of this policy on the incentive to work is ambiguous. A lower income tax rate has the effect of raising workers' wages in a real sense. The substitution effect will induce people to work more, but the income effect will induce them to work less. So this is an effective policy only if the substitution effect is stronger than the income effect.
  - The effect of this policy on the incentive to work is also ambiguous. A higher income tax rate has the effect of reducing workers' wages in a real sense. The substitution effect will induce people to work less, but the income effect will induce them to work more. So this is an effective policy only if the income effect is stronger than the substitution effect.
  - This policy will unambiguously encourage people to work more. The increase in the property tax rate makes people feel poorer, and as a result, they will consume less of all normal goods. Since leisure is a normal good, people will consume less leisure and work more. This policy influences how much labor is supplied only through the income effect. There is no substitution effect on the quantity of labor supplied in this case since the opportunity cost of leisure has not changed.

### WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



- 12.** Patty's Pizza Parlor has the production function per hour shown in the accompanying table. The hourly wage rate for each worker is \$10. Each pizza sells for \$2.

Quantity of labor (workers)	Quantity of pizza
0	0
1	9
2	15
3	19
4	22
5	24

- Calculate the marginal product of labor for each worker and the value of the marginal product of labor per worker.
- Draw the value of the marginal product of labor curve. Use your diagram to determine how many workers Patty should employ.
- Now the price of pizza increases to \$4. Calculate the value of the marginal product of labor per worker, and draw the new value of the marginal product of labor curve in your diagram. Use your diagram to determine how many workers Patty should employ now.



Now let's assume that Patty buys a new high-tech pizza oven that allows her workers to become twice as productive as before. That is, the first worker now produces 18 pizzas per hour instead of 9, and so on.

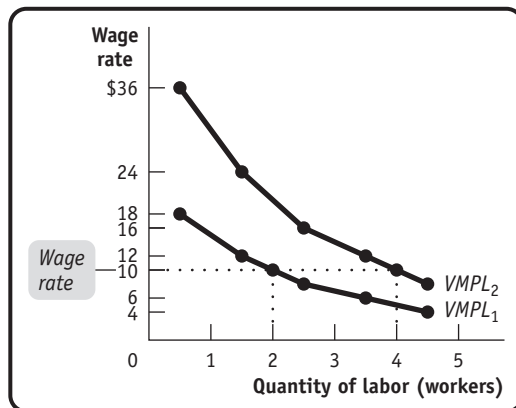
- d. Calculate the new marginal product of labor and the new value of the marginal product of labor at the original price of \$2 per pizza.
- e. Use a diagram to determine how Patty's hiring decision responds to this increase in the productivity of her workforce.

## Solution

12. a. The accompanying table shows the marginal product of labor ( $MPL$ ) and the value of the marginal product of labor ( $VMPL_1$ ).

Number of workers	Quantity of pizza	$MPL$ (pizzas per worker)	$VMPL_1$ (per worker) (price of pizza = \$2)	$VMPL_2$ (per worker) (price of pizza = \$4)
0	0			
1	9	9	\$18	\$36
2	15	6	12	24
3	19	4	8	16
4	22	3	6	12
5	24	2	4	8

- b. The accompanying diagram shows the value of the marginal product of labor curve ( $VMPL_1$ ). The value of the marginal product of labor equals the wage rate at 2 workers. So Patty should employ 2 workers.

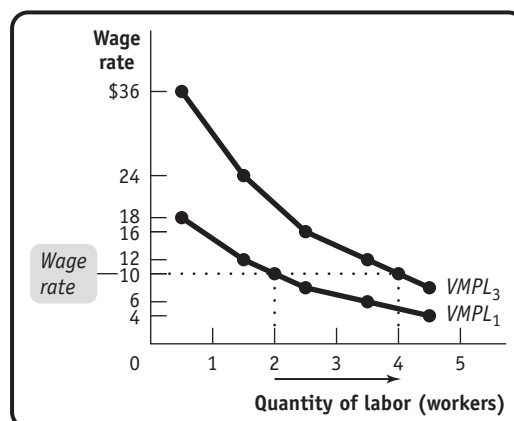


- c. The table shows the new value of the marginal product of labor ( $VMPL_2$ ). The value of the marginal product of labor curve is labeled  $VMPL_2$  in the diagram. The new value of the marginal product of labor equals the wage rate at 4 workers. So Patty should employ 4 workers.

- d. The accompanying table shows the new production function for Patty's Pizza Parlor, the new marginal product of labor ( $MPL_3$ ), and the new value of the marginal product of labor ( $VMPL_3$ ).

Quantity of labor (workers)	Quantity of pizza	$MPL_3$ (pizzas per worker)	$VMPL_3$ (per worker)
0	0		
1	18	18	\$36
2	30	12	24
3	38	8	16
4	44	6	12
5	48	4	8

- e. The accompanying diagram shows the original value of the marginal product of labor curve from part b ( $VMPL_1$ ) and the new value of the marginal product of labor curve ( $VMPL_3$ ). The value of the marginal product of labor now equals the wage rate at 4 workers. So Patty should employ 4 workers. As the value of the marginal product of labor increases—in this case as a result of a technological innovation (the new pizza oven)—Patty should hire more workers.



# Uncertainty, Risk, and Private Information

1. For each of the following situations, calculate the expected value.
  - a. Tanisha owns one share of IBM stock, which is currently trading at \$80. There is a 50% chance that the share price will rise to \$100 and a 50% chance that it will fall to \$70. What is the expected value of the future share price?
  - b. Sharon buys a ticket in a small lottery. There is a probability of 0.7 that she will win nothing, of 0.2 that she will win \$10, and of 0.1 that she will win \$50. What is the expected value of Sharon's winnings?
  - c. Aaron is a farmer whose rice crop depends on the weather. If the weather is favorable, he will make a profit of \$100. If the weather is unfavorable, he will make a profit of -\$20 (that is, he will lose money). The weather forecast reports that the probability of weather being favorable is 0.9 and the probability of weather being unfavorable is 0.1. What is the expected value of Aaron's profit?

## Solution

1.
  - a. The expected value of the share price is  $(0.5 \times \$100) + (0.5 \times \$70) = \$50 + \$35 = \$85$ .
  - b. The expected value of Sharon's winnings is  $(0.7 \times \$0) + (0.2 \times \$10) + (0.1 \times \$50) = \$0 + \$2 + \$5 = \$7$ .
  - c. The expected value of Aaron's profit is  $(0.9 \times \$100) + (0.1 \times (-\$20)) = \$90 + (-\$2) = \$88$ .
  
2. Vicky N. Vestor is considering investing some of her money in a startup company. She currently has income of \$4,000, and she is considering investing \$2,000 of that in the company. There is a 0.5 probability that the company will succeed and will pay out \$8,000 to Vicky (her original investment of \$2,000 plus \$6,000 of the company's profits). And there is a 0.5 probability that the company will fail and Vicky will get nothing (and lose her investment). The accompanying table illustrates Vicky's utility function.

Income	Total utility (utils)
\$0	0
1,000	50
2,000	85
3,000	115
4,000	140
5,000	163
6,000	183
7,000	200
8,000	215
9,000	229
10,000	241

- a. Calculate Vicky's marginal utility of income for each income level. Is Vicky risk-averse?

- b. Calculate the expected value of Vicky's income if she makes this investment.
- c. Calculate Vicky's expected utility from making the investment.
- d. What is Vicky's utility from not making the investment? Will Vicky therefore invest in the company?

### Solution

2. a. Vicky's marginal utility of income is given in the accompanying table. Since her marginal utility declines, she is risk-averse.

Income	Total utility (utils)	Marginal utility (utils)
\$0	0	50
1,000	50	35
2,000	85	30
3,000	115	25
4,000	140	23
5,000	163	20
6,000	183	17
7,000	200	15
8,000	215	14
9,000	229	12
10,000	241	

- b. If the company succeeds, Vicky will have income of \$10,000 (the \$2,000 she did not invest plus the \$8,000 the company pays out to her). If the company fails, Vicky will have income of \$2,000 (the \$2,000 she has not invested). The expected value of Vicky's income is  $(0.5 \times \$10,000) + (0.5 \times \$2,000) = \$5,000 + \$1,000 = \$6,000$ .
- c. Vicky's expected utility from making the investment is  $(0.5 \times 241) + (0.5 \times 85) = 42.5 + 120.5 = 163$ .
- d. If she does not make the investment, Vicky's utility is the utility of having \$4,000 income, that is, 140. Since the expected utility from making the investment is greater than her utility from not making the investment, she will invest in the company.

3. Vicky N. Vestor's utility function was given in Problem 2. As in Problem 2, Vicky currently has income of \$4,000. She is considering investing in a startup company, but the investment now costs \$4,000 to make. If the company fails, Vicky will get nothing from the company. But if the company succeeds, she will get \$10,000 from the company (her original investment of \$4,000 plus \$6,000 of the company's profits). Each event has a 0.5 probability of occurring. Will Vicky invest in the company?

### Solution

3. If the company succeeds, Vicky will have income of \$10,000. If the company fails, Vicky will have income of \$0 (she loses her entire investment). Vicky's expected utility from making the investment is  $(0.5 \times 241) + (0.5 \times 0) = 120.5 + 0 = 120.5$ . Since this is less than her utility from not investing (140 utils), she will not invest in the company.

4. You have \$1,000 that you can invest. If you buy Ford stock, you face the following returns and probabilities from holding the stock for one year: with a probability of 0.2 you will get \$1,500; with a probability of 0.4 you will get \$1,100; and with a probability of 0.4 you will get \$900. If you put the money into the bank, in one year's time you will get \$1,100 for certain.
- What is the expected value of your earnings from investing in Ford stock?
  - Suppose you are risk-averse. Can we say for sure whether you will invest in Ford stock or put your money into the bank?

## Solution

4. a. The expected value of your earnings from investing in Ford stock is  $(0.2 \times \$1,500) + (0.4 \times \$1,100) + (0.4 \times \$900) - \$1,000 = \$300 + \$440 + \$360 - \$1,000 = \$100$ .
- b. You have a choice between getting \$1,100 for certain by putting your money into the bank or getting \$1,100 *on average* by investing in Ford stock. Both investments pay the same on average, but investing in Ford stock is risky. Since you are risk-averse, you would prefer to get \$1,100 for certain. So you will definitely put your money in the bank.
5. Wilbur is an airline pilot who currently has income of \$60,000. If he gets sick and loses his flight medical certificate, he loses his job and has only \$10,000 income. His probability of staying healthy is 0.6, and his probability of getting sick is 0.4. Wilbur's utility function is given in the accompanying table.

Income	Total utility (utils)
\$0	0
10,000	60
20,000	110
30,000	150
40,000	180
50,000	200
60,000	210

- What is the expected value of Wilbur's income?
  - What is Wilbur's expected utility?
- Wilbur thinks about buying "loss-of-license" insurance that will compensate him if he loses his flight medical certificate.
- One insurance company offers Wilbur full compensation for his income loss (that is, the insurance company pays Wilbur \$50,000 if he loses his flight medical certificate), and it charges a premium of \$40,000. That is, regardless of whether he loses his flight medical certificate, Wilbur's income after insurance will be \$20,000. What is Wilbur's utility? Will he buy the insurance?
  - What is the highest premium Wilbur would just be willing to pay for full insurance (insurance that completely compensates him for the income loss)?

## Solution

5. a. The expected value of Wilbur's income is  $(0.6 \times \$60,000) + (0.4 \times \$10,000) = \$36,000 + \$4,000 = \$40,000$ .
- b. Wilbur's expected utility is  $(0.6 \times 210) + (0.4 \times 60) = 126 + 24 = 150$ .
- c. If Wilbur's income is \$20,000 for certain, his utility is 110. This is lower than his expected utility from not being insured, so he would not buy this insurance.

- d. If Wilbur had \$30,000 after insurance for certain, his utility would be 150, which is just the same as his expected utility from not being insured. So if an insurance company offered him full insurance (to compensate him completely if he loses his flight medical certificate) and charged him a premium of \$30,000, then Wilbur would have \$30,000 income available for consumption for certain. So a premium of \$30,000 is the highest he is willing to pay.
6. From 1990 to 2013, 1 in approximately every 277 cars produced in the United States was stolen. Beth owns a car worth \$20,000 and is considering purchasing an insurance policy to protect herself from car theft. For the following questions, assume that the chance of car theft is the same in all regions and across all car models.
- What should the premium for a fair insurance policy have been in 2013 for a policy that replaces Beth's car if it is stolen?
  - Suppose an insurance company charges 0.6% of the car's value for a policy that pays for replacing a stolen car. How much will the policy cost Beth?
  - Will Beth purchase the insurance in part b if she is risk-neutral?
  - Discuss a possible moral hazard problem facing Beth's insurance company if she purchases the insurance.

### Solution

6. a. The premium for a fair insurance policy is equal to the expected value of Beth's claim. Since the probability of having her car stolen is  $1/277 = 0.003$ , the expected value of Beth's claim is  $0.003 \times \$20,000 = \$60$ .
- b. The premium for this insurance policy is  $0.006 \times \$20,000 = \$120$ .
- c. Since this is a less than fair insurance policy, Beth will not purchase it unless she is risk-averse.
- d. If Beth is completely insured against loss of her car, she has no incentive to take care: she may leave it unlocked or park it in badly lit side streets instead of in a secure garage.
7. Hugh's income is currently \$5,000. His utility function is shown in the accompanying table.

Income	Total utility (utils)
\$0	0
1,000	100
2,000	140
3,000	166
4,000	185
5,000	200
6,000	212
7,000	222
8,000	230
9,000	236
10,000	240

- Calculate Hugh's marginal utility of income. What is his attitude toward risk?
- Hugh is thinking about gambling in a casino. With a probability of 0.5 he will lose \$3,000, and with a probability of 0.5 he will win \$5,000. What is the expected value of Hugh's income? What is Hugh's expected utility? Will he decide to gamble? (Suppose that he gets no extra utility from going to the casino.)

- c. Suppose that the “spread” (how much he can win versus how much he can lose) of the gamble narrows, so that with a probability of 0.5 Hugh will lose \$1,000, and with a probability of 0.5 he will win \$3,000. What is the expected value of Hugh’s income? What is his expected utility? Is this gamble better for him than the gamble in part b? Will he decide to gamble?

**Solution**

7. a. Hugh’s marginal utility is given in the accompanying table. Since his marginal utility is diminishing, he is risk-averse.

Income	Total utility (utils)	Marginal utility (utils)
\$0	0	100
1,000	100	40
2,000	140	26
3,000	166	19
4,000	185	15
5,000	200	12
6,000	212	10
7,000	222	8
8,000	230	6
9,000	236	4
10,000	240	

- b. Hugh will have \$2,000 income with probability 0.5 and \$10,000 income with probability 0.5. The expected value of his income is  $(0.5 \times \$2,000) + (0.5 \times \$10,000) = \$1,000 + \$5,000 = \$6,000$ . His expected utility is  $(0.5 \times 140) + (0.5 \times 240) = 70 + 120 = 190$ . His utility from not gambling is the utility of having \$5,000 for certain, which is 200. That is, he will not take the gamble.
- c. Hugh will have \$4,000 income with probability 0.5 and \$8,000 income with probability 0.5. The expected value of his income is  $(0.5 \times \$4,000) + (0.5 \times \$8,000) = \$2,000 + \$4,000 = \$6,000$ . This gamble has the same expected value as that in part b. However, Hugh’s expected utility is  $(0.5 \times 185) + (0.5 \times 230) = 92.5 + 115 = 207.5$ . This gamble is better for him than that in part b because it has less risk associated with it: his expected utility is higher than for the gamble in part b. And it is sufficiently less risky that he will now take the gamble: he prefers it over having \$5,000 for certain, which yields him only 200 utils.

8. Eva is risk-averse. Currently she has \$50,000 to invest. She faces the following choice: she can invest in the stock of a dot-com company, or she can invest in IBM stock. If she invests in the dot-com company, then with probability 0.5 she will lose \$30,000, but with probability 0.5 she will gain \$50,000. If she invests in IBM stock, then with probability 0.5 she will lose only \$10,000, but with probability 0.5 she will gain only \$30,000. Can you tell which investment she will prefer to make?

**Solution**

8. If Eva invests in the dot-com company, with probability 0.5 she has \$50,000 – \$30,000 = \$20,000 in stock value, and with probability 0.5 she has \$50,000 + \$50,000 = \$100,000 in stock value. So the expected value of Eva’s stock when she invests in the dot-com company is  $(0.5 \times \$20,000) + (0.5 \times \$100,000) = \$10,000 + \$50,000 = \$60,000$ . Similarly, if Eva invests in IBM stock, the expected value of her

stock is  $(0.5 \times \$40,000) + (0.5 \times \$80,000) = \$20,000 + \$40,000 = \$60,000$ . Both investments give Eva the same expected value, but the investment in IBM is less risky. She will therefore prefer to invest in IBM stock.

9. Suppose you have \$1,000 that you can invest in Ted and Larry's Ice Cream Parlor and/or Ethel's House of Cocoa. The price of a share of stock in either company is \$100. The fortunes of each company are closely linked to the weather. When it is warm, the value of Ted and Larry's stock rises to \$150 but the value of Ethel's stock falls to \$60. When it is cold, the value of Ethel's stock rises to \$150 but the value of Ted and Larry's stock falls to \$60. There is an equal chance of the weather being warm or cold.
- If you invest all your money in Ted and Larry's, what is your expected stock value? What if you invest all your money in Ethel's?
  - Suppose you diversify and invest half of your \$1,000 in each company. How much will your total stock be worth if the weather is warm? What if it is cold?
  - Suppose you are risk-averse. Would you prefer to put all your money in Ted and Larry's, as in part a? Or would you prefer to diversify, as in part b? Explain your reasoning.

### Solution

9. a. If you put all your money in Ted and Larry's, you can purchase ten shares of stock. The ten shares will be worth \$1,500 if the weather is warm and \$600 if it is cold. Since there is an equal chance of it being cold or warm, the expected stock value is  $(0.5 \times \$1,500) + (0.5 \times \$600) = \$750 + \$300 = \$1,050$ . This is the same as the expected stock value you would receive if you put all your money in Ethel's.
- b. If you put \$500 in each company, you would initially have five shares of each. Suppose the weather turned out to be warm and sunny. The five shares of Ted and Larry's would be worth \$750, and the five shares of Ethel's would be worth \$300. So your total stock value would be \$1,050. What would happen if it was cold? Now the five shares of Ted and Larry's would be worth \$300 and the five shares of Ethel's would be worth \$750, for a total stock value of \$1,050. This illustrates the importance of diversification.
- c. If you invest all your money in Ted and Larry's, you will get, on average, \$1,050, but there is risk attached. By investing your money in both stocks, you get the same payoff whether the weather is warm or cold. That is, you can earn \$1,050 for certain instead of an expected stock value of \$1,050. A risk-averse individual would diversify his or her risk by investing in both stocks. In this example, diversification eliminates all risk.
10. LifeStrategy Conservative Growth and Energy are two portfolios constructed and managed by the Vanguard Group of mutual funds, comprised of stocks of conservatively managed U.S. companies and stocks of U.S. energy companies. The accompanying table shows historical annualized return from the period 2004 to 2014, which suggest the expected value of the annual percentage returns associated with these portfolios.

Portfolio	Expected value of return (percent)
LifeStrategy Conservative Growth	5.88%
Energy	12.66

- Which portfolio would a risk-neutral investor prefer?
- Juan, a risk-averse investor, chooses to invest in the LifeStrategy Conservative Growth portfolio. What can be inferred about the risk of the two portfolios from Juan's choice of investment? Based on historical performance, would a risk-neutral investor ever choose LifeStrategy Conservative Growth?



- c. Juan is aware that diversification can reduce risk. He considers a portfolio in which half his investment is in conservatively managed companies and the other half in Energy companies. What is the expected value of the return for this combined portfolio? Would you expect this combined portfolio to be more risky or less risky than the LifeStrategy Conservative Growth portfolio? Why or why not?

## Solution

- 10.** a. A risk-neutral investor—someone who does not care about risk—is interested only in the expected value of the return. Since the expected value of the U.S. Energy portfolio (14.27%) is greater than the expected value of the LifeStrategy Conservative Growth portfolio (5.32%), a risk-neutral investor would prefer the Energy portfolio.
- b. Since Juan is risk-averse and chooses the portfolio with the lower expected return, this portfolio must be considerably less risky than the Energy portfolio. As you saw in part a of this question, a risk-neutral investor would always choose the Energy portfolio, regardless of the level of risk associated with the portfolios.
- c. The expected value of the return of this combined portfolio is  $((0.5 \times 0.0532) + (0.5 \times 0.142)) \times 100 = 9.76\%$ . If the two portfolios are not correlated (what happens to one portfolio is an independent event from what happens to the other portfolio), then the combined portfolio would be less risky. However, if there is positive correlation between the two portfolios, then the risk of the combined portfolio could still be higher than the risk of the LifeStrategy Conservative Growth portfolio on its own.

- 11.** You are considering buying a second-hand Volkswagen. From reading car magazines, you know that half of all Volkswagens have problems of some kind (they are “lemons”) and the other half run just fine (they are “plums”). If you knew that you were getting a plum, you would be willing to pay \$10,000 for it: this is how much a plum is worth to you. You would also be willing to buy a lemon, but only if its price was no more than \$4,000: this is how much a lemon is worth to you. And someone who owns a plum would be willing to sell it at any price above \$8,000. Someone who owns a lemon would be willing to sell it for any price above \$2,000.

- a. For now, suppose that you can immediately tell whether the car that you are being offered is a lemon or a plum. Suppose someone offers you a plum. Will there be trade?

Now suppose that the seller has private information about the car she is selling: the seller knows whether she has a lemon or a plum. But when the seller offers you a Volkswagen, you do not know whether it is a lemon or a plum. So this is a situation of adverse selection.

- b. Since you do not know whether you are being offered a plum or a lemon, you base your decision on the expected value to you of a Volkswagen, assuming you are just as likely to buy a lemon as a plum. Calculate this expected value.
- c. Suppose, from driving the car, the seller knows she has a plum. However, you don’t know whether this particular car is a lemon or a plum, so the most you are willing to pay is your expected value. Will there be trade?

## Solution

- 11.** a. You value a plum at \$10,000: you would be willing to pay any price up to \$10,000 to buy it. The seller values a plum at \$8,000: she would be willing to sell her car at any price above \$8,000. So there is room for trade: at some price between \$8,000 and \$10,000, both buyer and seller will want to engage in trade with each other.
- b. With probability 0.5 the car you are being offered is worth \$10,000 to you. And with probability 0.5 the car you are being offered is worth \$4,000 to you. So the expected value to you is  $(0.5 \times \$10,000) + (0.5 \times \$4,000) = \$5,000 + \$2,000 = \$7,000$ .

- c. The most you are willing to pay for a car whose quality you do not know is \$7,000. But the seller who knows she has a plum will only want to sell it for a price upwards of \$8,000. So there is no trade, although it would be mutually beneficial.

- 12.** You own a company that produces chairs, and you are thinking about hiring one more employee. Each chair produced gives you revenue of \$10. There are two potential employees, Fred Ast and Sylvia Low. Fred is a fast worker who produces ten chairs per day, creating revenue for you of \$100. Fred knows that he is fast and so will work for you only if you pay him more than \$80 per day. Sylvia is a slow worker who produces only five chairs per day, creating revenue for you of \$50. Sylvia knows that she is slow and so will work for you if you pay her more than \$40 per day. Although Sylvia knows she is slow and Fred knows he is fast, you do not know who is fast and who is slow. So this is a situation of adverse selection.
- a. Since you do not know which type of worker you will get, you think about what the expected value of your revenue will be if you hire one of the two. What is that expected value?
- b. Suppose you offered to pay a daily wage equal to the expected revenue you calculated in part a. Whom would you be able to hire: Fred, or Sylvia, or both, or neither?
- c. If you know whether a worker is fast or slow, which one would you prefer to hire and why? Can you devise a compensation scheme to guarantee that you employ only the type of worker you prefer?

- 12.** a. When you hire an additional worker, there is a 0.5 chance you will get a fast worker and a 0.5 chance you will get a slow worker. So the expected value of your additional revenue is  $(0.5 \times \$100) + (0.5 \times \$50) = \$50 + \$25 = \$75$ .
- b. If you offered to pay \$75, you will be able to hire only Sylvia: Fred would not want to work for that wage. That is, you will attract only an adverse selection of slow workers.
- c. You prefer to hire a fast worker. With a fast worker you earn  $\$100 - \$80 = \$20$  per day, but only earn  $\$50 - \$40 = \$10$  per day with a slow worker. Any compensation scheme that pays a worker \$80 per day if at least 10 chairs are produced, but less than \$40 per day if less than 10 chairs are produced, will guarantee that only a fast worker will choose to work for you.

- 13.** For each of the following situations, do the following: first describe whether it is a situation of moral hazard or of adverse selection. Then explain what inefficiency can arise from this situation and explain how the proposed solution reduces the inefficiency.
- a. When you buy a second-hand car, you do not know whether it is a lemon (low quality) or a plum (high quality), but the seller knows. A solution is for sellers to offer a warranty with the car that pays for repair costs.
- b. Some people are prone to see doctors unnecessarily for minor complaints like headaches, and health maintenance organizations do not know how urgently you need a doctor. A solution is for insurees to have to make a co-payment of a certain dollar amount (for example, \$10) each time they visit a health care provider. All insurees are risk-averse.
- c. When airlines sell tickets, they do not know whether a buyer is a business traveler (who is willing to pay a lot for a seat) or a leisure traveler (who has a low willingness to pay). A solution for a profit-maximizing airline is to offer an expensive ticket that is very flexible (it allows date and route changes) and a cheap ticket that is very inflexible (it has to be booked in advance and cannot be changed).
- d. A company does not know whether workers on an assembly line work hard or whether they slack off. A solution is to pay the workers “piece rates,” that is, pay them according to how much they have produced each day. All workers are risk-averse, but the company is not risk-neutral.

- e. When making a decision about hiring you, prospective employers do not know whether you are a productive or unproductive worker. A solution is for productive workers to provide potential employers with references from previous employers.

### Solution

- 13.**
- a. This is a situation of adverse selection: although the seller knows what type of car she has to sell, you don't. If you don't know the quality of a car you are offered, you are willing to pay only the average of what a lemon and a plum are worth to you. So sellers of plums are not able to get a price that is high enough for them to want to sell their car, even though—if you knew that you were getting a plum—you would be willing to pay enough for them to want to sell it. This is inefficient. By offering a warranty, a seller can signal to you that she has a plum: offering a warranty would be very expensive for the seller of a lemon, so only sellers of plums can afford to offer a warranty. So if you see a car being offered with a warranty, you know it must be a plum and you are willing to pay more for it.
- b. This is a situation of moral hazard: the insurer does not know whether you are doing the right thing (seeing a doctor only if you are genuinely sick). If the insurance company covered your visit fully, you might visit your physician even for minor headaches, leading to an excessively high level of claims. The co-payment gives you an incentive to visit your physician only if you are sick enough to be willing to make the co-payment. An inefficiency arises in the allocation of risk because you are bearing risk (the risk of paying the deductible) that you would prefer and be willing to pay the insurance company to bear.
- c. This is a situation of adverse selection: although the buyer knows what type of traveler he is (business or leisure), the airline does not know. If the airline sold all seats at the same price, it would lose potential revenue from business travelers, and some leisure travelers might decide not to travel at all because the fare is too high. When different tickets are offered, business travelers (who need flexibility in their travel plans) will buy the high-priced flexible tickets and leisure travelers will buy the low-priced inflexible tickets.
- d. This is a situation of moral hazard: the company does not know how much effort a worker expends. By paying piece rates, a worker now has a stake in how much effort he or she expends: higher output means more pay, and lower output means less pay. But this is an inefficient allocation of risk. Because the worker is risk-averse, he or she would prefer a certain level of salary for sure, a level that the company would be willing to pay except for the problem of moral hazard. So workers are forced to bear more risk than is efficient.
- e. This is a situation of adverse selection. Employers do not know what type of employee you are (productive or unproductive). This is inefficient because they will offer a wage that is the average between what unproductive and productive workers should be paid. If you are a productive worker, that might not be enough to compensate you and you might decide not to work at all. The solution is for productive workers to provide references from previous employers. Unproductive workers will be unable to provide good references, so they will not supply any references at all. So having references signals that you are a productive worker and induces firms to pay you a higher salary.
- 14.** Kory owns a house that is worth \$300,000. If the house burns down, she loses all \$300,000. If the house does not burn down, she loses nothing. Her house burns down with a probability of 0.02. Kory is risk-averse.
- a. What would a fair insurance policy cost?
- b. Suppose an insurance company offers to insure her fully against the loss from the house burning down, at a premium of \$1,500. Can you say for sure whether Kory will or will not take the insurance?

- c. Suppose an insurance company offers to insure her fully against the loss from the house burning down, at a premium of \$6,000. Can you say for sure whether Kory will or will not take the insurance?
- d. Suppose that an insurance company offers to insure her fully against the loss from the house burning down, at a premium of \$9,000. Can you say for sure whether Kory will or will not take the insurance?

### Solution

14. a. A fair insurance policy is one with a premium equal to the expected value of the claim. The expected value of Kory's claim is  $(0.02 \times \$300,000) + (0.98 \times \$0) = \$6,000$ .
- b. Kory will take this insurance. It is better than fair: the expected value of her claim is \$6,000, but she only pays \$1,500 for this insurance. Taking this insurance will increase Kory's expected income. Since we know that she is risk-averse, we know for sure that she will take this insurance.
- c. Kory will take this insurance. It is fair insurance: the expected value of her claim is \$6,000, and the premium is also \$6,000. Taking this insurance will leave Kory's expected income unchanged. Since we know that she is risk-averse, we know for sure that she will take this insurance.
- d. Kory may or may not take this insurance. It is "unfair": the expected value of her claim is \$6,000, but she would have to pay \$9,000 for this insurance. Taking this insurance will reduce Kory's expected income. She might still take this insurance if she is sufficiently risk-averse, but without more information about how risk-averse she is, we cannot tell for sure.

#### WORK IT OUT

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15. You have \$1,000 that you can invest. If you buy General Motors stock, then, in one year's time: with a probability of 0.4 you will get \$1,600; with a probability of 0.4 you will get \$1,100; and with a probability of 0.2 you will get \$800. If you put the money into the bank, in one year's time you will get \$1,100 for certain.
- a. What is the expected value of your earnings from investing in General Motors stock?
  - b. Suppose you prefer putting your money into the bank to investing it in General Motors stock. What does that tell us about your attitude to risk?

### Solution

15. a. The expected value of your earnings from investing in General Motors stock is  $(0.4 \times \$1,600) + (0.4 \times \$1,100) + (0.2 \times \$800) - \$1,000 = \$640 + \$440 + \$160 - \$1,000 = \$240$ .
- b. Since getting \$1,100 for certain is better for you than getting an average (but risky) \$1,240, you must be risk-averse: you are willing to take a lower (but certain) payoff instead of a higher (but risky) one.

# Macroeconomics: The Big Picture

1. Which of the following questions are relevant for the study of macroeconomics and which for microeconomics?
  - a. How will Ms. Martin's tips change when a large manufacturing plant near the restaurant where she works closes?
  - b. What will happen to spending by consumers when the economy enters a downturn?
  - c. How will the price of oranges change when a late frost damages Florida's orange groves?
  - d. How will wages at a manufacturing plant change when its workforce is unionized?
  - e. What will happen to U.S. exports as the dollar becomes less expensive in terms of other currencies?
  - f. What is the relationship between a nation's unemployment rate and its inflation rate?

## Solution

1.
  - a. This is a microeconomic question because it addresses the effects of a single firm's actions (the closure of a manufacturing plant) on a single individual (the waitress).
  - b. This is a macroeconomic question because it considers how overall spending by consumers is affected by the state of the macroeconomy.
  - c. This is a microeconomic question because it looks at how a single market (oranges) will be affected by a late frost.
  - d. This is a microeconomic question because it addresses how wages in a particular plant will change when the firm's workforce is unionized.
  - e. This is a macroeconomic question because it considers the change in the overall level of exports as the value of the dollar changes.
  - f. This is a macroeconomic question because it addresses the relationship between two aggregate measures of economic activity: inflation and unemployment.
2. When one person saves more, that person's wealth is increased, meaning that he or she can consume more in the future. But when everyone saves more, everyone's income falls, meaning that everyone must consume less today. Explain this seeming contradiction.

## Solution

2. This question concerns the paradox of thrift; what is true for an individual—that saving makes you better off—is not always true for the economy as a whole. When an individual saves, that person adds to his or her wealth, providing for higher consumption in the future. However, if everyone saves, firms will not sell as much and will lay off workers. Individuals find that their incomes fall as a result. So they must consume less today.
3. Before the Great Depression, the conventional wisdom among economists and policy makers was that the economy is largely self-regulating.
  - a. Is this view consistent or inconsistent with Keynesian economics? Explain.

- b. What effect did the Great Depression have on conventional wisdom?
- c. Contrast the response of policy makers during the 2007–2009 recession to the actions of policy makers during the Great Depression. What would have been the likely outcome of the 2007–2009 recession if policy makers had responded in the same fashion as policy makers during the Great Depression?

### Solution

3.
  - a. The view that the economy is largely self-regulating is at odds with Keynesian economics, which claims that managing the economy, via the tools of fiscal and monetary policy, is the government's responsibility.
  - b. The Great Depression was such a catastrophic occurrence that it shifted the conventional wisdom away from the view that the economy is largely self-regulating to the Keynesian view that the government should intervene to manage the economy.
  - c. In 2007–2009, policy makers actively used monetary and fiscal policy to boost the economy. If they had done nothing, as policy makers did during the Great Depression, it is very likely that the recession of 2007–2009 would have been even longer and deeper.
4. How do economists in the United States determine when a recession begins and when it ends? How do other countries determine whether or not a recession is occurring?

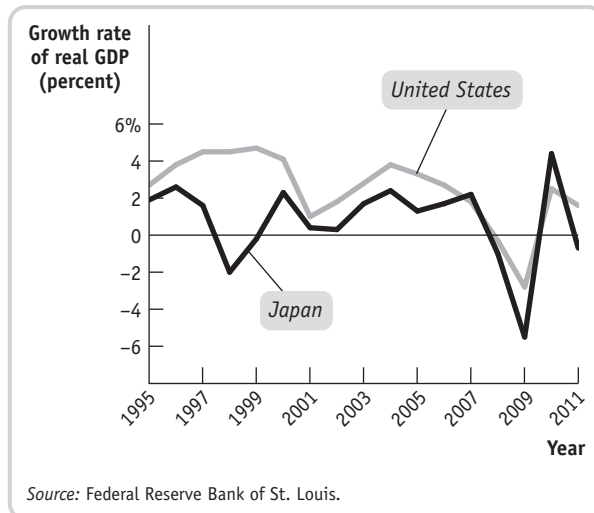
### Solution

4. In the United States, economists assign the task of identifying recessions to an independent panel of experts at the National Bureau of Economic Research who determine when a recession begins and when it ends. It makes this determination by looking at a variety of economic indicators, with the main focus on employment and production. In many other countries, economists adopt the rule that a recession is a period of at least two consecutive quarters during which the overall output of the economy shrinks.
5. The U.S. Department of Labor reports statistics on employment and earnings that are used as key indicators by many economists to gauge the health of the economy. Figure 6-4 in the text plots historical data on the unemployment rate each month. Noticeably, the numbers were high during the recessions in the early 1990s, in 2001, and in the aftermath of the Great Recession, 2008–2014.
  - a. Locate the latest data on the national unemployment rate. (*Hint: Go to the website of the Bureau of Labor Statistics, [www.bls.gov](http://www.bls.gov), and locate the latest release of the Employment Situation.*)
  - b. Compare the current numbers with those during the early 1990s, 2001, and during 2008–2014, as well as with the periods of relatively high economic growth just before the recessions. Are the current numbers indicative of a recessionary trend?

### Solution

5.
  - a. Answers will vary. In the December 2011 Employment Situation, the Bureau of Labor Statistics states that the October 2014 unemployment rate was 5.8%.
  - b. During the recession of the early 1990s, the unemployment rate rose from 5.5% to 6.8%. During the recession of 2001, the unemployment rate rose from 4.3% to 5.5%. During the recession of 2007–2009, the unemployment rate rose from 5% to 9.5%. The unemployment rate continued to rise for a time after the official end of the recession, reaching a high of 10% in November of 2009. The current numbers are not indicative of a recessionary trend. The current rate of 5.8% is the lowest since unemployment surged in 2009 in the wake of the Great Recession.

6. In the 1990s there were some dramatic economic events that came to be known as the *Asian financial crisis*. A decade later similar events came to be known as the *global financial crisis*. The accompanying figure shows the growth rate of real GDP in the United States and Japan from 1995 to 2011. Using the graph, explain why the two sets of events are referred to this way.



## Solution

6. In the late 1990s, Japanese real GDP slumped, but U.S. growth continued without interruption. So the recession of the late 1990s took place only in Asia—it was specifically an Asian crisis. By contrast, the slump in the late 2000s involved plunging real GDP in both Japan and the United States, so it was a global crisis.
7. a. What three measures of the economy tend to move together during the business cycle? Which way do they move during an upturn? During a downturn?  
 b. Who in the economy is hurt during a recession? How?  
 c. How did Milton Friedman alter the consensus that had developed in the aftermath of the Great Depression on how the economy should be managed? What is the current goal of policy makers in managing the economy?

## Solution

7. a. The three measures that tend to move together are (1) industrial output, called real gross domestic product, (2) employment, and (3) inflation. All three tend to rise during an upturn and fall during a downturn.  
 b. Workers and their families experience a great deal of pain and hardship during recessions because many people lose their jobs and many who retain their jobs see their wages suffer. As a result, living standards decline and the number of people living in poverty rises. Corporations also experience a fall in profits during recessions.  
 c. According to the Keynesian view that developed after the Great Depression, it was the government's responsibility to manage the economy to reduce the severity of downturns. According to Milton Friedman, booms in the economy should also be managed in order to reduce their magnitude. So the current goal of economic policy makers is to "smooth out" the business cycle—to reduce the magnitude of both booms and busts.
8. Why do we consider a business-cycle expansion different from long-run economic growth? Why do we care about the size of the long-run growth rate of real GDP relative to the size of the growth rate of the population?

## Solution

8. Long-run economic growth is the sustained upward trend in the economy's output over long periods of time. Long-run growth per capita is the key to rising wages and sustained increases in the standard of living. A business-cycle expansion results in a short-run (many months or a few years) increase in real GDP, but long-run growth results in a long-run (many decades) increase in real GDP per capita. We care about the relative size of the long-run growth rate of real GDP and the population growth rate because living standards will fall unless the long-run growth rate of real GDP is at least as high as the growth rate of the population.
9. In 1798, Thomas Malthus's *Essay on the Principle of Population* was published. In it, he wrote: "Population, when unchecked, increases in a geometrical ratio. Subsistence increases only in an arithmetical ratio. . . . This implies a strong and constantly operating check on population from the difficulty of subsistence." Malthus was saying that the growth of the population is limited by the amount of food available to eat; people will live at the subsistence level forever. Why didn't Malthus's description apply to the world after 1800?

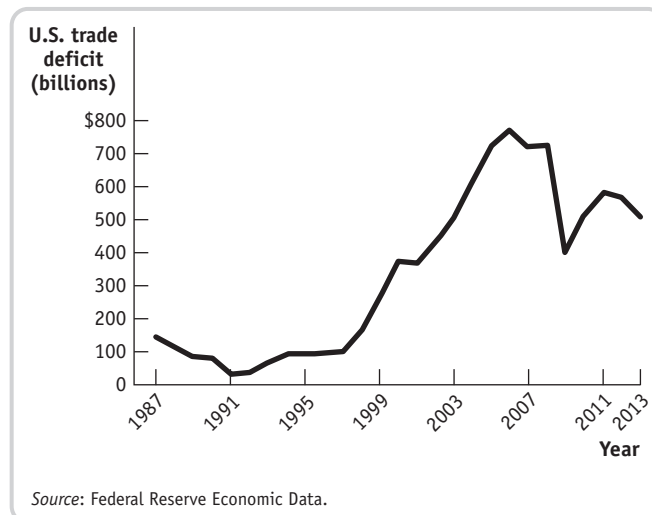
## Solution

9. Malthus expected that life would continue as it had for the previous 800 or so years. He did not know that advances in technology would bring large changes in productivity and that the long-run growth of the economy's output would exceed population growth. As we learned in the chapter, in the period before 1800, the world economy grew extremely slowly by contemporary standards. Furthermore, the population grew almost as fast, meaning that there was hardly any increase in output per person. However, since 1800, long-run economic growth has resulted in sustained increases in living standards.
10. Each year, *The Economist* publishes data on the price of the Big Mac in different countries and exchange rates. The accompanying table shows some data from 2007 and 2014. Use this information to answer the following questions.
- Where was it cheapest to buy a Big Mac in U.S. dollars in 2007?
  - Where was it cheapest to buy a Big Mac in U.S. dollars in 2014?
  - Using the increase in the local currency price of the Big Mac in each country to measure the percent change in the overall price level from 2007 to 2014, which nation experienced the most inflation? Did any of the nations experience deflation?

Country	2007		2014	
	Price of Big Mac (in local currency)	Price of Big Mac (in U.S. dollars)	Price of Big Mac (in local currency)	Price of Big Mac (in U.S. dollars)
Argentina	peso8.25	\$2.65	peso21.0	\$2.57
Canada	C\$3.63	\$3.08	C\$5.25	\$5.64
Euro area	€2.94	\$3.82	€3.68	\$4.95
Japan	¥280	\$2.31	¥370	\$3.64
United States	\$3.22	\$3.22	\$4.80	\$4.80



- 10.** a. In U.S. dollars, a Big Mac was cheapest in Japan in 2007.  
 b. In U.S. dollars, a Big Mac was cheapest in Argentina in 2014.  
 c. First we must calculate the percent change of the local currency price of the Big Mac during the period from 2007 to 2014.
- Percent price change in Argentina =  $(\text{peso}21 - \text{peso}8.25) / \text{peso}8.25 \times 100 = 155\%$   
 Percent price change in Canada =  $(\text{C}\$5.25 - \text{C}\$3.63) / \text{C}\$3.63 \times 100 = 45\%$   
 Percent price change in Euro area =  $(\text{€}3.68 - \text{€}2.94) / \text{€}2.94 \times 100 = 25\%$   
 Percent price change in Japan =  $(\text{¥}370 - \text{¥}280) / \text{¥}280 \times 100 = 32\%$   
 Percent price change in the United States =  $(\$4.80 - \$3.22) / \$3.22 \times 100 = 49\%$
- Argentina experienced the highest inflation over the period, a price change of 155%. Every country experienced a positive change in its price level, so no country experienced deflation.
- 11.** The accompanying figure illustrates the increasing trade deficit of the United States since 1987. The United States has been consistently and, on the whole, increasingly importing more goods than it has been exporting. One of the countries it runs a trade deficit with is China. Which of the following statements are valid possible explanations of this fact? Explain.



- a. Many products, such as televisions, that were formerly manufactured in the United States are now manufactured in China.  
 b. The wages of the average Chinese worker are far lower than the wages of the average American worker.  
 c. Investment spending in the United States is high relative to its level of savings.
- 11.** a. This is not a valid possible explanation. The determination of where goods are produced around the world is a microeconomic phenomenon, based on comparative advantage. Macroeconomics, not microeconomics, determines whether a country runs a trade deficit or surplus.  
 b. This is not a valid possible explanation. Low Chinese wages could possibly explain why some goods are produced in China and not in the United States, is a microeconomic question. Macroeconomics, not microeconomics, determines whether a country runs a trade deficit or surplus.

- c. This is a valid explanation. A country's levels of savings and investment spending are macroeconomic phenomena that determine whether it runs a trade surplus or deficit.

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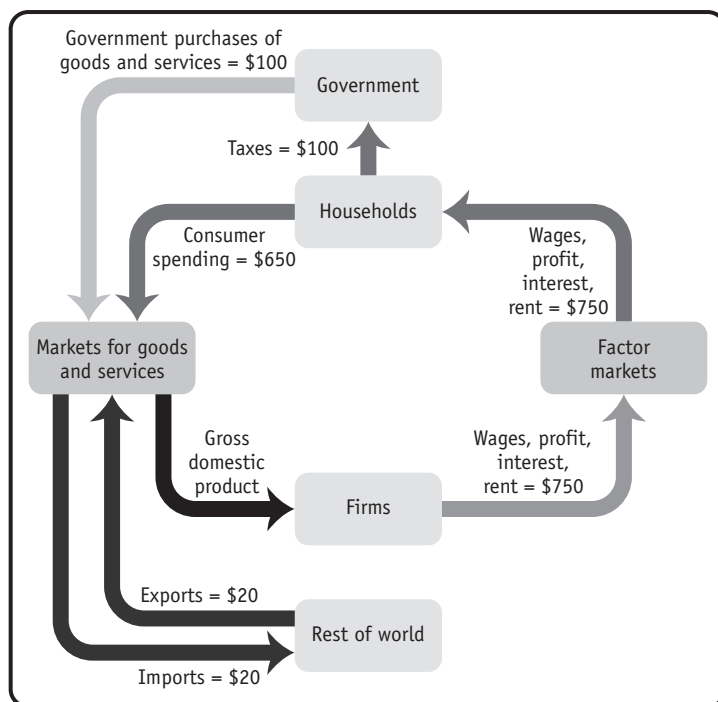


- 12.** College tuition has risen significantly in the last few decades. From the 1981–1982 academic year to the 2011–2012 academic year, total tuition, room, and board paid by full-time undergraduate students went from \$2,871 to \$16,789 at public institutions and from \$6,330 to \$33,716 at private institutions. This is an average annual tuition increase of 6.1% at public institutions and 5.7% at private institutions. Over the same time, average personal income after taxes rose from \$9,785 to \$39,409 per year, which is an average annual rate of growth of personal income of 4.8%. Have these tuition increases made it more difficult for the average student to afford college tuition?

- 12.** To determine whether it is more or less difficult for a typical person to afford college, we would need to compare the increase in tuition to the average increase in personal income after taxes. The average annual increase in tuition at public institutions of 6.4% was a 30% higher rate of increase than the average annual increase in personal income ( $6.4\% - 4.9\%/4.9\% = 0.30$ ). The average annual increase in private institutions of 6.5% was a 33% higher rate of increase ( $6.5\% - 4.9\%/4.9\% = 0.33$ ). Hence it has become more difficult for a typical person to afford college.

# GDP and the CPI: Tracking the Macroeconomy

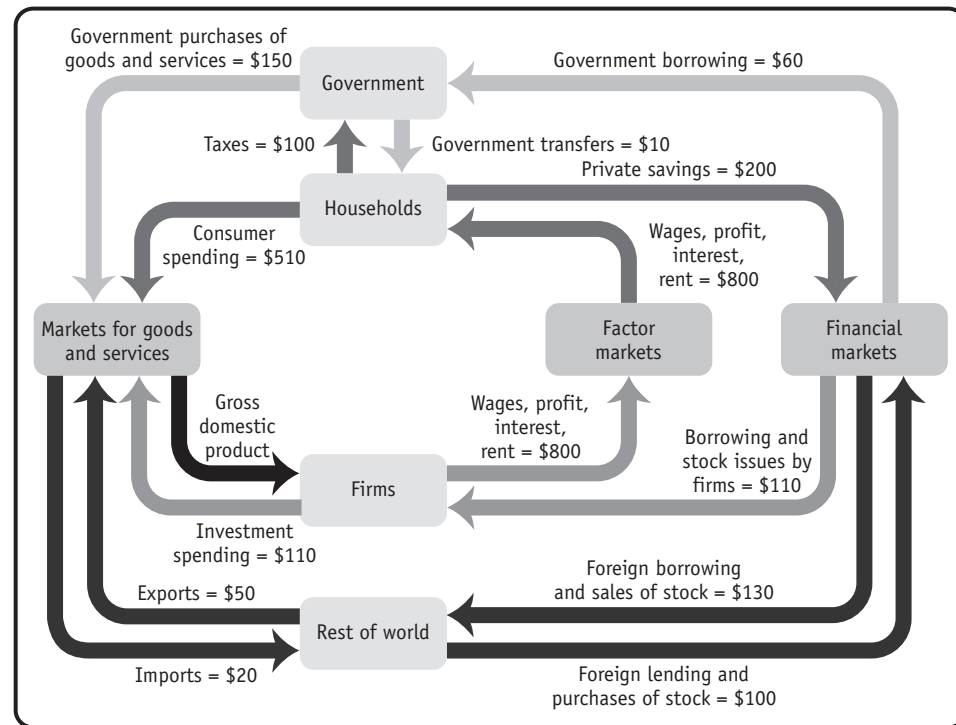
1. Below is a simplified circular-flow diagram for the economy of Micronia. (Note that there is no investment spending in Micronia.)
  - a. What is the value of GDP in Micronia?
  - b. What is the value of net exports?
  - c. What is the value of disposable income?
  - d. Does the total flow of money out of households—the sum of taxes paid and consumer spending—equal the total flow of money into households?
  - e. How does the government of Micronia finance its purchases of goods and services?



## Solution

1. a. We can measure GDP in Micronia as the sum of all spending on domestically produced final goods and services. Spending consists of consumer spending, government purchases of goods and services, and exports less imports, or \$750 ( $\$650 + \$100 + \$20 - \$20$ ).
- b. Net exports are exports less imports. In Micronia, net exports equal zero ( $\$20 - \$20$ ).
- c. Disposable income is income received by households less taxes plus government transfers. In Micronia, disposable income equals \$650 ( $\$750 - \$100$ ).
- d. Yes. Consumer spending plus taxes equals \$750—the same as the wages, profit, interest, and rent received by households.
- e. The government finances its purchases of goods and services with tax revenue.

2. A more complex circular-flow diagram for the economy of Macronia is shown below. (Note that Macronia has investment spending and financial markets.)
- What is the value of GDP in Macronia?
  - What is the value of net exports?
  - What is the value of disposable income?
  - Does the total flow of money out of households—the sum of taxes paid, consumer spending, and private savings—equal the total flow of money into households?
  - How does the government finance its spending?



- 2. a.** We can measure GDP in Macronia as the sum of all spending on domestically produced final goods and services. Spending consists of consumer spending, investment spending, government purchases of goods and services, and exports less imports, or \$800 ( $\$510 + \$110 + \$150 + \$50 - \$20$ ).
- b.** Net exports are exports less imports. In Macronia, net exports equal \$30 ( $\$50 - \$20$ ).
- c.** Disposable income is income received by households less taxes plus government transfers. In Macronia, disposable income equals \$710 ( $\$800 - \$100 + \$10$ ).
- d.** Yes. Consumer spending plus taxes plus private savings equals \$810—the same as the wages, profit, interest, rent, and government transfers received by households.
- e.** In Macronia, the government needs to finance \$160 in spending (\$150 on purchases of goods and services and \$10 in government transfers). The government finances \$100 of its spending with tax revenue and the other \$60 through borrowing in financial markets.

3. The components of GDP in the accompanying table were produced by the Bureau of Economic Analysis.

Category	Components of GDP in 2013 (billions of dollars)
<b>Consumer spending</b>	
Durable goods	\$1,263.0
Nondurable goods	2,622.9
Services	7,615.7
<b>Private investment spending</b>	
Fixed investment spending	2,564.0
Nonresidential	2,047.1
Structures	456.4
Equipment and intellectual property products	1,590.7
Residential	516.9
Change in private inventories	106.1
<b>Net exports</b>	
Exports	2,259.9
Imports	2,757.2
<b>Government purchases of goods and services and investment spending</b>	
Federal	1,245.9
National defense	770.7
Nondefense	475.1
State and local	1,879.6

- Calculate 2013 consumer spending.
- Calculate 2013 private investment spending.
- Calculate 2013 net exports.
- Calculate 2013 government purchases of goods and services and government investment spending.
- Calculate 2013 gross domestic product.
- Calculate 2013 consumer spending on services as a percentage of total consumer spending.
- Calculate 2013 exports as a percentage of imports.
- Calculate 2013 government purchases on national defense as a percentage of federal government purchases of goods and services.

### Solution

3. All figures below are in billions of dollars.
- Consumer spending in 2013 was  $\$1,263.0 + \$2,622.9 + \$7,615.7 = \$11,501.6$ .
  - Private investment spending in 2013 was  $\$2,564.0 + \$106.1 = \$2,670.1$ .
  - Net exports in 2013 were  $\$2,259.9 - \$2,757.2 = -\$497.3$ .
  - Government purchases of goods and services and investment spending in 2013 were  $\$1,245.9 + \$1,879.6 = \$3,125.5$ .
  - Gross domestic product in 2013 was  $\$11,501.6 + \$2,670.1 + \$3,125.5 - \$497.3 = \$16,799.9$ .
  - Consumer spending on services as a percentage of total consumer spending in 2013 was  $(\$7,615.7/\$11,501.6) \times 100 = 66.2\%$ .

- g. Exports as a percentage of imports in 2013 were  $(\$2,259.9/\$2,757.2) \times 100 = 82.0\%$ .
- h. Government purchases of goods and services on national defense as a percentage of federal purchases of goods and services in 2013 were  $(\$770.7/\$1,245.9) \times 100 = 62.0\%$ .

4. The small economy of Pizzania produces three goods (bread, cheese, and pizza), each produced by a separate company. The bread and cheese companies produce all the inputs they need to make bread and cheese, respectively. The pizza company uses the bread and cheese from the other companies to make its pizzas. All three companies employ labor to help produce their goods, and the difference between the value of goods sold and the sum of labor and input costs is the firm's profit. The accompanying table summarizes the activities of the three companies when all the bread and cheese produced are sold to the pizza company as inputs in the production of pizzas.

	Bread company	Cheese company	Pizza company
Cost of inputs	\$0	\$0	\$50 (bread) 35 (cheese)
Wages	15	20	75
Value of output	50	35	200

- a. Calculate GDP as the value added in production.
- b. Calculate GDP as spending on final goods and services.
- c. Calculate GDP as factor income.

## Solution

4. a. To calculate GDP as the value added in production, we need to sum all value added (value of output minus the value of intermediate goods) for each company. Value added in the bread company is \$50; in the cheese company, \$35; and in the pizza company, \$115 ( $\$200 - \$50 - \$35$ ). The total value added in production is \$200 ( $\$50 + \$35 + \$115$ ).
- b. To calculate GDP as spending on final goods and services, we only need to include the value of pizzas because all bread and cheese produced are intermediate goods used in the production of pizzas. Spending on final goods and services is \$200.
- c. To calculate GDP as factor income, we need to sum factor income (wages and profits) for each firm. For the bread company, factor income is \$50: labor earns \$15 and profit is \$35. For the cheese company, factor income is \$35: labor earns \$20 and profit is \$15. For the pizza company, factor income is \$115: labor earns \$75 and profit is \$40 ( $\$200 - \$75 - \$50 - \$35$ ). Factor income is \$200 ( $\$50 + \$35 + \$115$ ).
5. In the economy of Pizzania (from Problem 4), bread and cheese produced are sold both to the pizza company for inputs in the production of pizzas and to consumers as final goods. The accompanying table summarizes the activities of the three companies.

	Bread company	Cheese company	Pizza company
Cost of inputs	\$0	\$0	\$50 (bread) 35 (cheese)
Wages	25	30	75
Value of output	100	60	200

- a. Calculate GDP as the value added in production.
- b. Calculate GDP as spending on final goods and services.
- c. Calculate GDP as factor income.

## Solution

5.
  - a. To calculate GDP as the value added in production, we need to sum all value added (value of output minus the value of intermediate goods) for each company. Value added in the bread company is \$100; in the cheese company, \$60; and in the pizza company, \$115 ( $\$200 - \$50 - \$35$ ). The total value added in production is  $\$100 + \$60 + \$115 = \$275$ .
  - b. To calculate GDP as spending on final goods and services, we need to sum the value of bread, cheese, and pizzas sold as final goods. The bread company produces a value of output of \$50, which goes to the pizza company as an intermediate good, leaving \$50 ( $\$100 - \$50$ ) as final goods. The cheese company produces a value of output of \$60, of which \$35 goes to the pizza company as an intermediate good, leaving \$25 ( $\$60 - \$35$ ) as final goods. Finally, the pizza company's value of output is all final goods since it produces no intermediate product. So GDP is equal to \$275 ( $\$50 + \$25 + \$200$ ).
  - c. To calculate GDP as factor income, we need to sum factor income (labor and profits) for each firm. For the bread company, factor income is \$100: labor earns \$25 and profit is \$75. For the cheese company, factor income is \$60: labor earns \$30 and profit is \$30. For the pizza company, factor income is \$115: labor earns \$75 and profit is \$40 ( $\$200 - \$75 - \$50 - \$35$ ). As factor income, GDP equals \$275 ( $\$100 + \$60 + \$115$ ).
  
6. Which of the following transactions will be included in GDP for the United States?
  - a. Coca-Cola builds a new bottling plant in the United States.
  - b. Delta sells one of its existing airplanes to Korean Air.
  - c. Ms. Moneybags buys an existing share of Disney stock.
  - d. A California winery produces a bottle of Chardonnay and sells it to a customer in Montreal, Canada.
  - e. An American buys a bottle of French perfume in Paris.
  - f. A book publisher produces too many copies of a new book; the books don't sell this year, so the publisher adds the surplus books to inventories.

## Solution

6.
  - a. When Coca-Cola builds a new bottling plant, it is investment spending and included in GDP.
  - b. If Delta sells one of its airplanes to Korean Air, this transaction is not included in GDP because it does not represent production during the current time period. The airplane would have been included in GDP when it was produced; now it is just a sale of a used item.
  - c. When an individual buys an existing share of stock, the transaction is not included in GDP because there is no production.
  - d. If a California winery sells a bottle of Chardonnay to a customer in Montreal, it is a U.S. export and is entered as such in U.S. GDP.
  - e. When an American buys a bottle of French perfume, it is a consumption expenditure as measured by GDP. But since it does not represent production in the United States of either perfume manufacture or perfume retailing, it is also deducted from GDP as an import. The net effect of the transaction does not change GDP in the United States.

- f. If a book publisher produces too many copies of a new book and the books don't sell in the year they are produced, the publisher adds the surplus books to inventories. These books are considered investment spending and added to GDP. It is as if the publisher bought the books itself.

7. The accompanying table shows data on nominal GDP (in billions of dollars), real GDP (in billions of 2005 dollars), and population (in thousands) of the United States in 1960, 1970, 1980, 1990, 2000, and 2010. The U.S. price level rose consistently over the period 1960–2010.

Year	Nominal GDP (billions of dollars)	Real GDP (billions of 2005 dollars)	Population (thousands)
1960	\$526.4	\$2,828.5	180,760
1970	1,038.5	4,266.3	205,089
1980	2,788.1	5,834.0	227,726
1990	5,800.5	8,027.1	250,181
2000	9,951.5	11,216.4	282,418
2010	14,526.5	13,088.0	310,106

- a. Why is real GDP greater than nominal GDP for all years until 2000 and lower for 2010?
- b. Calculate the percent change in real GDP from 1960 to 1970, 1970 to 1980, 1980 to 1990, 1990 to 2000, and 2000 to 2010. Which period had the highest growth rate?
- c. Calculate real GDP per capita for each of the years in the table.
- d. Calculate the percent change in real GDP per capita from 1960 to 1970, 1970 to 1980, 1980 to 1990, 1990 to 2000, and 2000 to 2010. Which period had the highest growth rate?
- e. How do the percent change in real GDP and the percent change in real GDP per capita compare? Which is larger? Do we expect them to have this relationship?

## Solution

7. a. The base year is 2004, and from 1960 to 2005, prices rose. To calculate real GDP for the years 1960, 1970, 1980, and 2000, we would multiply output in those years by the higher prices that existed in 2005. To calculate nominal GDP, we would multiply output by the lower prices that existed in those particular years. Therefore, real GDP (which values output in 2010 using the lower 2005 prices) will result in a lower number than nominal GDP (which values the output in 2010 using the higher 2010 prices). Note that real GDP would equal nominal GDP in 2005 since 2005 is the base year, and we use the same set of prices to value both real and nominal GDP in that year.
- b. The accompanying table shows the percent change in real GDP from 1960 to 1970, 1970 to 1980, 1980 to 1990, 1990 to 2000, and 2000 to 2010. The percent change in real GDP was the highest during the 1960s.

Year	Real GDP (billions of 2005 dollars)	Percent change in real GDP
1960	\$2,828.5	
1970	4,266.3	50.8%
1980	5,834.0	36.7%
1990	8,027.1	37.6%
2000	11,216.4	39.7%
2010	13,088.0	16.7%



**c. Real GDP per capita (2005 dollars)**

1960	\$15,648
1970	20,802
1980	25,619
1990	32,085
2000	39,716
2010	42,205

d. The years from 1960 through 1970 had the highest growth rate, as shown in the table.

**Percent change in real GDP per capita**

1960–1970	32.9%
1970–1980	23.2%
1980–1990	25.2%
1990–2000	23.8%
2000–2010	6.3%

e. For a given time period, the percent change in real GDP is consistently larger than the percent change in real GDP per capita. We should expect this pattern because the U.S. population was growing from 1960 to 2010.

8. Eastland College is concerned about the rising price of textbooks that students must purchase. To better identify the increase in the price of textbooks, the dean asks you, the Economics Department's star student, to create an index of textbook prices. The average student purchases three English, two math, and four economics textbooks per year. The prices of these books are given in the accompanying table.

	2012	2013	2014
English textbook	\$100	\$110	\$114
Math textbook	140	144	148
Economics textbook	160	180	200

- What is the percent change in the price of an English textbook from 2012 to 2014?
- What is the percent change in the price of a math textbook from 2012 to 2014?
- What is the percent change in the price of an economics textbook from 2012 to 2014?
- Using 2013 as a base year, create a price index for these books for all years.
- What is the percent change in the price index from 2012 to 2014?

**Solution**

8. a. The percent change in the price of an English textbook from 2012 to 2014 is 14.0% (equal to  $(\$114 - \$100)/\$100 \times 100$ ).
- b. The percent change in the price of a math textbook from 2012 to 2014 is 5.7% (equal to  $(\$148 - \$140)/\$140 \times 100$ ).
- c. The percent change in the price of an economics textbook from 2012 to 2014 is 25% (equal to  $(\$200 - \$160)/\$160 \times 100$ ).
- d. To create an index of textbook prices, you must first calculate the cost of the market basket (three English, two math, and four economics textbooks) in each of the three years; then normalize it by dividing the cost of the market basket in a given year by the cost of the market basket in the base period; and then multiply by 100 to get an index value (base period of 2013 = 100).

$$\text{Cost of textbooks in 2012} = (3 \times \$100) + (2 \times \$140) + (4 \times \$160) = \$1,220$$

$$\text{Cost of textbooks in 2013} = (3 \times \$110) + (2 \times \$144) + (4 \times \$180) = \$1,338$$

$$\text{Cost of textbooks in 2014} = (3 \times \$114) + (2 \times \$148) + (4 \times \$200) = \$1,438$$

$$\text{Index value for 2012} = (\$1,220/\$1,338) \times 100 = 91.2$$

$$\text{Index value for 2013} = (\$1,338/\$1,338) \times 100 = 100$$

$$\text{Index value for 2014} = (\$1,438/\$1,338) \times 100 = 107.5$$

- e. The percent change in the price index for textbooks from 2012 to 2014 is 17.9% (equal to  $((107.5 - 91.2)/91.2) \times 100$ ).

9. The consumer price index, or CPI, measures the cost of living for a typical urban household by multiplying the price for each category of expenditure (housing, food, and so on) times a measure of the importance of that expenditure in the average consumer's market basket and summing over all categories. However, using data from the consumer price index, we can see that changes in the cost of living for different types of consumers can vary a great deal. Let's compare the cost of living for a hypothetical retired person and a hypothetical college student. Let's assume that the market basket of a retired person is allocated in the following way: 10% on housing, 15% on food, 5% on transportation, 60% on medical care, 0% on education, and 10% on recreation. The college student's market basket is allocated as follows: 5% on housing, 15% on food, 20% on transportation, 0% on medical care, 40% on education, and 20% on recreation. The accompanying table shows the March 2014 CPI for each of the relevant categories.

	CPI March 2014
Housing	228.7
Food	239.7
Transportation	219.3
Medical care	436.5
Education	229.1
Recreation	115.7

Calculate the overall CPI for the retired person and for the college student by multiplying the CPI for each of the categories by the relative importance of that category to the individual and then summing each of the categories. The CPI for all items in March 2014 was 235.6. How do your calculations for a CPI for the retired person and the college student compare to the overall CPI?

### Solution

9. For the retired person:

	Weight	CPI March 2014	CPI Contribution
Housing	0.1	228.7	22.87
Food	0.15	239.7	35.955
Transportation	0.05	219.3	10.965
Medical care	0.6	436.5	261.9
Education	0	229.1	0
Recreation	0.1	115.7	11.57
<b>Overall CPI</b>			<b>343.26</b>

For the college student:

	Weight	CPI March 2014	CPI Contribution
Housing	0.05	228.7	11.435
Food	0.15	239.7	35.955
Transportation	0.2	219.3	43.86
Medical care	0	436.5	0
Education	0.4	229.1	91.64
Recreation	0.2	115.7	23.14
<b>Overall CPI</b>			<b>206.03</b>

To calculate the CPI for the retired person and for the college student, we need to weight the CPI for each component with the importance of that component in his or her market basket. The CPI for the retired person is 343.26 and for the college student 206.03. Since the CPI for the average consumer was 235.6, the CPI will overstate the increase in the cost of living for the college student and understate it for the retired person.

10. Go to The Bureau of Labor Statistics home page at [www.bls.gov](http://www.bls.gov). Place the cursor over the “Economic Releases” tab and then click on “Major Economic Indicators” in the drop-down menu that appears. Once on the “Major Economic Indicators” page, click on “Consumer Price Index.” On that page, under “Table of Contents,” click on “Table 1: Consumer Price Index for All Urban Consumers.” Using the “unadjusted” figures, determine what the CPI was for the previous month. How did it change from the previous month? How does the CPI compare to the same month one year ago?

10. Answers will vary with the latest data. For July 2014, the CPI was 238.250; it rose 0.1% from June 2014. The CPI was 2.0% higher than in July 2013.

11. The accompanying table provides the annual real GDP (in billions of 2009 dollars) and nominal GDP (in billions of dollars) for the United States.

	2009	2010	2011	2012	2013
Real GDP (billions of 2009 dollars)	14,417.9	14,779.4	15,052.4	15,470.7	15,761.3
Nominal GDP (billions of dollars)	14,417.9	14,958.3	15,533.8	16,244.6	16,799.7

- a. Calculate the GDP deflator for each year.  
b. Use the GDP deflator to calculate the inflation rate for all years except 2009.

11. a. The GDP deflator in a given year is 100 times the ratio of nominal GDP to real GDP, yielding the figures in the accompanying table.

	2009	2010	2011	2012	2013
Real GDP (billions of 2009 dollars)	14,417.9	14,779.4	15,052.4	15,470.7	15,761.3
Nominal GDP (billions of dollars)	14,417.9	14,958.3	15,533.8	16,244.6	16,799.7
GDP deflator	100	101.2	103.2	105.0	106.6

- b. The inflation rate obtained by using the GDP deflator is calculated using the formula  $((\text{current GDP deflator} - \text{GDP deflator in the previous year}) / (\text{GDP deflator in the previous year})) \times 100$ , yielding the figures in the accompanying table.

	2009	2010	2011	2012	2013
GDP deflator	100	101.2	103.2	105.0	106.6
Inflation		1.2%	2.0%	1.7%	1.5%

12. The accompanying table contains two price indexes for the years 2011, 2012, and 2013: the GDP deflator and the CPI. For each price index, calculate the inflation rate from 2011 to 2012 and from 2012 to 2013.

Year	GDP deflator	CPI
2011	103.199	224.939
2012	105.002	229.594
2013	106.588	232.957

12. The accompanying table calculates the inflation rates based on the GDP deflator and on the CPI.

Year	GDP deflator	Inflation rate (based on GDP deflator)	CPI	Inflation rate (based on CPI)
2011	103.199		224.939	
2012	105.002	1.7%	229.594	2.1%
2013	106.588	1.5%	232.957	1.5%

13. The cost of a college education in the United States is rising at a rate faster than inflation. The following table shows the average cost of a college education in the United States during the academic year that began in 2011 and the academic year that began in 2012 for public and private colleges. Assume the costs listed in the table are the only costs experienced by the various college students in a single year.

	Cost of college education during academic year beginning 2011 (averages in 2011 dollars)			
	Tuition and fees	Room and board	Books and supplies	Other expenses
Two-year public college: commuter	\$2,970	\$5,552	\$1,314	\$2,988
Four-year public college: in-state, on-campus	7,731	8,831	1,232	3,203
Four-year public college: out-of-state, on-campus	20,823	8,831	1,232	3,203
Four-year private college: on-campus	27,949	9,853	1,238	2,378
	Cost of college education during academic year beginning 2012 (averages in 2012 dollars)			
	Tuition and fees	Room and board	Books and supplies	Other expenses
Two-year public college: commuter	\$3,080	\$5,817	\$1,341	\$3,040
Four-year public college: in-state, on-campus	8,805	9,183	1,243	3,253
Four-year public college: out-of-state, on-campus	21,706	9,183	1,243	3,253
Four-year private college: on-campus	29,115	10,181	1,243	2,423

- a. Calculate the cost of living for an average college student in each category for 2011 and 2012.
- b. Calculate an inflation rate for each type of college student between 2011 and 2012.

### Solution

13. a. To calculate the cost of living, we add all the costs in each category. The cost of living for each type of student is calculated in the accompanying table.

	Average cost of attendance in dollars	
	2011	2012
Two-year public college: commuter	\$12,824	\$13,278
Four-year public college: in-state, on-campus	20,997	22,484
Four-year public college: out-of-state, on-campus	34,089	35,385
Four-year private college: on-campus	41,418	42,962

b. The inflation rate for each type of student is calculated as follows:  $((\text{price index in 2012} - \text{price index in 2011}) / (\text{price index in 2011})) \times 100$ . Because each type of student consumes the same goods and services in 2011 and 2012, the cost of living can be used as a price index. Using the formula, the inflation rates are calculated in the following table.

	Inflation rate
Two-year public college: commuter	3.5%
Four-year public college: in-state, on-campus	7.1%
Four-year public college: out-of-state, on-campus	3.8%
Four-year private college: on-campus	3.7%

14. The economy of Britannica produces three goods: computers, DVDs, and pizza. The accompanying table shows the prices and output of the three goods for the years 2012, 2013, and 2014.

Year	Computers		DVDs		Pizzas	
	Price	Quantity	Price	Quantity	Price	Quantity
2012	\$900	10	\$10	100	\$15	2
2013	1,000	10.5	12	105	16	2
2014	1,050	12	14	110	17	3

- a. What is the percent change in production of each of the goods from 2012 to 2013 and from 2013 to 2014?
- b. What is the percent change in prices of each of the goods from 2012 to 2013 and from 2013 to 2014?
- c. Calculate nominal GDP in Britannica for each of the three years. What is the percent change in nominal GDP from 2012 to 2013 and from 2013 to 2014?
- d. Calculate real GDP in Britannica using 2012 prices for each of the three years. What is the percent change in real GDP from 2012 to 2013 and from 2013 to 2014?

#### WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



# Unemployment and Inflation

1. Each month, usually on the first Friday of the month, the Bureau of Labor Statistics releases the Employment Situation Summary for the previous month. Go to [www.bls.gov](http://www.bls.gov) and find the latest report. On the Bureau of Labor Statistics home page, at the top of the page, select the “Subjects” tab, find “Unemployment,” and select “National Unemployment Rate.” You will find the Employment Situation Summary under “CPS News Releases” on the left-hand side of the page. How does the current unemployment rate compare to the rate one month earlier? How does the current unemployment rate compare to the rate one year earlier?

## Solution

1. Answers will vary with the latest data. For July 2014, the unemployment rate was 6.2%, unchanged from June 2014. Since July 2013, the unemployment rate has fallen by 1.1 percentage points.
2. In general, how do changes in the unemployment rate vary with changes in real GDP? After several quarters of a severe recession, explain why we might observe a decrease in the official unemployment rate. Explain why we could see an increase in the official unemployment rate after several quarters of a strong expansion.

## Solution

2. In general, the change in the unemployment rate varies inversely with the rate of growth in real GDP: when the rate of real GDP growth is above average, we expect the unemployment rate to fall rapidly, and when the rate of real GDP growth is below average we expect the unemployment rate to rise. However, after several quarters of a severe recession, unemployed workers may become discouraged and stop looking for work. Since the definition of unemployed persons requires that they be looking for work, officially measured unemployment falls as workers become discouraged and stop looking. We could see an increase in the official unemployment rate after several quarters of a strong expansion as existing workers, encouraged by an increase in wages, leave existing jobs to search for new ones and discouraged workers begin to search for jobs again.
3. In each of the following situations, what type of unemployment is Melanie facing?
  - a. After completing a complex programming project, Melanie is laid off. Her prospects for a new job requiring similar skills are good, and she has signed up with a programmer placement service. She has passed up offers for low-paying jobs.
  - b. When Melanie and her co-workers refused to accept pay cuts, her employer outsourced their programming tasks to workers in another country. This phenomenon is occurring throughout the programming industry.
  - c. Due to the current slump, Melanie has been laid off from her programming job. Her employer promises to rehire her when business picks up.

## Solution

3. a. Melanie is frictionally unemployed because she is refusing offers for low-paying jobs in favor of engaging in a job search for a higher-paying job.

- b. Melanie is structurally unemployed because she is demanding a higher wage than the current equilibrium wage in her industry. In this case, the equilibrium wage has been lowered by the outsourcing of work to other countries.
- c. Melanie is cyclically unemployed because her bout of unemployment is tied to the business cycle. It is likely she will be reemployed once the economy picks up.
4. Part of the information released in the Employment Situation Summary concerns how long individuals have been unemployed. Go to [www.bls.gov](http://www.bls.gov) to find the latest report. Use the same technique as in Problem 1 to find the Employment Situation Summary. Near the end of the Employment Situation, click on table A-12, titled “Unemployed persons by duration of unemployment.” Use the seasonally adjusted numbers to answer the following questions.
- a. How many workers were unemployed less than 5 weeks? What percentage of all unemployed workers do these workers represent? How do these numbers compare to the previous month’s data?
- b. How many workers were unemployed for 27 or more weeks? What percentage of all unemployed workers do these workers represent? How do these numbers compare to the previous month’s data?
- c. How long has the average worker been unemployed (average duration, in weeks)? How does this compare to the average for the previous month’s data?
- d. Comparing the latest month for which there are data with the previous month, has the problem of long-term unemployment improved or deteriorated?

## Solution

4. Answers will vary depending on when you look up the information.
- a. In July 2014, 2,587,000 workers had been unemployed less than 5 weeks, representing 27.0% of all unemployed workers. This was an increase from June 2014, when 2,410,000 workers had been unemployed less than 5 weeks, representing 25.7% of the unemployed.
- b. In July 2014, 3,155,000 workers had been unemployed for 27 or more weeks, representing 32.9% of all unemployed workers. This was up from June 2014, when 3,081,000 workers had been unemployed for 27 or more weeks, as was the percentage of workers unemployed for 27 or more weeks, representing 32.8% of the unemployed.
- c. In July 2014, the average worker was unemployed for 32.4 weeks, down from 33.5 weeks in June 2014.
- d. The problem of long-term unemployment seems to be slowly improving; the numbers for July 2014 were slightly better than for June 2014.
5. A country’s labor force is the sum of the number of employed and unemployed workers. The accompanying table provides data on the size of the labor force and the number of unemployed workers for different regions of the United States.

Region	Labor force (thousands)		Unemployed (thousands)	
	April 2013	April 2014	April 2013	April 2014
Northeast	28,407.2	28,288.9	2,174.4	1,781.3
South	56,787.8	57,016.4	4,089.9	3,363.8
Midwest	34,320.0	34,467.0	2,473.7	2,109.0
West	36,122.2	36,307.3	2,940.8	2,535.7

Source: Bureau of Labor Statistics.

- a. Calculate the number of workers employed in each of the regions in April 2013 and April 2014. Use your answers to calculate the change in the total number of workers employed between April 2013 and April 2014.
- b. For each region, calculate the growth in the labor force from April 2013 to April 2014.
- c. Compute unemployment rates in the different regions of the country in April 2013 and April 2014.
- d. What can you infer about the fall in unemployment rates over this period? Was it caused by a net gain in the number of jobs or by a large fall in the number of people seeking jobs?

## Solution

5. a. The number of employed people equals the size of the labor force minus the number of unemployed people, as shown in the accompanying table.

Region	Employed (thousands)		Change (thousands)
	April 2013	April 2014	
Northeast	26,232.8	26,507.6	274.8
South	52,697.9	53,652.6	954.7
Midwest	31,846.3	32,358.0	511.7
West	33,181.4	33,771.6	590.2

- b. The accompanying table shows the change in the size of the labor force during the period April 2013 to April 2014.

Region	Growth in the labor force (thousands)
Northeast	-118.3
South	228.6
Midwest	147.0
West	185.1

- c. The unemployment rate is calculated as (Number of unemployed workers/labor force)  $\times$  100, as shown in the accompanying table.

Region	Unemployment rate	
	April 2013	April 2014
Northeast	7.7%	6.3%
South	7.2	5.9
Midwest	7.2	6.1
West	8.1	7.0

- d. In the Northeast the fall in the unemployment rate was caused by a rise in the number of people with jobs and a decline in the labor force. In the South, midwest, and west, the fall in the unemployment rate was caused by both a net rise in the number of jobs and a fall in the number of people seeking jobs. In the South there was both a net rise in the number of jobs and the number of people seeking jobs. But the number of jobs increased more than the labor force, and the unemployment rate fell.



- 6.** In which of the following cases is it more likely for efficiency wages to exist? Why?
- Jane and her boss work as a team selling ice cream.
  - Jane sells ice cream without any direct supervision by her boss.
  - Jane speaks Korean and sells ice cream in a neighborhood in which Korean is the primary language. It is difficult to find another worker who speaks Korean.

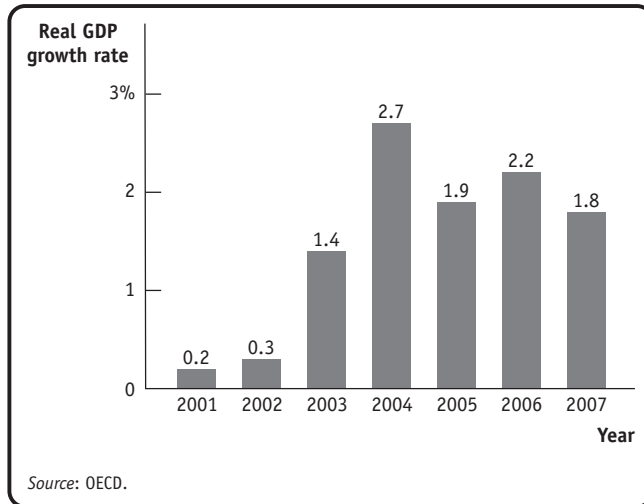
### Solution

- 6.**
- If Jane and her boss work as a team selling ice cream, Jane will want her boss to see her doing a good job. The boss knows that the quality of her work will be high without an efficiency wage because he is there to observe her.
  - If Jane sells ice cream without any direct supervision, the boss is not certain that Jane will try her best to sell as much ice cream as she can. The boss may want to pay her an efficiency wage to encourage her to work harder.
  - Jane's boss will offer her an efficiency wage because he doesn't want to lose an employee who cannot be easily replaced because of her skill (speaking Korean).
- 7.** How will the following changes affect the natural rate of unemployment?
- The government reduces the time during which an unemployed worker can receive unemployment benefits.
  - More teenagers focus on their studies and do not look for jobs until after college.
  - Greater access to the internet leads both potential employers and potential employees to use the internet to list and find jobs.
  - Union membership declines.

### Solution

- 7.**
- If the government reduces the time during which an unemployed worker can obtain benefits, workers will be less willing to spend time searching for a job. This will reduce the amount of frictional unemployment and lower the natural rate of unemployment.
  - Since teenagers have a higher rate of frictional unemployment, this will lower the overall amount of frictional unemployment and lower the natural rate of unemployment.
  - Greater access to the internet would facilitate job searches, reducing frictional unemployment and lowering the natural rate of unemployment.
  - Since strong unions negotiate wages above the equilibrium level, they are a source of structural unemployment. A decline in union membership will reduce structural unemployment and, with it, the natural rate of unemployment.
- 8.** With its tradition of a job for life for most citizens, Japan once had a much lower unemployment rate than that of the United States; from 1960 to 1995, the unemployment rate in Japan exceeded 3% only once. However, since the crash of its stock market in 1989 and slow economic growth in the 1990s, the job-for-life system has broken down and unemployment rose to more than 5% in 2003.
- Explain the likely effect of the breakdown of the job-for-life system in Japan on the Japanese natural rate of unemployment.
  - As the accompanying diagram shows, the rate of growth of real GDP has picked up in Japan after 2001 and before the global economic crisis of 2007–2009. Explain the likely effect of this increase in real GDP growth on the unemployment

rate. Is the likely cause of the change in the unemployment rate during this period a change in the natural rate of unemployment or a change in the cyclical unemployment rate?

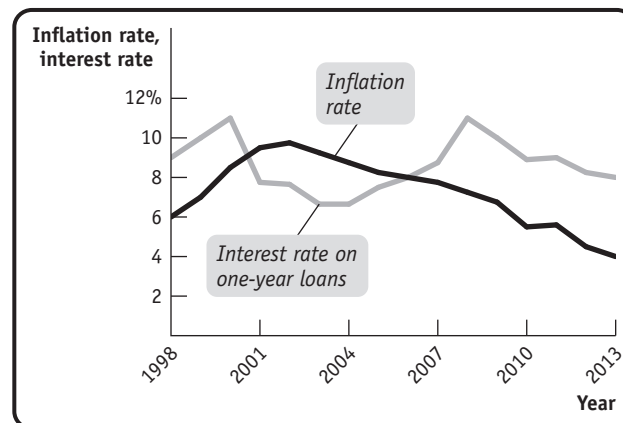


## Solution

8. a. The job-for-life system of employment in Japan led to a very low level of frictional unemployment. The only search for jobs occurred when workers first joined the labor force. The low level of frictional unemployment led to a low natural rate of unemployment. Since the stock market crash of 1989 and the slow economic growth of the 1990s, Japan has moved away from the job-for-life system. As some Japanese firms laid off workers who believed they had their jobs for life, it was difficult for many to find new jobs. Consequently, frictional unemployment has risen in Japan, leading to a higher natural rate of unemployment.
- b. The increase in real GDP growth should result in a decrease in the unemployment rate in Japan. Indeed, the unemployment rate has dropped from 5.3% in 2003 to 3.9% in 2007. The likely cause of this is a decrease in the cyclical unemployment rate. The increase in real GDP growth indicates that the Japanese economy has expanded during this period.
9. In the following examples, is inflation creating winners and losers at no net cost to the economy or is inflation imposing a net cost on the economy? If a net cost is being imposed, which type of cost is involved?
- When inflation is expected to be high, workers get paid more frequently and make more trips to the bank.
  - Lanwei is reimbursed by her company for her work-related travel expenses. Sometimes, however, the company takes a long time to reimburse her. So when inflation is high, she is less willing to travel for her job.
  - Hector Homeowner has a mortgage with a fixed nominal 6% interest rate that he took out five years ago. Over the years, the inflation rate has crept up unexpectedly to its present level of 7%.
  - In response to unexpectedly high inflation, the manager of Cozy Cottages of Cape Cod must reprint and resend expensive color brochures correcting the price of rentals this season.

## Solution

9. a. This is an example of the effect of shoe-leather costs, a net cost of inflation to the economy. Workers spend valuable resources going to the bank more frequently, firms spend valuable resources (such as bookkeepers' time) in paying workers more frequently, and banks spend more resources in processing the greater volume of transactions.
- b. This is an example of unit-of-account costs. A dollar when Lanwei spends it on a work-related expense is worth more than a dollar she receives much later in reimbursement from her company. Because she is less willing to travel for her job, there is a net cost to the economy of her forgone output.
- c. This is an example of inflation creating winners and losers. As the inflation rate creeps up unexpectedly, the real value of the funds that Hector pays to the mortgage company falls. So Hector is better off as inflation increases, and the lender of his mortgage is worse off. At present, the real interest rate on his mortgage is negative:  $6\% - 7\% = -1\%$ . So he is now financing his house virtually cost-free.
- d. This is an example of menu costs, a net cost of inflation to the economy. The manager of Cozy Cottages of Cape Cod must reprint and resend an expensive brochure because it is necessary to raise the price of rentals due to unexpectedly high inflation.
10. The accompanying diagram shows the interest rate on one-year loans and inflation during 1998–2013 in the economy of Albernia. When would one-year loans have been especially attractive and why?



## Solution

10. One-year loans in Albernia would have been especially attractive during the time in which the inflation rate exceeded the interest rate, corresponding to the years 2001 to 2006. Whenever nominal interest rates are lower than inflation, borrowers are better off and lenders are worse off.

11. The accompanying table provides the inflation rate in the year 2000 and the average inflation rate over the period 2001–2013 for seven different countries.

Country	Inflation rate in 2000	Average inflation rate in 2001–2013
Brazil	7.06%	6.72%
China	0.40	2.34
France	1.83	1.86
Indonesia	3.77	7.56
Japan	-0.78	-0.23
Turkey	55.03	18.79
United States	3.37	2.43

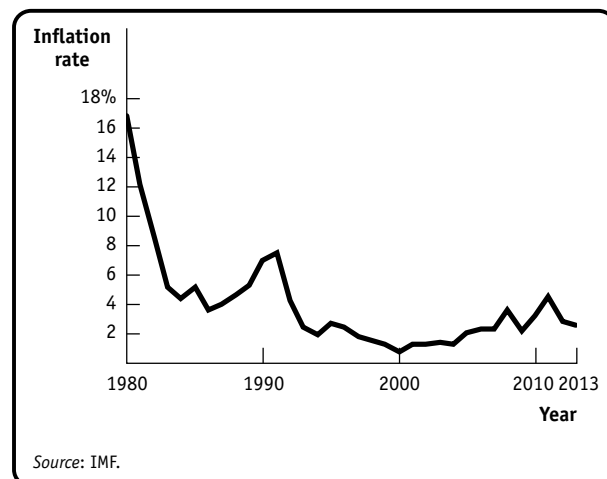
Source: IMF.

- Given the expected relationship between average inflation and menu costs, rank the countries in descending order of menu costs using average inflation over the period 2001–2013.
- Rank the countries in order of inflation rates that most favored borrowers with ten-year loans that were taken out in 2000. Assume that the loans were agreed upon with the expectation that the inflation rate for 2001 to 2013 would be the same as the inflation rate in 2000.
- Did borrowers who took out ten-year loans in Japan gain or lose overall versus lenders? Explain.

### Solution

11. a. The countries with the highest average inflation rates should have the highest menu costs. Order: Turkey, Indonesia, Brazil, United States, China, France, Japan.
- b. The countries with an average inflation rate higher than the inflation rate in 2000 should favor borrowers with ten-year loans payable in 2013. The higher the difference between the average inflation rate during 2001–2013 and the inflation rate in 2000, the lower the real value of the loan. Order: Indonesia, China, Japan, France, Brazil, United States, Turkey.
- c. During this period, borrowers would have gained at the expense of lenders in Japan since  $-0.23\%$  is greater than  $-0.78\%$ . Average inflation in Japan was greater between 2000 and 2013 than it was in 2000.

12. The accompanying diagram shows the inflation rate in the United Kingdom from 1980 to 2013.



- a. Between 1980 and 1985, policy makers in the United Kingdom worked to lower the inflation rate. What would you predict happened to unemployment between 1980 and 1985?
- b. Policy makers in the United Kingdom react forcefully when the inflation rate rises above a target rate of 2%. Why would it be harmful if inflation rose from 3.4% (the level in 2013) to, say, a level of 5%?

### Solution

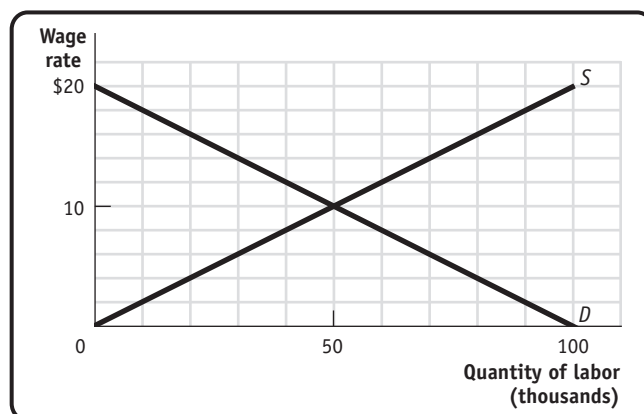
12. a. Because of the disinflation that occurred between 1980 and 1985, one would predict that the unemployment rate rose during this period. Indeed, the unemployment rate rose from 6.5% in 1980 to a high of 11.4% in 1985.
- b. There is not much evidence that 5% inflation would do a great deal of harm to the economy. However, policy makers in the United Kingdom usually move forcefully to bring inflation back to 2% whenever it rises above this level because experience has shown that disinflation is very difficult and costly once a higher rate of inflation has become well established in the economy.

#### WORK IT OUT

Interactive, step-by-step help solving this problem is available to your students via



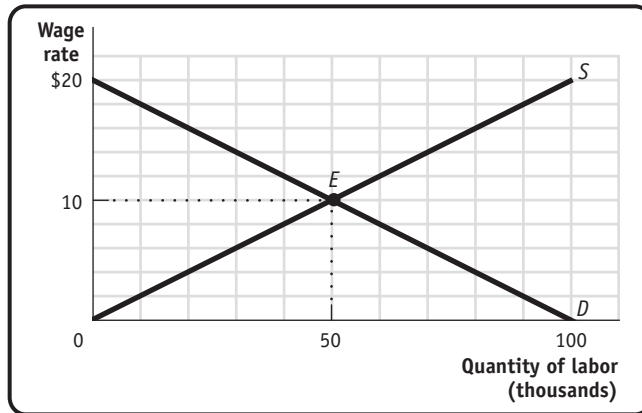
13. There is only one labor market in Profunctia. All workers have the same skills, and all firms hire workers with these skills. Use the accompanying diagram, which shows the supply of and demand for labor, to answer the following questions. Illustrate each answer with a diagram.



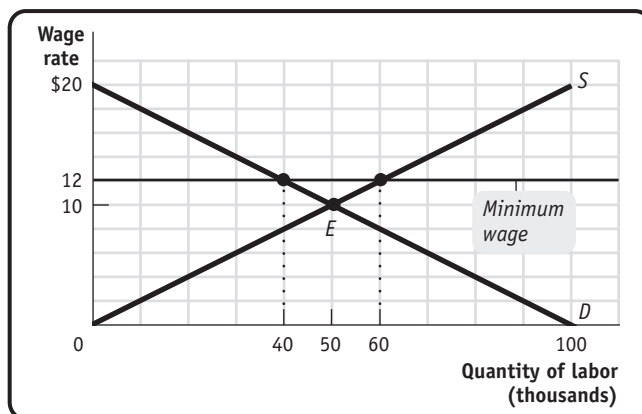
- a. What is the equilibrium wage rate in Profunctia? At this wage rate, what are the level of employment, the size of the labor force, and the unemployment rate?
- b. If the government of Profunctia sets a minimum wage equal to \$12, what will be the level of employment, the size of the labor force, and the unemployment rate?
- c. If unions bargain with the firms in Profunctia and set a wage rate equal to \$14, what will be the level of employment, the size of the labor force, and the unemployment rate?
- d. If the concern for retaining workers and encouraging high-quality work leads firms to set a wage rate equal to \$16, what will be the level of employment, the size of the labor force, and the unemployment rate?

### Solution

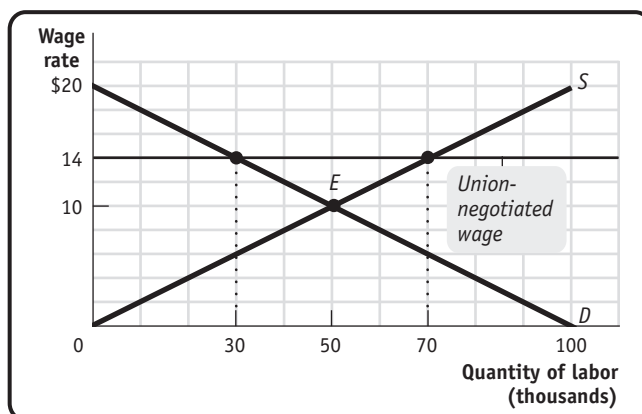
13. a. The equilibrium wage rate is \$10. At this wage rate, there will be 50,000 employed workers, no unemployed workers, a labor force of 50,000, and an unemployment rate of 0%.



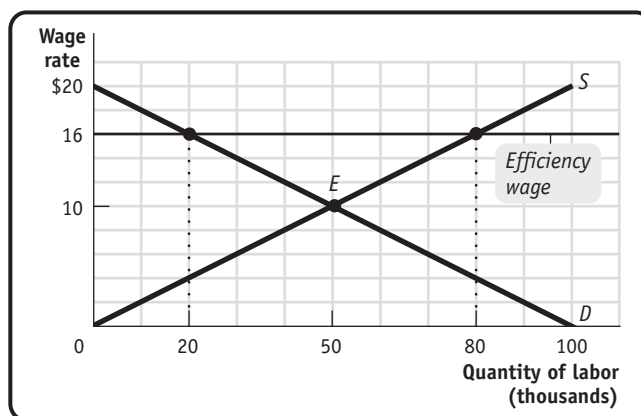
- b. If the government of Profunctia sets a minimum wage equal to \$12, then 60,000 workers (the size of the labor force) will be looking for work but only 40,000 will find jobs. There will be 20,000 unemployed workers, and the unemployment rate will be 33.3%  $((20,000/60,000) \times 100)$ .



- c. If unions bargain with the firms in Profunctia and set a wage rate equal to \$14, then 70,000 workers (the size of the labor force) will be looking for work but only 30,000 will find jobs. There will be 40,000 unemployed workers, and the unemployment rate will be 57.1%  $((40,000/70,000) \times 100)$ .



- d. If the concern for retaining workers and encouraging high-quality work leads firms to set a wage rate of \$16, then 80,000 workers (the size of the labor force) will be looking for work but only 20,000 will find jobs. There will be 60,000 unemployed workers, and the unemployment rate will be 75% ( $(60,000/80,000) \times 100$ ).



# Long-Run Economic Growth

CHAPTER  
**9**

1. The accompanying table shows data from the Penn World Table, Version 8.0, for real GDP per capita in 2005 U.S. dollars for Argentina, Ghana, South Korea, and the United States for 1960, 1970, 1980, 1990, 2000, and 2011.

Year	Argentina			Ghana			South Korea			United States		
	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita
1960	\$6,585	?	?	\$1,557	?	?	\$1,610	?	?	\$15,136	?	?
1970	8,147	?	?	1,674	?	?	2,607	?	?	20,115	?	?
1980	8,938	?	?	1,418	?	?	5,161	?	?	25,221	?	?
1990	6,889	?	?	1,296	?	?	11,376	?	?	31,431	?	?
2000	9,208	?	?	1,530	?	?	20,016	?	?	39,498	?	?
2011	13,882	?	?	2,349	?	?	29,618	?	?	42,244	?	?

- a. Complete the table by expressing each year's real GDP per capita as a percentage of its 1960 and 2011 levels.
- b. How does the growth in living standards from 1960 to 2011 compare across these four nations? What might account for these differences?

## Solution

1. a. The accompanying table shows each nation's real GDP per capita in terms of its 1960 and 2011 levels.

Year	Argentina			Ghana			South Korea			United States		
	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of 1960 real GDP per capita	Percentage of 2011 real GDP per capita
1960	\$6,585	100%	47%	\$1,557	100%	66%	\$1,610	100%	5%	\$15,136	100%	36%
1970	8,147	124	59	1,674	108	71	2,607	162	9	20,115	133	48
1980	8,938	136	64	1,418	91	60	5,161	321	17	25,221	167	60
1990	6,889	105	50	1,296	83	55	11,376	707	38	31,431	208	74
2000	9,208	140	66	1,530	98	65	20,016	1,243	68	39,498	261	93
2011	13,882	211	100	2,349	151	100	29,618	1,840	100	42,244	279	100



b. South Korea experienced the greatest increase in living standards from 1960 to 2011; in 2011 it produced 1,840% ( $\$29.618/\$1,610 \times 100$ ) of what it produced in 1960. Argentina experienced only a modest growth in living standards over the same period, and Argentina's path was less consistent than that of Ghana. Compared with real GDP per capita in 1960, the United States in 2011 produced 279% ( $\$42,244/\$15,136 \times 100$ ) of what it produced in 1960. The growth in living standards in Argentina, Ghana, and South Korea reflects the pattern for their different regions of the world. South Korea, like many other East Asian countries, had high productivity growth because of high savings and investment rates, a good education system, and substantial technological progress. Living standards grew more modestly in Argentina, as in other Latin American countries, because of low savings and investment spending rates, underinvestment in education, political instability, and irresponsible government policies. Ghana, in particular recently, has made some progress. Living standards in Africa suffered because of major political instabilities, poor education and infrastructure, and disease.

2. The accompanying table shows the average annual growth rate in real GDP per capita for Argentina, Ghana, and South Korea using data from the Penn World Table, Version 8.0, for the past few decades.

Years	Average annual growth rate of real GDP per capita		
	Argentina	Ghana	South Korea
1960–1970	2.15%	0.73%	4.94%
1970–1980	0.93	–1.64	7.07
1980–1990	–2.57	–0.9	8.22
1990–2000	3.4	1.67	5.81
2000–2010	7.92	3.16	3.67

- a. For each decade and for each country, use the Rule of 70 where possible to calculate how long it would take for that country's real GDP per capita to double.
- b. Suppose that the average annual growth rate that each country achieved over the period 2000–2010 continues indefinitely into the future. Starting from 2010, use the Rule of 70 to calculate, where possible, the year in which a country will have doubled its real GDP per capita.

## Solution

2. a. The accompanying table shows the number of years it would take for real GDP per capita to double according to the Rule of 70 using the average annual growth rate in real GDP per capita per decade in each country. Values corresponding to years with negative growth rates are left uncalculated because we cannot apply the Rule of 70 to a negative growth rate.

Years	Years for real GDP per capita to double according to the Rule of 70		
	Argentina	Ghana	South Korea
1960–1970	32.6	95.9	14.2
1970–1980	75.3	—	9.9
1980–1990	—	—	8.5
1990–2000	20.6	41.9	12.0
2000–2010	8.8	22.2	19.1

- b. If each nation continues to grow as it did from 2000 to 2010, real GDP per capita will have doubled in Argentina by 2019, in Ghana by 2032 and in South Korea by 2029.
3. The accompanying table provides approximate statistics on per capita income levels and growth rates for regions defined by income levels. According to the Rule of 70, starting in 2012 the high-income countries are projected to double their per capita GDP in approximately 78 years, in 2088. Throughout this question, assume constant growth rates for each of the regions that are equal to their average value between 2000 and 2012.

Region	Real GDP per capita (2012)	Average annual growth rate of real GDP per capita (2000–2012)
High-income countries	\$31,372	1.1%
Middle-income countries	2,730	4.7
Low-income countries	422	3.2

Source: World Bank.

- a. Calculate the ratio of per capita GDP in 2012 of the following:
- Middle-income to high-income countries
  - Low-income to high-income countries
  - Low-income to middle-income countries
- b. Calculate the number of years it will take the low-income and middle-income countries to double their per capita GDP.
- c. Calculate the per capita GDP of each of the regions in 2076. (*Hint:* How many times does their per capita GDP double in 64 years, the number of years from 2012 to 2076?)
- d. Repeat part a with the projected per capita GDP in 2076.
- e. Compare your answers to parts a and d. Comment on the change in economic inequality between the regions.

## Solution

3. a. i. The ratio of per capita GDP in 2012 of middle-income to high-income countries is 0.087 or 8.7%.
- ii. The ratio of per capita GDP in 2012 of low-income to high-income countries is 0.014 or 1.4%.
- iii. The ratio of per capita GDP in 2012 of low-income to middle-income countries is 0.155 or 15.5%.
- b. Middle-income countries are projected to take  $70/4.7 = 14.9$  years to double their per capita GDP, and low-income countries are projected to take 21.9 years.
- c. With a real GDP per capita growth rate of 1.1%, it will take  $70/1.1 = 64$  years for GDP to double. Therefore high-income countries are projected to double their GDP in 64 years to \$62,744. During the same period, middle-income countries are projected to double their per capita GDP approximately  $64/14.9 = 4$  times. So the projected per capita GDP for middle-income countries is  $\$2,730 \times 2 \times 2 \times 2 \times 2 = \$43,680$ . In 2076, low-income countries are expected to increase their per capita GDP by approximately  $64/21.9 = 3$  times. Hence, projected per capita GDP for low-income countries is  $\$422 \times 2 \times 2 \times 2 = \$3,376$ .

- d. Using the projected per capita GDP figures in 2076, the percentages are as follows:
  - i. Middle-income to high-income countries: 0.696 or 69.6%
  - ii. Low-income to high-income countries: 0.053 or 5.3%
  - iii. Low-income to middle-income countries: 0.077 or 7.7%
- e. Both the low-income countries and the middle-income countries (as defined in 2012) have improved their per capita GDP relative to high-income countries due to their higher growth rates. The result is that inequality will be lower. However, since middle-income countries are growing faster than low-income countries, the inequality between those two regions will have widened.

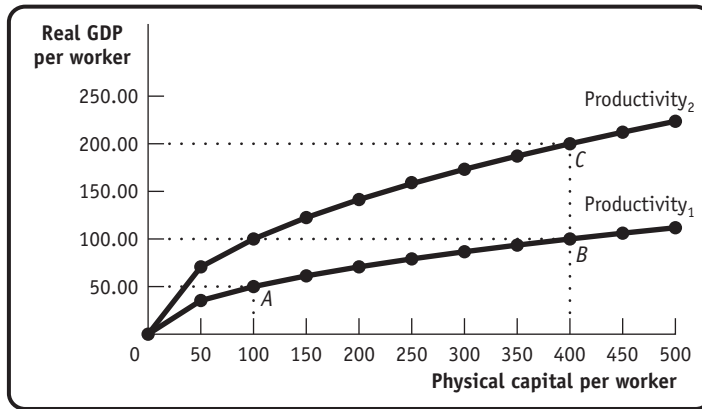
4. The country of Androde is currently using Method 1 for its production function. By chance, scientists stumble onto a technological breakthrough that will enhance Androde’s productivity. This technological breakthrough is reflected in another production function, Method 2. The accompanying table shows combinations of physical capital per worker and output per worker for both methods, assuming that human capital per worker is fixed.

Method 1		Method 2	
Physical capital per worker	Real GDP per worker	Physical capital per worker	Real GDP per worker
0	0.00	0	0.00
50	35.36	50	70.71
100	50.00	100	100.00
150	61.24	150	122.47
200	70.71	200	141.42
250	79.06	250	158.11
300	86.60	300	173.21
350	93.54	350	187.08
400	100.00	400	200.00
450	106.07	450	212.13
500	111.80	500	223.61

- a. Using the data in the accompanying table, draw the two production functions in one diagram. Androde’s current amount of physical capital per worker is 100. In your figure, label that point A.
- b. Starting from point A, over a period of 70 years, the amount of physical capital per worker in Androde rises to 400. Assuming Androde still uses Method 1, in your diagram, label the resulting point of production B. Using the Rule of 70, calculate by how many percent per year output per worker has grown.
- c. Now assume that, starting from point A, over the same period of 70 years, the amount of physical capital per worker in Androde rises to 400, but that during that time period, Androde switches to Method 2. In your diagram, label the resulting point of production C. Using the Rule of 70, calculate by how many percent per year output per worker has grown now.
- d. As the economy of Androde moves from point A to point C, what share of the annual productivity growth is due to higher total factor productivity?

Solution

4. a. In the accompanying diagram, the line labeled “Productivity<sub>1</sub>” shows the production function using Method 1, and the line labeled “Productivity<sub>2</sub>” shows the production function using Method 2. Point A is the point, using Method 1, at which Androde produces output using 100 units of physical capital per worker.



- b. In the accompanying diagram, Point B is the point, using Method 1, at which Androde produces output using 400 units of physical capital per worker. Output per worker has grown from 50 units to 100 units. Since over a period of 70 years, output per worker has doubled, output per worker must have grown by 1% per year.
- c. In the accompanying diagram, Point C is the point, using Method 2, at which Androde produces output using 400 units of physical capital per worker. From point A to point C, output per worker has grown from 50 units to 200 units. Since over a period of 70 years, output per worker has quadrupled, output per worker must have grown on average by 2% per year. (Taking  $70/2 = 35$  years to double from 50 to 100, and then another 35 years to double again from 100 to 200).
- d. Since, without the increase in technological progress, output per worker would have grown at an annual rate of only 1%, but with the increase in technological progress, output per worker has grown by 2%, half of that growth rate has to be due to an increase in total factor productivity.
5. The Bureau of Labor Statistics regularly releases the “Productivity and Costs” report for the previous month. Go to [www.bls.gov](http://www.bls.gov) and find the latest report. (On the Bureau of Labor Statistics home page, from the tab “Subjects,” select the link to “Labor Productivity & Costs”; then, from the heading “LPC News Releases,” find the most recent “Productivity and Costs” report.) What were the percent changes in business and nonfarm business productivity for the previous quarter? How does the percent change in that quarter’s productivity compare to data from the previous quarter?

Solution

5. Answers will vary with the latest data. For the second quarter of 2014, business productivity increased at a 2.0% annual rate and nonfarm business productivity increased by 2.5%. These were better than the productivity growth figures for the first quarter of 2014, which showed a decrease of -5.0% in business productivity and a decrease of -4.5% in nonfarm business productivity.

6. What roles do physical capital, human capital, technology, and natural resources play in influencing long-run economic growth of aggregate output per capita?

**Solution**

6. Physical capital, human capital, technology, and natural resources play important roles in influencing long-run growth in real GDP per capita. Increases in both physical capital and human capital help a given labor force to produce more over time. Although economic studies have suggested that increases in human capital may explain increases in productivity better than do increases in physical capital per worker, technological progress is probably the most important driver of productivity growth. Although natural resources played a prominent role historically in determining productivity, today they play a less important role in increasing productivity than do increases in human or physical capital in most countries.

7. How have U.S. policies and institutions influenced the country's long-run economic growth?

**Solution**

7. U.S. institutions and policies have greatly aided the country's economic growth. The United States has been politically stable, and its laws and institutions protect private property. The economy has attracted significant savings, both domestic and foreign, that have allowed investment spending to spur the growth of the capital stock and fund research and development. The government has directly supported economic growth through its support of public education as well as research and development.

8. Over the next 100 years, real GDP per capita in Groland is expected to grow at an average annual rate of 2.0%. In Sloiland, however, growth is expected to be somewhat slower, at an average annual growth rate of 1.5%. If both countries have a real GDP per capita today of \$20,000, how will their real GDP per capita differ in 100 years? [Hint: A country that has a real GDP today of \$x and grows at y% per year will achieve a real GDP of  $\$x \times (1 + (y/100))^z$  in z years. We assume that  $0 \leq y < 10$ .]

**Solution**

8. If real GDP per capita in Groland grows at an average annual rate of 2.0%, real GDP per capita in 100 years will be \$144,893 [ $\$20,000 \times (1 + 0.02)^{100}$ ]. At an average annual rate of growth of 1.5%, real GDP per capita in Sloiland in 100 years will be \$88,641 [ $\$20,000 \times (1 + 0.015)^{100}$ ]. Although both nations start with the same real GDP per capita today, the differential growth rates will result in living standards in Sloiland that are 61.2% ( $\$88,641 / \$144,893 \times 100$ ) of those in Groland.

9. The accompanying table shows data from the Penn World Table, Version 8.0, for real GDP per capita (2005 U.S. dollars) in France, Japan, the United Kingdom, and the United States in 1950 and 2011. Complete the table. Have these countries converged economically?

	1950		2011	
	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita
France	\$6,475	?	\$29,476	?
Japan	2,329	?	31,587	?
United Kingdom	9,669	?	32,079	?
United States	15,136	?	42,244	?

**Solution**

9. The accompanying table shows real GDP per capita (2005 U.S. dollars) in France, Japan, and the United Kingdom as a percentage of real GDP per capita in the United States.

	1950		2011	
	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita
France	\$6,475	42.8%	\$29,476	69.8%
Japan	2,329	15.4	31,587	74.8
United Kingdom	9,669	63.9	32,079	75.9
United States	15,136	100.0	42,244	100.0

Growth of real GDP per capita in France, Japan, and the United Kingdom closed some of the gap in living standards with the United States between 1950 and 2011. Japan's real GDP per capita grew from only 15.4% of that in the United States to 74.8%, and France's rose from 42.8% to 69.8%. Living standards in the United Kingdom relative to those in the United States rose relatively little; real GDP per capita grew from 63.9% of that in the United States to 75.9%. The real GDP per capita in these countries has converged.

10. The accompanying table shows data from the Penn World Table, Version 8.0, for real GDP per capita (2005 U.S. dollars) for Argentina, Ghana, South Korea, and the United States in 1960 and 2011. Complete the table. Have these countries converged economically?

	1960		2011	
	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita
Argentina	\$6,585	?	\$13,882	?
Ghana	1,557	?	2,349	?
South Korea	1,610	?	29,618	?
United States	15,136	?	42,244	?

**Solution**

10. The accompanying table shows real GDP per capita (2005 U.S. dollars) in Argentina, Ghana, and South Korea as a percentage of real GDP per capita in the United States.

	1960		2011	
	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita	Real GDP per capita (2005 dollars)	Percentage of U.S. real GDP per capita
Argentina	\$6,585	43.5%	\$13,882	32.9%
Ghana	1,557	10.3	2,349	5.6
South Korea	1,610	10.6	29,618	70.1
United States	15,136	100.0	42,244	100.0

There is little evidence of convergence for Argentina. Living standards actually declined relative to those in the United States. In Argentina, real GDP per capita fell from 43.5% of that of the United States to 32.9%. There is also no evidence of convergence for Ghana; Ghana's real GDP declined from 10.3% of that of the United States to 5.6%. South Korea's real GDP per capita showed strong signs of convergence; real GDP per capita rose from 10.6% of that in the United States to 70.1%.

- 11.** Why would you expect real GDP per capita in California and Pennsylvania to exhibit convergence but not in California and Baja California, a state of Mexico that borders the United States? What changes would allow California and Baja California to converge?

### Solution

- 11.** According to the conditional convergence hypothesis, *other things equal*, countries with relatively low real GDP per capita tend to have higher rates of growth than countries with relatively high real GDP per capita. We can apply this hypothesis to regions as well. It is more likely that the factors that affect growth will be equal in California and Pennsylvania: both states have similar educational systems, infrastructure, rule of law, and so on. But that is not true of California and Baja California: in comparing them, the factors that affect growth are not likely to be equal. California and Baja California have very different educational systems, different infrastructures, and differences in how the rule of law is applied. So it is less likely that they will converge. For California and Baja California to converge in real GDP per capita, they would have to become more similar in the factors that affect growth.
- 12.** According to the *Oil & Gas Journal*, the proven oil reserves existing in the world in 2012 consisted of 1,525 billion barrels. In that year, the U.S. Energy Information Administration reported that the world daily oil production was 75.58 million barrels a day.
- At this rate, for how many years will the proven oil reserves last? Discuss the Malthusian view in the context of the number you just calculated.
  - In order to do the calculations in part a, what did you assume about the total quantity of oil reserves over time? About oil prices over time? Are these assumptions consistent with the Malthusian view on resource limits?
  - Discuss how market forces may affect the amount of time the proven oil reserves will last, assuming that no new oil reserves are discovered and that the demand curve for oil remains unchanged.

### Solution

- 12. a.** In one year, approximately  $75.58 \text{ million} \times 365 = 27.5$  billion barrels of oil are produced. At this rate, 1,525 billion barrels of oil will last for approximately 55 years. The numbers support the Malthusian view that there is a limit to the standard of living. Because population growth also results in a growing need for natural resources to continually raise the standard of living, the limited supply of resources like oil results in a limit on the standard of living.
- b.** The calculation assumes that the reserves of oil cannot increase and that the search for alternative fuels would not affect the annual production of oil. More importantly, it assumes that the possibility of rising oil prices as reserves drain out will neither create incentives for alternative fuels nor affect total consumption. These assumptions are consistent with the Malthusian view on resource limits.
- c.** Assuming that the demand curve for oil does not change, with decreasing supply as some oil reserves start drying out, prices should rise. This will cause a fall in the quantity demanded, extending the time during which proven oil reserves will last.

13. The accompanying table shows the annual growth rate for the years 2000–2011 in per capita emissions of carbon dioxide ( $\text{CO}_2$ ) and the annual growth rate in real GDP per capita for selected countries.

Country	2000–2011 average annual growth rate of:	
	Real GDP per capita	$\text{CO}_2$ emissions per capita
Argentina	2.25%	2.95%
Bangladesh	4.16	6.52
Canada	1.1	−0.33
China	10.72	9.31
Germany	1.25	−1.20
Ireland	0.57	−0.96
Japan	0.59	−0.16
South Korea	3.74	3.06
Mexico	0.79	1.72
Nigeria	5.93	−0.55
Russia	5.08	1.61
South Africa	2.73	1.63
United Kingdom	1.05	−1.09
United States	0.74	−0.60

Sources: Energy Information Administration; The Conference Board.

- Rank the countries in terms of their growth in  $\text{CO}_2$  emissions, from highest to lowest. What five countries have the highest growth rate in emissions? What five countries have the lowest growth rate in emissions?
- Now rank the countries in terms of their growth in real GDP per capita, from highest to lowest. What five countries have the highest growth rate? What five countries have the lowest growth rate?
- Would you infer from your results that  $\text{CO}_2$  emissions are linked to growth in output per capita?
- Do high growth rates necessarily lead to high  $\text{CO}_2$  emissions?



## Solution

13. a. As shown in the accompanying table, the five countries with the highest growth rate in per capita CO<sub>2</sub> emissions are China, Bangladesh, South Korea, Argentina, and Mexico. The five countries with the lowest growth rate in per capita CO<sub>2</sub> emissions are Germany, the United Kingdom, Ireland, the United States, and Nigeria.

Country	2000–2011 average annual growth rate of CO <sub>2</sub> emissions per capita
China	9.31%
Bangladesh	6.52
South Korea	3.06
Argentina	2.95
Mexico	1.72
South Africa	1.63
Russia	1.61
Japan	-0.16
Canada	-0.33
Nigeria	-0.55
United States	-0.60
Ireland	-0.96
United Kingdom	-1.09
Germany	-1.20

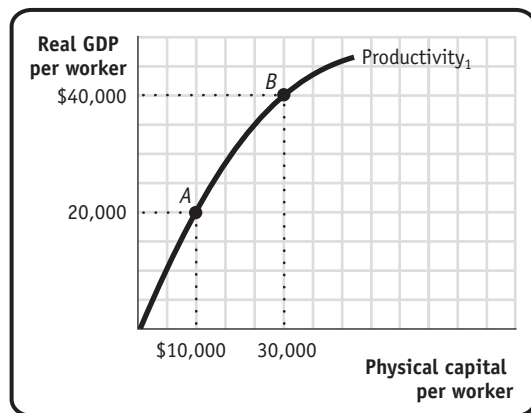
Sources: Energy Information Administration;  
The Conference Board.

- b. As shown in the accompanying table, the five countries with the highest growth rate in real GDP per capita are China, Nigeria, Russia, Bangladesh, and South Korea. The five countries with the lowest growth rate in real GDP per capita are Ireland, Japan, the United States, Mexico, and the United Kingdom.

Country	2000–2011 average annual growth rate of real GDP per capita
China	10.72%
Nigeria	5.93
Russia	5.08
Bangladesh	4.16
South Korea	3.74
South Africa	2.73
Argentina	2.25
Germany	1.25
Canada	1.10
United Kingdom	1.05
Mexico	0.79
United States	0.74
Japan	0.59
Ireland	0.57

Sources: Energy Information Administration;  
International Monetary Fund.

- c. Yes. Three of the five countries with the highest growth rate in per capita  $\text{CO}_2$  emissions also have the highest growth rate in real GDP per capita: China, Bangladesh, and South Korea. Three of the five countries with the lowest growth rate in per capita  $\text{CO}_2$  emissions also have the lowest growth rate in real GDP per capita: the United States, Ireland, and the United Kingdom.
- d. Although growth rates in GDP per capita and  $\text{CO}_2$  emissions per capita are linked, the experience of Nigeria and, to a lesser extent, Germany shows that it is possible both to have a high growth rate of GDP and to reduce  $\text{CO}_2$  emissions. This can be done in a variety of ways, including using alternative energy sources and better designs for buildings and automobiles. Estimates suggest that large  $\text{CO}_2$  reductions would put only a minor dent in long-run GDP per capita growth.
14. You are hired as an economic consultant to the countries of Albernia and Britannia. Each country's current relationship between physical capital per worker and output per worker is given by the curve labeled "Productivity<sub>1</sub>" in the accompanying diagram. Albernia is at point A and Britannia is at point B.



- a. In the relationship depicted by the curve Productivity<sub>1</sub>, what factors are held fixed? Do these countries experience diminishing returns to physical capital per worker?
- b. Assuming that the amount of human capital per worker and the technology are held fixed in each country, can you recommend a policy to generate a doubling of real GDP per capita in Albernia?
- c. How would your policy recommendation change if the amount of human capital per worker could be changed? Assume that an increase in human capital doubles the output per worker when physical capital per worker equals \$10,000. Draw a curve on the diagram that represents this policy for Albernia.

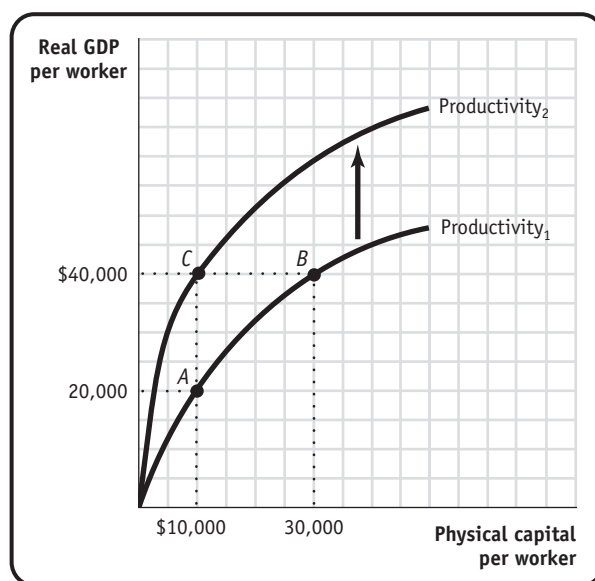
**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



## Solution

14. a. The curve reflecting the relationship between physical capital per worker and output per worker is drawn holding human capital per worker and technology fixed. Both Albernia and Britannia experience diminishing returns to physical capital since in both countries equal successive increases in physical capital per worker—holding human capital per worker and technology constant—will result in smaller and smaller increases in real GDP per worker.
- b. Albernia should increase its physical capital per worker to \$30,000.
- c. An increase in human capital per worker shifts the curve  $\text{Productivity}_1$  to  $\text{Productivity}_2$  and Albernia doubles real GDP per worker without a change in the physical capital per worker. On the accompanying diagram, Albernia would move from point A to point C. So your policy recommendation should be to increase the amount of human capital per worker.



# Savings, Investment Spending, and the Financial System

1. Given the following information about the closed economy of Brittania, what is the level of investment spending and private savings, and what is the budget balance? What is the relationship among the three? Is national savings equal to investment spending? There are no government transfers.

$$\begin{aligned} \text{GDP} &= \$1,000 \text{ million} & T &= \$50 \text{ million} \\ C &= \$850 \text{ million} & G &= \$100 \text{ million} \end{aligned}$$

## Solution

1. In a closed economy, investment spending is equal to GDP minus consumer spending minus government purchases of goods and services. In Brittania, investment spending is \$50 million:

$$I = \text{GDP} - C - G$$

$$I = \$1,000 \text{ million} - \$850 \text{ million} - \$100 \text{ million} = \$50 \text{ million}$$

Private savings is equal to disposable income (income net of taxes—and recall that there are no government transfers) minus consumer spending. In Brittania, private savings is \$100 million:

$$\text{Private savings} = \text{GDP} - T - C = \$1,000 \text{ million} - \$50 \text{ million} - \$850 \text{ million} = \$100 \text{ million}$$

The budget balance is equal to tax revenue minus government purchases of goods and services. In Brittania, the government is running a budget deficit of \$50 million:

$$\text{Budget balance} = T - G = \$50 \text{ million} - \$100 \text{ million} = -\$50 \text{ million}$$

National savings is the sum of private savings and the budget balance; that is, it is \$100 million – \$50 million = \$50 million. So investment spending does equal national savings.

2. Given the following information about the open economy of Regalia, what is the level of investment spending and private savings, and what are the budget balance and net capital inflow? What is the relationship among the four? There are no government transfers. (*Hint*: net capital inflow equals the value of imports (*IM*) minus the value of exports (*X*).)

$$\begin{aligned} \text{GDP} &= \$1,000 \text{ million} & G &= \$100 \text{ million} \\ C &= \$850 \text{ million} & X &= \$100 \text{ million} \\ T &= \$50 \text{ million} & \text{IM} &= \$125 \text{ million} \end{aligned}$$

## Solution

2. In an economy with capital inflows or outflows, investment spending is equal to GDP minus consumer spending minus government purchases of goods and services plus net capital inflow, the value of imports minus the value of exports. In Regalia, investment spending is \$75 million:

$$I = (\text{GDP} - C - G) + (\text{IM} - X)$$

$$I = (\$1,000 \text{ million} - \$850 \text{ million} - \$100 \text{ million}) + (\$125 \text{ million} - \$100 \text{ million})$$

$$I = \$50 \text{ million} + \$25 \text{ million} = \$75 \text{ million}$$

Private savings and the budget balance are measured in the same way regardless of whether or not there are capital inflows or outflows. (Again, recall that there are no government transfers.) In Regalia, private savings is \$100 million and the budget balance is -\$50 million (that is, the government is running a deficit of \$50 million):

$$\text{Private savings} = \text{GDP} - T - C = \$1,000 \text{ million} - \$50 \text{ million} - \$850 \text{ million} = \$100 \text{ million}$$

$$\text{Budget balance} = T - G = \$50 \text{ million} - \$100 \text{ million} = -\$50 \text{ million}$$

An economy will experience a positive net capital inflow equal to the difference between imports and exports when imports exceed exports; it will experience a capital outflow (a negative net capital inflow) equal to the difference between imports and exports when exports exceed imports. Regalia has a positive net capital inflow equal to \$25 million:

$$\text{Net capital inflow} = IM - X = \$125 \text{ million} - \$100 \text{ million} = \$25 \text{ million}$$

Investment spending must equal the sum of private savings, the budget balance, and the net capital inflow. In Regalia, we can see that this relationship holds among the four:

$$I = \text{Private savings} + \text{Budget balance} + \text{Net capital inflow} = \$75 \text{ million}$$

3. The accompanying table shows the percentage of GDP accounted for by private savings, investment spending, and net capital inflow in the economies of Capsland and Marsalia. Capsland is currently experiencing a positive net capital inflow and Marsalia, a negative net capital outflow. What is the budget balance (as a percentage of GDP) in both countries? Are Capsland and Marsalia running a budget deficit or surplus?

	Capsland	Marsalia
Investment spending as a percentage of GDP	20%	20%
Private savings as a percentage of GDP	10	25
Net capital inflow as a percentage of GDP	5	-2

### Solution

3. In both countries, investment spending as a percentage of GDP must be equal to the sum of private savings, the budget balance, and net capital inflow as a percentage of GDP. We can calculate the budget balance as investment spending minus the sum of private savings and net capital inflow:

$$I = \text{Private savings} + \text{Budget balance} + \text{Net capital inflow}$$

$$\text{Budget balance} = I - \text{Private savings} - \text{Net capital inflow}$$

In Capsland, the budget balance is 5% of GDP; the government is running a budget surplus equal to 5% of GDP:

$$\text{Budget balance} = 20\% - 10\% - 5\%$$

$$\text{Budget balance} = 5\%$$

In Marsalia, the budget balance is -3% of GDP; the government is running a budget deficit equal to 3% of GDP:

$$\text{Budget balance} = 20\% - 25\% - (-2\%) = 20\% - 25\% + 2\%$$

$$\text{Budget balance} = -3\%$$

4. Assume the economy is open to capital inflows and outflows and therefore net capital inflow equals imports ( $IM$ ) minus exports ( $X$ ). Answer each of the following questions.
- $X = \$125$  million  
 $IM = \$80$  million  
 Budget balance =  $-\$200$  million  
 $I = \$350$  million  
 Calculate private savings.
  - $X = \$85$  million  
 $IM = \$135$  million  
 Budget balance =  $\$100$  million  
 Private savings =  $\$250$  million  
 Calculate  $I$ .
  - $X = \$60$  million  
 $IM = \$95$  million  
 Private savings =  $\$325$  million  
 $I = \$300$  million  
 Calculate the budget balance.
  - Private savings =  $\$325$  million  
 $I = \$400$  million  
 Budget balance =  $\$10$  million  
 Calculate  $IM - X$ .

### Solution

4. According to the savings–investment spending identity in an economy open to capital flows from and to abroad, the following must hold:  $I = \text{Private savings} + \text{Budget balance} + (IM - X)$ . We use this to solve for the missing variable in each problem.
- $\$350 \text{ million} = \text{Private savings} - \$200 \text{ million} + (\$80 \text{ million} - \$125 \text{ million})$   
 So private savings =  $\$595$  million
  - $I = \$250 \text{ million} + \$100 \text{ million} + (\$135 \text{ million} - \$85 \text{ million})$   
 So  $I = \$400$  million
  - $\$300 \text{ million} = \$325 \text{ million} + \text{Budget balance} + (\$95 \text{ million} - \$60 \text{ million})$   
 So the budget balance =  $-\$60$  million
  - $\$400 \text{ million} = \$325 \text{ million} + \$10 \text{ million} + (IM - X)$   
 So net capital inflow ( $IM - X$ ) =  $\$65$  million

5. The accompanying table, taken from the National Income and Product Accounts Tables, shows the various components of U.S. GDP in 2012 and 2013 in billions of dollars.

Year	Gross domestic product	Private consumption	Gross domestic investment	Government purchases of goods and services	Government savings (budget balance)	Net government taxes after transfers
	(billions of dollars)					
2012	\$16,163.2	\$11,083.1	\$2,479.2	\$2,549.7	$-\$1,311.7$	?
2013	16,768.1	11,484.3	2,648.0	2,547.6	?	1,673.3

- Complete the table by filling in the missing figures.
- For each year, calculate taxes (after transfers) as a percentage of GDP.
- For each year, calculate national savings and private savings.

## Solution

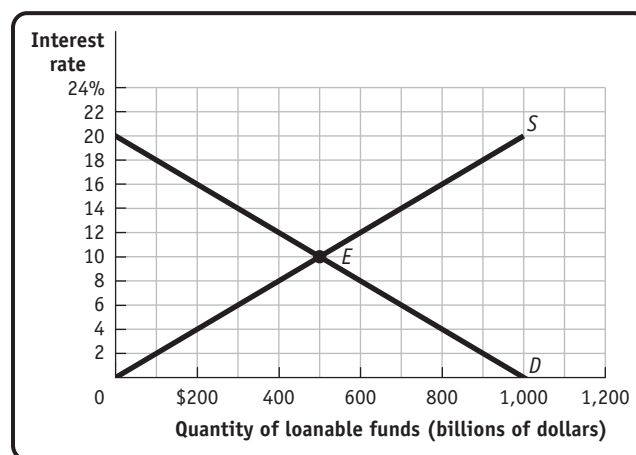
5. a. Because savings by the government is equal to the difference between the tax revenue that it collects (after transfers) and current government purchases of goods and services, the table can be completed as shown below.

Year	Gross domestic product	Private consumption	Gross domestic investment	Government purchases of goods and services	Government savings (budget balance)	Net government taxes after transfers
(billions of dollars)						
2012	\$16,163.2	\$11,083.1	\$2,479.2	\$2,549.7	-\$1,311.7	\$1,238.0
2013	16,768.1	11,484.3	2,648.0	2,547.6	-874.3	1,673.3

- b. In 2012, taxes (after transfers) as a percentage of GDP were 7.7%, and in 2013, 10.0%. This can be found by dividing taxes (after transfers) by GDP.
- c. National and private savings for 2012 and 2013 are listed in the accompanying table. Private savings is equal to disposable income, that is, income after taxes and transfers ( $GDP - T + TR$ ) minus consumption ( $C$ ). For instance, in 2012, private savings is  $\$16,163.2 - \$1,238 - \$11,083.1 = \$3,842.1$ . National savings is the sum of the budget balance and private savings. For instance, in 2012, national savings is  $\$3,842.1 - \$1,311.7 = \$2,530.4$ . Alternatively, of course, you could calculate national savings as the sum of the budget balance ( $T - G - TR$ ) and private savings ( $GDP - T + TR - C$ ), which is equal to  $T - G - TR + GDP - T + TR - C = GDP - G - C$ , which of course gives the same result.

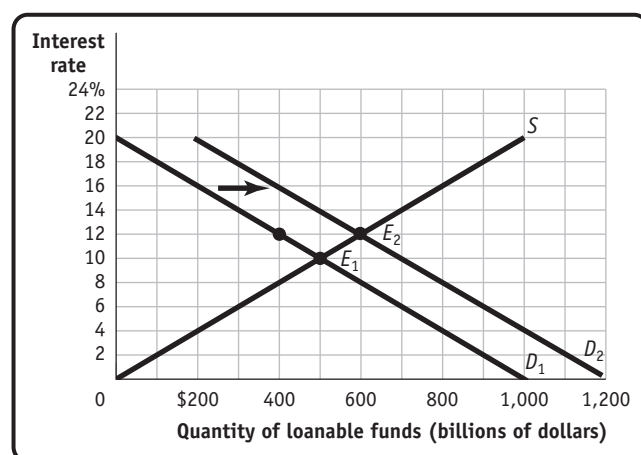
Year	National savings	Private savings
(billions of dollars)		
2012	\$2,530.4	\$3,842.1
2013	2,736.2	3,610.5

6. The government is running a budget balance of zero when it decides to increase education spending by \$200 billion and finance the spending by selling bonds. The accompanying diagram shows the market for loanable funds before the government sells the bonds. Assume that there are no capital inflows or outflows. How will the equilibrium interest rate and the equilibrium quantity of loanable funds change? Is there any crowding out in the market?



## Solution

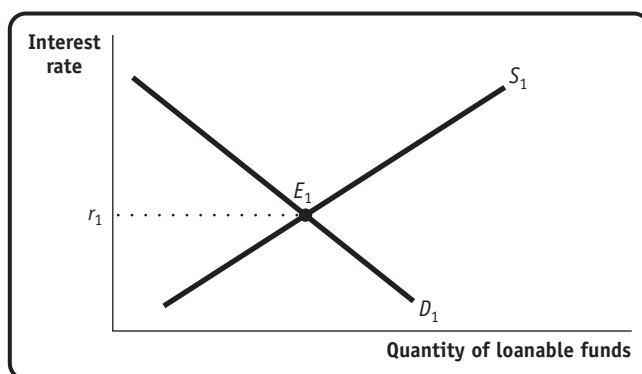
6. The \$200 billion in government borrowing will increase the demand for loanable funds from  $D_1$  to  $D_2$  as shown in the accompanying diagram. The equilibrium interest rate rises from 10% to 12%, and the equilibrium quantity of loanable funds increases from \$500 billion to \$600 billion. The rise in the interest rate will lead to an increase in private savings of \$100 billion, and private investment spending will fall by \$100 to \$400 billion. Through the rise in the interest rate, the increase in government borrowing crowded out \$100 billion in private investment spending.



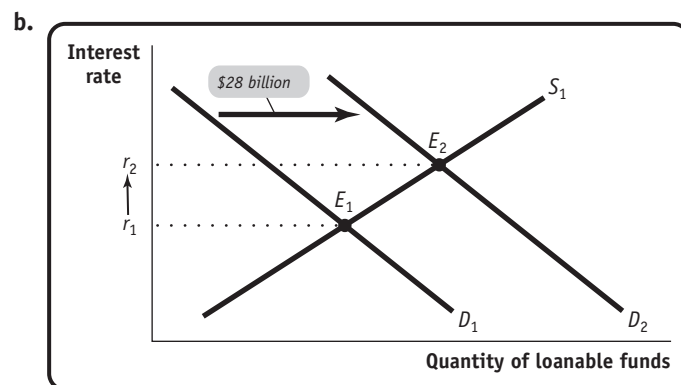
7. In 2014, Congress estimated that the cost of increasing support and expanding pre-kindergarten education and infant and toddler childcare would cost \$28 billion. Since the U.S. government was running a budget deficit at the time, assume that the new pre-K funding was financed by government borrowing, which increases the demand for loanable funds without affecting supply. This question considers the likely effect of this government expenditure on the interest rate.
- Draw typical demand ( $D_1$ ) and supply ( $S_1$ ) curves for loanable funds without the cost of the expanded pre-K programs accounted for. Label the vertical axis “Interest rate” and the horizontal axis “Quantity of loanable funds.” Label the equilibrium point ( $E_1$ ) and the equilibrium interest rate ( $r_1$ ).
  - Now draw a new diagram with the cost of the expanded pre-K programs included in the analysis. Shift the demand curve in the appropriate direction. Label the new equilibrium point ( $E_2$ ) and the new equilibrium interest rate ( $r_2$ ).
  - How does the equilibrium interest rate change in response to government expenditure on the expanded pre-K programs? Explain.

## Solution

7. a. The demand for loanable funds without government borrowing to finance the expanded pre-K programs is shown in the accompanying diagram.







c. Government borrowing to finance the expanded pre-K programs raises the interest rate in equilibrium because the supply of loanable funds remains constant but the demand rises.

8. Explain why equilibrium in the loanable funds market maximizes efficiency.

### Solution

8. Equilibrium in the loanable funds market maximizes efficiency because it ensures that investment spending projects with higher rates of return get funded before those with lower rates of return. At the same time, private savers with the lowest opportunity cost for their funds will have their offers of loans accepted before savers with higher opportunity costs of funds. So in equilibrium the projects with the highest rates of return will be funded by savers with the lowest costs of lending. This makes it more likely that lenders and borrowers will make mutually beneficial trades—trades that make society as a whole better off.

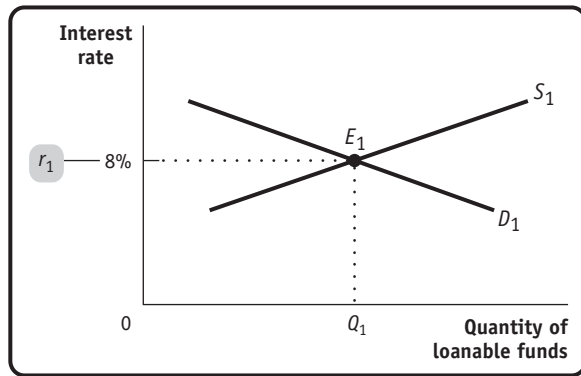
9. How would you respond to a friend who claims that the government should eliminate all purchases that are financed by borrowing because such borrowing crowds out private investment spending?

### Solution

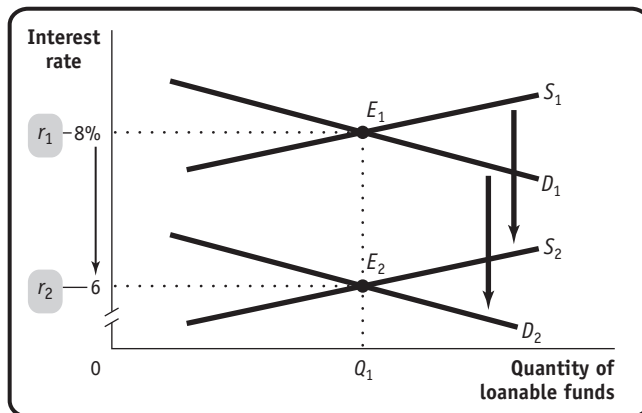
9. You might first acknowledge that, other things equal, when the government runs a budget deficit, there is an increase in the demand for loanable funds. The increase in demand raises interest rates and decreases private investment spending. This means that businesses will add less physical capital each year and productivity growth may be slower than it would be if the government had not borrowed to cover its deficit. However, you might then explain that some government purchases are necessary for economic growth. Government funds much of the infrastructure within which the economy operates (for example, the legal framework, the court system, and the communications network), and the government also invests in education, roads, and airports necessary for economic growth.

10. Boris Borrower and Lynn Lender agree that Lynn will lend Boris \$10,000 and that Boris will repay the \$10,000 with interest in one year. They agree to a nominal interest rate of 8%, reflecting a real interest rate of 3% on the loan and a commonly shared expected inflation rate of 5% over the next year.
- If the inflation rate is actually 4% over the next year, how does that lower-than-expected inflation rate affect Boris and Lynn? Who is better off?
  - If the actual inflation rate is 7% over the next year, how does that affect Boris and Lynn? Who is better off?

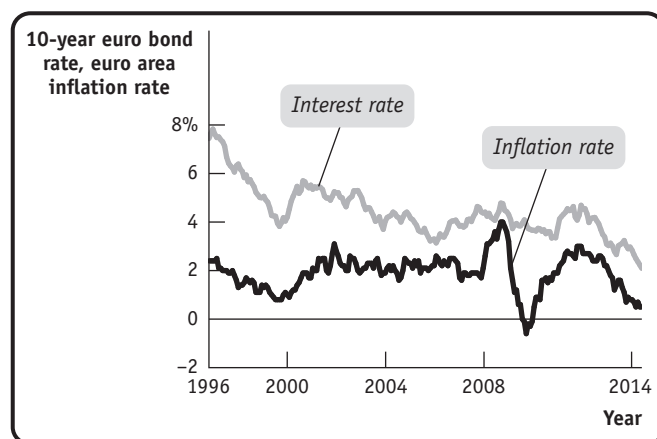
- 10.** a. If the actual inflation rate is 4%, Lynn is better off and Boris is worse off. Boris had expected to pay, and Lynn had expected to receive, a real interest rate of 3%. However, with an actual inflation rate of 4%, an 8% nominal interest rate yields a real interest rate of 4% ( $8\% - 4\% = 4\%$ ). So, in real terms, Boris pays more, and Lynn receives more, than was expected.
- b. If the actual inflation rate is 7%, Boris is better off and Lynn is worse off. Boris had expected to pay, and Lynn had expected to receive, a real interest rate of 3%. However, with an actual inflation rate of 7%, an 8% nominal interest rate yields a real interest rate of 1% ( $8\% - 7\% = 1\%$ ). So, in real terms, Boris pays less, and Lynn receives less, than was expected.
- 11.** Using the accompanying diagram, explain what will happen to the market for loanable funds when there is a fall of 2 percentage points in the expected future inflation rate. How will the change in the expected future inflation rate affect the equilibrium quantity of loanable funds?



- 11.** In the accompanying diagram, the market for loanable funds is initially in equilibrium at  $E_1$ , with a nominal interest rate of 8%. A fall of 2 percentage points in the expected future inflation rate leads, by the Fisher effect, to a fall of 2 percentage points in the nominal interest rate to 6%. The real interest rate and the equilibrium quantity of loanable funds remain unchanged. The change in expected inflation causes both a downward shift of the supply curve for loanable funds, from  $S_1$  to  $S_2$ , and a downward shift of the demand curve for loanable funds, from  $D_1$  to  $D_2$ .



12. The accompanying diagram shows data for the interest rate on 10-year euro area government bonds and inflation for the euro area for 1996 through mid-2014, as reported by the European Central Bank. How would you describe the relationship between the two? How does the pattern compare to that of the United States in Figure 10-8?



- 12.** As in the case of the United States in panel (a) of Figure 10-8, the euro area experience is largely one of low and relatively constant inflation. As expectations of future inflation declined, so did interest rates during the first part of the period illustrated in the accompanying diagram. Based on the expectation of continuing low inflation, fluctuations in the interest rate after about 2000 reflect changes in the demand for, and the supply of, loanable funds, rather than changes in inflation expectations. In the euro area, unlike in the United States, the interest rate did not markedly increase during the period of the U.S. housing boom, and it did not markedly decrease after the bust in the U.S. housing market. Instead, the interest rate remained relatively constant, suggesting that there was either no change in the demand for, and the supply of, loanable funds, or that the demand for, and the supply of, loanable funds decreased during the recession at about the same rate, keeping the interest rate relatively constant.

- 13.** For each of the following, is it an example of investment spending, investing in financial assets, or investing in physical assets?
- Rupert Moneybucks buys 100 shares of existing Coca-Cola stock.
  - Rhonda Moviestar spends \$10 million to buy a mansion built in the 1970s.
  - Ronald Basketballstar spends \$10 million to build a new mansion with a view of the Pacific Ocean.
  - Rawlings builds a new plant to make catcher's mitts.
  - Russia buys \$100 million in U.S. government bonds.

- 13.**
- When Rupert Moneybucks buys 100 shares of existing Coca-Cola stock, he is investing in a financial asset. He has a paper claim that entitles him to future income from Coca-Cola. It is not an example of investment spending because it does not add to the stock of physical capital in the economy.
  - When Rhonda Moviestar spends \$10 million to buy a mansion built in the 1970s, she is investing in a physical asset; she has bought something that she has the right to use or to dispose of as she wishes. It is not an example of investment spending because it does not add to the stock of physical capital in the economy—the mansion was preexisting.

- c. When Ronald Basketballstar spends \$10 million to build a new mansion with a view of the Pacific Ocean, he has engaged in investment spending because he has added to the amount of housing in the economy.
  - d. When Rawlings builds a new plant to make catcher's mitts, it has engaged in investment spending because it has added to the economy's stock of physical capital.
  - e. When the government of Russia buys \$100 million in U.S. government bonds, it has invested in a financial asset. The Russian government has a paper claim on the United States that entitles it to future income. It is not an example of investment spending because it does not add to the stock of physical capital in either economy.
- 14.** Explain how a well-functioning financial system increases savings and investment spending, holding the budget balance and any capital flows fixed.

**14.** A well-functioning financial system increases both the supply of loanable funds and the demand for loanable funds in three ways. (1) It reduces the transaction costs of making financial deals incurred by either lenders or borrowers. (2) It reduces the risk associated with making investments or engaging in investment spending. (3) By increasing the liquidity of financial assets, it makes saving and the purchasing of financial assets more attractive to potential lenders, which increases investment spending.

- 15.** What are the important types of financial intermediaries in the U.S. economy? What are the primary assets of these intermediaries, and how do they facilitate investment spending and saving?

**15.** Mutual funds, pension funds, life insurance companies, and banks are the most important types of financial intermediaries in the U.S. economy. Mutual funds are companies that buy stocks of other companies (the mutual funds companies' primary assets) and resell shares of the portfolio composed of those stocks to individual investors. Pension funds are a type of mutual fund that hold financial assets of other companies (the pension funds' primary assets) and sell shares to individual savers for retirement income. A life insurance company also holds financial assets (the life insurance company's primary assets) and sells policies that guarantee a payment to a policyholder's beneficiary when the policyholder dies. A bank makes loans to individuals and corporations (the bank's primary assets) and accepts deposits from the public that are payable on demand. By either reducing risk through diversification (mutual funds, pension funds), reducing risk through insurance (life insurance companies), lowering transaction costs (mutual funds, pension funds), or providing liquidity (banks), these financial intermediaries facilitate savings and investment spending.

- 16.** Explain the effect on a company's stock price today of each of the following events, other things held constant.
- a. The interest rate on bonds falls.
  - b. Several companies in the same sector announce surprisingly higher sales.
  - c. A change in the tax law passed last year reduces this year's profit.
  - d. The company unexpectedly announces that due to an accounting error, it must amend last year's accounting statement and reduce last year's reported profit by \$5 million. It also announces that this change has no implications for future profits.

## Solution

- 16.**
- Because bonds are a substitute asset for stocks, this will lead to a rise in all stock prices, including this company's stock price.
  - This will lead to an immediate rise in the company's stock price because it is unexpected information that communicates to investors that the company's sector is doing well, and so it is likely that the company will also experience higher sales and a higher-than-expected future profit.
  - This will have no effect on the company's stock price today because the effect of the change in the tax law on this year's profit would have been incorporated into the company's stock price when the tax law change was announced.
  - This will have no effect on the company's stock price today because the stock price is based on expectations about the future stock price, and this is unaffected by changes in previous years' profits.
- 17.** Sallie Mae is a quasi-governmental agency that packages individual student loans into pools of loans and sells shares of these pools to investors as Sallie Mae bonds.
- What is this process called? What effect will it have on investors compared to situations in which they could only buy and sell individual student loans?
  - What effect do you think Sallie Mae's actions will have on the ability of students to get loans?
  - Suppose that a very severe recession hits and, as a consequence, many graduating students cannot get jobs and default on their student loans. What effect will this have on Sallie Mae bonds? Why is it likely that investors now believe Sallie Mae bonds to be riskier than expected? What will be the effect on the availability of student loans?

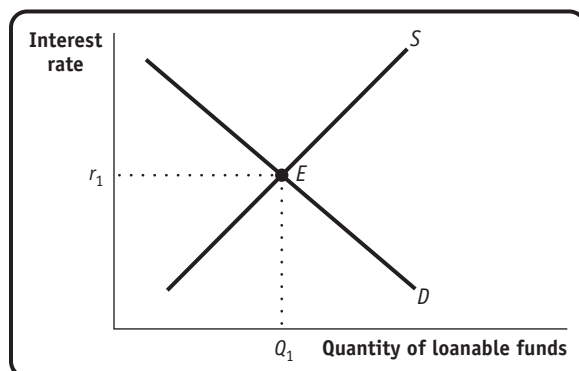
## Solution

- 17.**
- By pooling individual loans and selling shares of those pools as bonds, Sallie Mae has engaged in *securitization*. Because the likelihood that a default by one student is usually unrelated to, or independent from, the likelihood of default by some other student, buying a Sallie Mae bond provides greater diversification for an investor than an individual student loan. It also provides liquidity because it can be bought and sold like a typical bond.
  - With Sallie Mae bonds, investors will be more willing to supply funds for students compared to a situation in which only individual loans were available. As a result, students should be able to receive more loans at a lower interest rate.
  - Widespread defaults by students will result in losses for investors who hold Sallie Mae bonds. Investors will come to believe that due to the recession potential defaults among students are no longer unrelated events and so these bonds are riskier than they expected. As a result, there will be fewer investors willing to buy Sallie Mae bonds at any given interest rate. Students will find it harder to get loans and will have to pay a higher interest rate on those they do get.

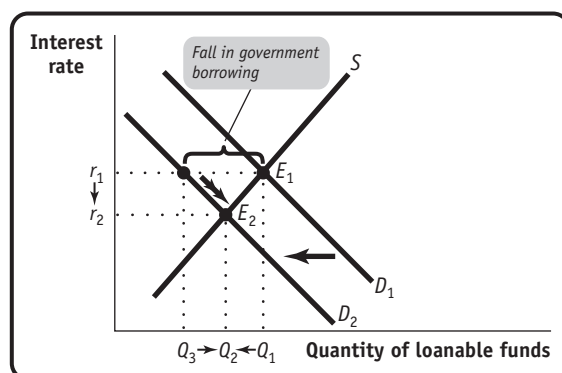
18. Use the market for loanable funds shown in the accompanying diagram to explain what happens to private savings, private investment spending, and the interest rate if each of the following events occur. Assume that there are no capital inflows or outflows.
- The government reduces the size of its deficit to zero.
  - At any given interest rate, consumers decide to save more. Assume the budget balance is zero.
  - At any given interest rate, businesses become very optimistic about the future profitability of investment spending. Assume the budget balance is zero.

**WORK IT OUT**

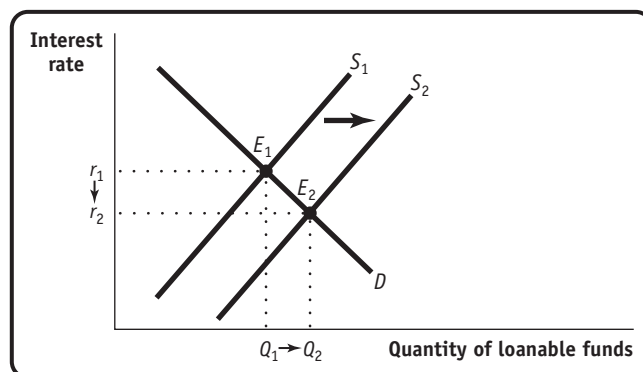
Interactive, step-by-step help solving this problem is available to your students via



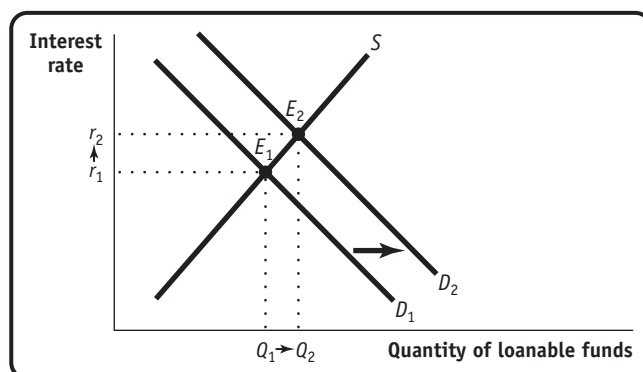
- 18. a.** If the government reduces its deficit to zero, there will be a decrease in the demand for loanable funds, from  $D_1$  to  $D_2$ , equal to the reduction in the size of the deficit. In the accompanying figure, the amount  $Q_1 - Q_3$  represents the amount by which the government decreases its deficit. In response to the decrease in demand, the interest rate falls from  $r_1$  to  $r_2$ . This fall in interest rates will increase private investment spending from  $Q_3$  to  $Q_2$  and decrease private savings from  $Q_1$  to  $Q_2$ .



- b. If consumers decide to save more, there will be an increase in the supply of loanable funds. In the accompanying figure, this is represented by the rightward shift of the supply curve from  $S_1$  to  $S_2$ . The increase in the supply of loanable funds reduces the equilibrium interest rate from  $r_1$  to  $r_2$ . In response to the lower interest rate, private investment spending will rise from  $Q_1$  to  $Q_2$ .



- c. Higher investment spending at any given interest rate leads to an increase in the demand for loanable funds. In the accompanying figure, the increase in the demand for loanable funds shifts the demand curve from  $D_1$  to  $D_2$  and raises the equilibrium interest rate from  $r_1$  to  $r_2$ . In response to the higher interest rate, private savings will rise from  $Q_1$  to  $Q_2$ .



# Income and Expenditure

1. Due to an increase in consumer wealth, there is a \$40 billion autonomous increase in consumer spending in the economies of Westlandia and Eastlandia. Assuming that the aggregate price level is constant, the interest rate is fixed in both countries, and there are no taxes and no foreign trade, complete the accompanying tables to show the various rounds of increased spending that will occur in both economies if the marginal propensity to consume is 0.5 in Westlandia and 0.75 in Eastlandia. What do your results indicate about the relationship between the size of the marginal propensity to consume and the multiplier?

Westlandia		
Rounds	Incremental change in GDP	Total change in GDP
1	$\Delta C = \$40$ billion	?
2	$MPC \times \Delta C =$	?
3	$MPC \times MPC \times \Delta C =$	?
4	$MPC \times MPC \times MPC \times \Delta C =$	?
...	...	...
<b>Total change in GDP</b>	$(1/(1 - MPC)) \times \Delta C =$	?

Eastlandia		
Rounds	Incremental change in GDP	Total change in GDP
1	$\Delta C = \$40$ billion	?
2	$MPC \times \Delta C =$	?
3	$MPC \times MPC \times \Delta C =$	?
4	$MPC \times MPC \times MPC \times \Delta C =$	?
...	...	...
<b>Total change in GDP</b>	$(1/(1 - MPC)) \times \Delta C =$	?



## Solution

1. The accompanying tables clearly show that the larger the marginal propensity to consume, the larger the size of the multiplier. In Westlandia, with the marginal propensity to consume of 0.5, the multiplier equals 2. In Eastlandia, with the marginal propensity to consume of 0.75, the multiplier equals 4.

Westlandia		
Rounds	Incremental change in GDP	Total change in GDP
1	$\Delta C = \$40$ billion	\$40 billion
2	$MPC \times \Delta C = \$20$ billion	\$60 billion
3	$MPC \times MPC \times \Delta C = \$10$ billion	\$70 billion
4	$MPC \times MPC \times MPC \times \Delta C = \$5$ billion	\$75 billion
...	...	...
<b>Total change in GDP</b>		
$(1/(1 - MPC)) \times \Delta C = (1/(1 - 0.5)) \times \$40$ billion = \$80 billion		

Eastlandia		
Rounds	Incremental change in GDP	Total change in GDP
1	$\Delta C = \$40$ billion	\$40 billion
2	$MPC \times \Delta C = \$30$ billion	\$70 billion
3	$MPC \times MPC \times \Delta C = \$22.5$ billion	\$92.5 billion
4	$MPC \times MPC \times MPC \times \Delta C = \$16.88$ billion	\$109.38 billion
...	...	...
<b>Total change in GDP</b>		
$(1/(1 - MPC)) \times \Delta C = (1/(1 - 0.75)) \times \$40$ billion = \$160 billion		

2. Assuming that the aggregate price level is constant, the interest rate is fixed, and there are no taxes and no foreign trade, what will be the change in GDP if the following events occur?
- There is an autonomous increase in consumer spending of \$25 billion; the marginal propensity to consume is  $2/3$ .
  - Firms reduce investment spending by \$40 billion; the marginal propensity to consume is 0.8.
  - The government increases its purchases of military equipment by \$60 billion; the marginal propensity to consume is 0.6.

## Solution

2. a. An autonomous increase in consumer spending of \$25 billion, with a marginal propensity to consume of  $2/3$ , will increase GDP by \$75 billion:

$$\text{Total change in GDP} = (1/(1 - MPC)) \times \Delta C$$

$$\text{Total change in GDP} = (1/(1 - 2/3)) \times \$25 \text{ billion}$$

$$\text{Total change in GDP} = 3 \times \$25 \text{ billion}$$

$$\text{Total change in GDP} = \$75 \text{ billion}$$

- b. If firms reduce investment spending by \$40 billion and the marginal propensity to consume is 0.8, GDP will fall by \$200 billion:

$$\text{Total change in GDP} = (1/(1 - MPC)) \times \Delta I$$

$$\text{Total change in GDP} = (1/(1 - 0.8)) \times (-\$40 \text{ billion})$$

$$\text{Total change in GDP} = 5 \times (-\$40 \text{ billion})$$

$$\text{Total change in GDP} = -\$200 \text{ billion}$$

- c. If government purchases of goods and services rise by \$60 billion and the marginal propensity to consume is 0.6, GDP will increase by \$150 billion:

$$\text{Total change in GDP} = (1/(1 - MPC)) \times \Delta G$$

$$\text{Total change in GDP} = (1/(1 - 0.6)) \times \$60 \text{ billion}$$

$$\text{Total change in GDP} = 2.5 \times \$60 \text{ billion}$$

$$\text{Total change in GDP} = \$150 \text{ billion}$$

3. Economists observed the only five residents of a very small economy and estimated each one's consumer spending at various levels of current disposable income. The accompanying table shows each resident's consumer spending at three income levels.

Individual consumer spending by	Individual current disposable income		
	\$0	\$20,000	\$40,000
Andre	1,000	\$15,000	29,000
Barbara	2,500	12,500	22,500
Casey	2,000	20,000	38,000
Declan	5,000	17,000	29,000
Elena	4,000	19,000	34,000

- a. What is each resident's consumption function? What is the marginal propensity to consume for each resident?  
 b. What is the economy's aggregate consumption function? What is the marginal propensity to consume for the economy?

### Solution

3. a. Each resident's consumption function and marginal propensity to consume are given in the table below. To determine autonomous consumer spending for each resident (the vertical intercept of his or her consumption function), we can look at each one's consumer spending when disposable income is zero. To calculate each resident's marginal propensity to consume (the slope of his or her consumption function), we can calculate the change in consumer spending when there is a change in disposable income. For example, Andre's marginal propensity to consume is equal to  $(\$29,000 - \$15,000)/(\$40,000 - \$20,000) = 0.70$ .

	Autonomous consumption (a)	Marginal propensity to consume (MPC)	Consumption function (c)
Andre	\$1,000	0.70	$\$1,000 + 0.70 \times yd$
Barbara	2,500	0.50	$2,500 + 0.50 \times yd$
Casey	2,000	0.90	$2,000 + 0.90 \times yd$
Declan	5,000	0.60	$5,000 + 0.60 \times yd$
Elena	4,000	0.75	$4,000 + 0.75 \times yd$

- b. To find the economy's consumption function, we calculate aggregate consumer spending at each level of aggregate disposable income:
- When each resident earns \$0 in disposable income, aggregate consumer spending is \$14,500.
  - When each resident earns \$20,000 in disposable income, aggregate disposable income is \$100,000 and aggregate consumer spending is \$83,500.
  - When each resident earns \$40,000 in disposable income, aggregate disposable income is \$200,000 and aggregate consumer spending is \$152,500.

Aggregate autonomous consumer spending is \$14,500, and the marginal propensity to consume is 0.69 [= (\$83,500 - \$14,500)/(\$100,000 - \$0)]. The aggregate consumption function is:

$$C = \$14,500 + 0.69 \times YD$$

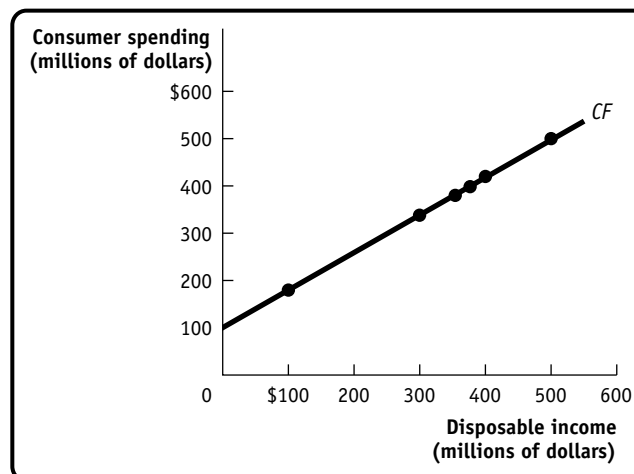
4. From 2009 to 2014, Eastlandia experienced large fluctuations in both aggregate consumer spending and disposable income, but wealth, the interest rate, and expected future disposable income did not change. The accompanying table shows the level of aggregate consumer spending and disposable income in millions of dollars for each of these years. Use this information to answer the following questions.

Year	Disposable income (millions of dollars)	Consumer spending (millions of dollars)
2009	\$100	\$180
2010	350	380
2011	300	340
2012	400	420
2013	375	400
2014	500	500

- Plot the aggregate consumption function for Eastlandia.
- What is the marginal propensity to consume? What is the marginal propensity to save?
- What is the aggregate consumption function?

## Solution

4. a. The accompanying diagram shows the aggregate consumption function for Eastlandia.



- b. The marginal propensity to consume is 0.8, and the marginal propensity to save is 0.2.
- c. The aggregate consumption function is of the form  $C = A + MPC \times YD$ . We know  $MPC = 0.8$ , so we must now solve for  $A$ . Rearranging, we have  $A = C - MPC \times YD$ . Plugging in the data from the first row of the table, we have  $A = \$180 \text{ million} - 0.8 \times \$100 \text{ million} = \$100 \text{ million}$ . Hence, the aggregate consumption function is  $C = \$100 \text{ million} + 0.8 \times YD$ .

5. The Bureau of Economic Analysis reported that, in real terms, overall consumer spending increased by \$66.2 billion during the second quarter of 2014.
- a. If the marginal propensity to consume is 0.52, by how much will real GDP change in response?
  - b. If there are no other changes to autonomous spending other than the increase in consumer spending in part a, and unplanned inventory investment,  $I_{\text{Unplanned}}$ , decreased by \$50 billion, what is the change in real GDP?
  - c. GDP at the end of September 2014 was \$16,014.1 billion. If GDP were to increase by the amount calculated in part b, what would be the percent increase in GDP?

### Solution

5. a. Real GDP increases as a result of this change in consumer spending by  $(1/(1 - 0.52)) \times \$66.2 \text{ billion} = \$137.92 \text{ billion}$ .
- b. If, in addition to the consumer spending change in part a, unplanned inventory investment decreases by \$50 billion, the resulting change in real GDP is  $(1/(1 - 0.52)) \times (\$66.2 \text{ billion} - \$50 \text{ billion}) = \$33.75 \text{ billion}$ .
- c. The percent increase in GDP is  $(\$33.75 \text{ billion}/\$16,014.1) \times 100 = 0.21\%$ —approximately the actual percent increase in real GDP over that period.
6. During the early 2000s, the Case-Shiller U.S. Home Price Index, a measure of average home prices, rose continuously until it peaked in March 2006. From March 2006 to May 2009, the index lost 32% of its value. Meanwhile, the stock market experienced similar ups and downs. From March 2003 to October 2007, the Standard and Poor's 500 (S&P 500) stock index, a broad measure of stock market prices, almost doubled, from 800.73 to a high of 1,565.15. From that time until March 2009, the index fell by almost 60%, to a low of 676.53. How do you think the movements in home prices both influenced the growth in real GDP during the first half of the decade and added to the concern about maintaining consumer spending after the collapse in the housing market that began in 2006? To what extent did the movements in the stock market hurt or help consumer spending?

### Solution

6. As home prices increased, homeowners experienced a large increase in the value of their wealth held in real estate. At the same time, as the S&P 500 almost doubled from March 2003 to October 2007, stockholders experienced a large increase in the value of their wealth held in stocks. Both of these increased consumer spending in the economy dramatically. However, as home prices plummeted from their peak in early 2006, consumer spending should have fallen, other things equal, as homeowners' wealth decreased. And, as the S&P 500 fell almost 60% from its peak in October 2007 to its low in March 2009, there was great concern that the decline in the stock market was exacerbating the decrease in consumers' wealth that had occurred because of the collapse in the housing market.
7. How will planned investment spending change as the following events occur?
- a. The interest rate falls as a result of Federal Reserve policy.
  - b. The U.S. Environmental Protection Agency decrees that corporations must upgrade or replace their machinery in order to reduce their emissions of sulfur dioxide.
  - c. Baby boomers begin to retire in large numbers and reduce their savings, resulting in higher interest rates.

## Solution

7. a. The lower interest rate will lead to a rise in planned investment spending.  
 b. Firms will need to replace older machinery with newer, less polluting machinery. This will increase planned investment spending.  
 c. As the interest rate rises, planned investment spending will fall.
8. Explain how each of the following actions will affect the level of planned investment spending and unplanned inventory investment. Assume the economy is initially in income-expenditure equilibrium.
- a. The Federal Reserve raises the interest rate.  
 b. There is a rise in the expected growth rate of real GDP.  
 c. A sizable inflow of foreign funds into the country lowers the interest rate.

## Solution

8. a. A rise in the interest rate will reduce planned investment spending. Planned aggregate spending will now be less than GDP, and inventories will accumulate. So unplanned inventory investment will be positive.  
 b. A rise in the expected growth rate of real GDP will lead firms to increase their planned investment spending. Planned aggregate spending will now exceed GDP. Sales will exceed firms' expectations, firms will draw down inventories unexpectedly, and unplanned inventory investment will be negative.  
 c. A fall in the interest rate will lead to an increase in planned investment spending. Planned aggregate spending will now exceed GDP. Sales will exceed firms' expectations, firms will draw down inventories unexpectedly, and unplanned inventory investment will be negative.
9. In an economy with no government and no foreign sectors, autonomous consumer spending is \$250 billion, planned investment spending is \$350 billion, and the marginal propensity to consume is  $2/3$ .
- a. Plot the aggregate consumption function and planned aggregate spending.  
 b. What is unplanned inventory investment when real GDP equals \$600 billion?  
 c. What is  $Y^*$ , income-expenditure equilibrium GDP?  
 d. What is the value of the multiplier?  
 e. If planned investment spending rises to \$450 billion, what will be the new  $Y^*$ ?

## Solution

9. a. If autonomous consumer spending is \$250 billion and the marginal propensity to consume is  $\frac{2}{3}$ , the aggregate consumption function is:

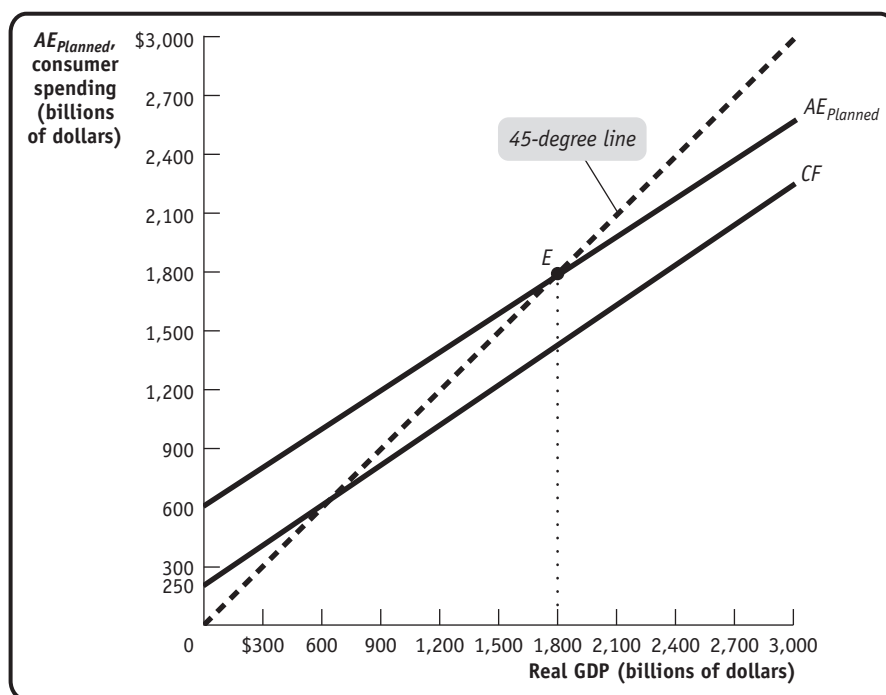
$$C = \$250 \text{ billion} + \frac{2}{3} \times YD$$

Planned aggregate spending equals consumer spending plus planned investment spending:

$$AE_{Planned} = C + I_{Planned}$$

$$AE_{Planned} = (\$250 \text{ billion} + \frac{2}{3} \times YD) + \$350 \text{ billion}$$

$$AE_{Planned} = \$600 \text{ billion} + \frac{2}{3} \times YD$$



- b. When real GDP equals \$600 billion, planned aggregate spending is \$1,000 billion [= \$600 billion +  $\frac{2}{3} \times \$600$  billion]. Unplanned inventory investment equals real GDP minus planned aggregate spending, or -\$400 billion.
- c.  $Y^*$  occurs where real GDP equals planned aggregate spending. From the accompanying diagram, we can see that this occurs at real GDP equal to \$1,800 billion.
- d. The value of the multiplier is 3 [=  $1/(1 - \frac{2}{3})$ ].
- e. If planned investment spending rises to \$450 billion, that will be an increase of \$100 billion in planned investment spending. Given a multiplier of 3,  $Y^*$  will rise by \$300 billion to \$2,100 billion.

10. An economy has a marginal propensity to consume of 0.5, and  $Y^*$ , income-expenditure equilibrium GDP, equals \$500 billion. Given an autonomous increase in planned investment of \$10 billion, show the rounds of increased spending that take place by completing the accompanying table. The first and second rows are filled in for you. In the first row, the increase of planned investment spending of \$10 billion raises real GDP and  $YD$  by \$10 billion, leading to an increase in consumer spending of \$5 billion ( $MPC \times$  change in disposable income) in row 2, raising real GDP and  $YD$  by a further \$5 billion.

Rounds	Change in $I_{Planned}$ or $C$	Change in real GDP	Change in $YD$
	(billions of dollars)		
1	$\Delta I_{Planned} = \$10.00$	\$10.00	\$10.00
2	$\Delta C = \$ 5.00$	\$ 5.00	\$ 5.00
3	$\Delta C = ?$	?	?
4	$\Delta C = ?$	?	?
5	$\Delta C = ?$	?	?
6	$\Delta C = ?$	?	?
7	$\Delta C = ?$	?	?
8	$\Delta C = ?$	?	?
9	$\Delta C = ?$	?	?
10	$\Delta C = ?$	?	?

- a. What is the total change in real GDP after the 10 rounds? What is the value of the multiplier? What would you expect the total change in  $Y^*$  to be based on the multiplier formula? How do your answers to the first and third questions compare?
- b. Redo the table starting from round 2, assuming the marginal propensity to consume is 0.75. What is the total change in real GDP after 10 rounds? What is the value of the multiplier? As the marginal propensity to consume increases, what happens to the value of the multiplier?

### Solution

10. a. The total change in GDP after the 10 rounds is \$19.98 billion, obtained by adding up the change in GDP for each of the first 10 rounds. The multiplier is 2 [ $= (1/(1 - 0.5))$ ]. We would expect the total change in  $Y^*$  to be twice the change in planned investment spending. Since the autonomous change in planned investment spending was \$10 billion, we would expect a change in  $Y^*$  of \$20 billion. This is very similar to the change in GDP after 10 rounds (\$19.98 billion).

Rounds	Change in $I_{Planned}$ or $C$	Change in real GDP	Change in $YD$
	(billions of dollars)		
1	$\Delta I_{Planned} = \$10.00$	\$10.00	\$10.00
2	$\Delta C = 5.00$	5.00	5.00
3	$\Delta C = 2.50$	2.50	2.50
4	$\Delta C = 1.25$	1.25	1.25
5	$\Delta C = 0.63$	0.63	0.63
6	$\Delta C = 0.31$	0.31	0.31
7	$\Delta C = 0.16$	0.16	0.16
8	$\Delta C = 0.08$	0.08	0.08
9	$\Delta C = 0.04$	0.04	0.04
10	$\Delta C = 0.02$	0.02	0.02

- b. The total change in GDP after 10 rounds is \$37.74 billion, obtained by adding up the change in GDP for each of the first 10 rounds. The value of the multiplier is 4. As the marginal propensity to consume increases, so does the value of the multiplier.

Rounds	Change in $I_{Planned}$ or $C$	Change in real GDP (billions of dollars)	Change in $YD$
1	$\Delta I_{Planned} = \$10.00$	\$10.00	\$10.00
2	$\Delta C = 7.50$	7.50	7.50
3	$\Delta C = 5.63$	5.63	5.63
4	$\Delta C = 4.22$	4.22	4.22
5	$\Delta C = 3.16$	3.16	3.16
6	$\Delta C = 2.37$	2.37	2.37
7	$\Delta C = 1.78$	1.78	1.78
8	$\Delta C = 1.33$	1.33	1.33
9	$\Delta C = 1.00$	1.00	1.00
10	$\Delta C = 0.75$	0.75	0.75

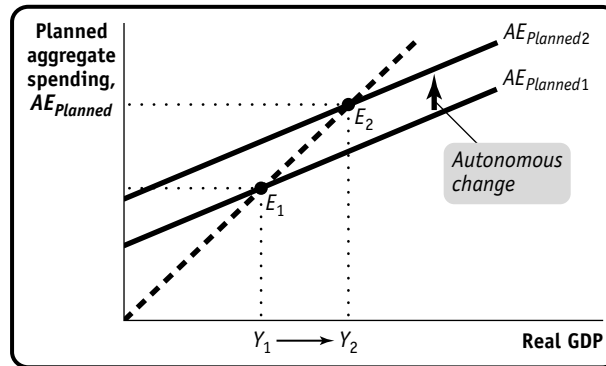
11. Although the United States is one of the richest nations in the world, it is also the world's largest debtor nation. We often hear that the problem is the nation's low savings rate. Suppose policy makers attempt to rectify this by encouraging greater savings in the economy. What effect will their successful attempts have on real GDP?

### Solution

11. If policy makers successfully encouraged greater savings, there would be a decrease in either consumer spending or planned investment spending. A drop in  $C$  or in  $I_{Planned}$  would decrease the income-expenditure equilibrium GDP by several times the change in spending. This is the paradox of thrift. If households and producers decrease spending to reduce the nation's debt, these actions will depress the economy, leaving households and producers worse off than they were with the nation's large debt.
12. The U.S. economy slowed significantly in early 2008, and policy makers were extremely concerned about growth. To boost the economy, Congress passed several relief packages (the Economic Stimulus Act of 2008 and the American Recovery and Reinvestment Act of 2009) that combined would deliver about \$700 billion in government spending. Assume, for the sake of argument, that this spending was in the form of payments made directly to consumers. The objective was to boost the economy by increasing the disposable income of American consumers.
- Calculate the initial change in aggregate consumer spending as a consequence of this policy measure if the marginal propensity to consume ( $MPC$ ) in the United States is 0.5. Then calculate the resulting change in real GDP arising from the \$700 billion in payments.
  - Illustrate the effect on real GDP with the use of a graph depicting the income-expenditure equilibrium. Label the vertical axis "Planned aggregate spending,  $AE_{Planned}$ " and the horizontal axis "Real GDP." Draw two planned aggregate expenditure curves ( $AE_{Planned_1}$  and  $AE_{Planned_2}$ ) and a 45-degree line to show the effect of the autonomous policy change on the equilibrium.



- 12.** a. Government spending increases the disposable income of American consumers. The MPC can be used to calculate the effect of government spending on consumer spending:  $\Delta C = MPC \times \Delta YD = 0.5 \times \$700 \text{ billion} = \$350 \text{ billion}$ . We can then use the change in consumer spending along with the multiplier to calculate the resulting change in real GDP.  $\Delta Y = (1/(1 - MPC)) \times \Delta C = (1/(1 - 0.5)) \times \$350 \text{ billion} = \$700 \text{ billion}$ .
- b. As shown in the accompanying diagram, the payments result in an autonomous increase in planned aggregate spending. This change results in an increase in real GDP.



**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



- 13.** a. The accompanying table shows gross domestic product (GDP), disposable income (YD), consumer spending (C), and planned investment spending ( $I_{Planned}$ ) in an economy. Assume there is no government or foreign sector in this economy. Complete the table by calculating planned aggregate spending ( $AE_{Planned}$ ) and unplanned inventory investment ( $I_{Unplanned}$ ).

GDP	YD	C	$I_{Planned}$	$AE_{Planned}$	$I_{Unplanned}$
(billions of dollars)					
\$0	\$0	\$100	\$300	?	?
400	400	400	300	?	?
800	800	700	300	?	?
1,200	1,200	1,000	300	?	?
1,600	1,600	1,300	300	?	?
2,000	2,000	1,600	300	?	?
2,400	2,400	1,900	300	?	?
2,800	2,800	2,200	300	?	?
3,200	3,200	2,500	300	?	?

- b. What is the aggregate consumption function?
- c. What is  $Y^*$ , income–expenditure equilibrium GDP?
- d. What is the value of the multiplier?
- e. If planned investment spending falls to \$200 billion, what will be the new  $Y^*$ ?
- f. If autonomous consumer spending rises to \$200 billion, what will be the new  $Y^*$ ?

## Solution

13. a.

GDP	YD	C	$I_{Planned}$	$AE_{Planned}$	$I_{Unplanned}$
(billions of dollars)					
\$0	\$0	\$100	\$300	\$400	-\$400
400	400	400	300	700	-300
800	800	700	300	1,000	-200
1,200	1,200	1,000	300	1,300	-100
1,600	1,600	1,300	300	1,600	0
2,000	2,000	1,600	300	1,900	100
2,400	2,400	1,900	300	2,200	200
2,800	2,800	2,200	300	2,500	300
3,200	3,200	2,500	300	2,800	400

- b. We can find the aggregate consumption function by calculating aggregate autonomous consumer spending and the marginal propensity to consume. Aggregate autonomous consumer spending equals aggregate consumer spending when disposable income is zero; in this case, aggregate autonomous consumer spending is \$100 billion. The marginal propensity to consume is the change in aggregate consumer spending divided by the change in disposable income; in this case, it is 0.75 [= (\$400 - \$100)/(\$400 - \$0)]. The aggregate consumption function is:

$$C = \$100 \text{ billion} + 0.75 \times YD$$

- c.  $Y^*$  is the level of GDP at which planned aggregate spending equals GDP. From the accompanying table,  $Y^*$  is \$1,600 billion.
- d. The multiplier equals  $1/(1 - MPC)$ ; the value of the multiplier is  $4 = 1/(1 - 0.75)$ .
- e. If planned investment spending falls to \$200 billion, the new  $Y^*$  will equal \$1,200 billion. If planned investment spending equals \$200 billion, it has fallen by \$100 billion. Since the multiplier is 4,  $Y^*$  will change by four times the change in planned investment spending, or decrease by \$400 billion.
- f. If autonomous consumer spending rises to \$200 billion, the new  $Y^*$  will equal \$2,000 billion. If autonomous consumer spending equals \$200 billion, it has risen by \$100 billion. Since the multiplier is 4,  $Y^*$  will change by four times the change in autonomous consumer spending, or increase by \$400 billion.



# Aggregate Demand and Aggregate Supply

1. A fall in the value of the dollar against other currencies makes U.S. final goods and services cheaper to foreigners even though the U.S. aggregate price level stays the same. As a result, foreigners demand more American aggregate output. Your study partner says that this represents a movement down the aggregate demand curve because foreigners are demanding more in response to a lower price. You, however, insist that this represents a rightward shift of the aggregate demand curve. Who is right? Explain.

## Solution

1. You are right. When a fall in the value of the dollar against other currencies makes U.S. final goods and services cheaper to foreigners, this represents a shift of the aggregate demand curve. Although foreigners may be demanding more U.S. goods because the price of those goods in their own currency is lower, there is no change in the U.S. aggregate price level. From the U.S. perspective, there is an increase in aggregate output demanded at any given aggregate price level.
2. Your study partner is confused by the upward-sloping short-run aggregate supply curve and the vertical long-run aggregate supply curve. How would you explain this?

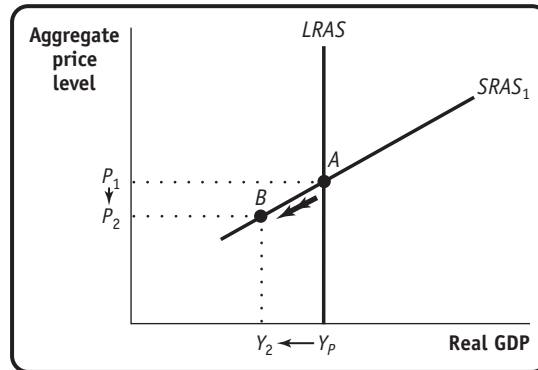
## Solution

2. The short-run aggregate supply curve slopes upward because nominal wages are sticky in the short run. Nominal wages are fixed by either formal contracts or informal agreements in the short run. So, as the aggregate price level falls and nominal wages remain the same, production costs will not fall by the same proportion as the aggregate price level. This will reduce profit per unit of output, leading producers to reduce output in the short run. Similarly, as the aggregate price level rises, production costs will not rise by the same proportion because nominal wages will remain fixed in the short run. Profit per unit of output will increase, leading producers to increase output in the short run. So there is a positive relationship between the aggregate price level and the quantity of aggregate output producers are willing to supply in the short run because nominal wages are sticky. However, in the long run, nominal wages can and will be renegotiated. Nominal wages will change along with the aggregate price level. As the aggregate price level rises, production costs will rise by the same proportion. When the aggregate price level and production costs rise by the same percentage, every unit of output that had been profitable to produce before the price rise is still profitable, and every unit of output that had been unprofitable to produce before the price rise is still unprofitable. So aggregate output does not change. In the long run, when nominal wages are perfectly flexible, an increase or decrease in the aggregate price level will not change the quantity of aggregate output produced. So the long-run aggregate supply curve is vertical.
3. Suppose that in Wageland all workers sign annual wage contracts each year on January 1. No matter what happens to prices of final goods and services during the year, all workers earn the wage specified in their annual contract. This year, prices of final goods and services fall unexpectedly after the contracts are signed. Answer the following questions using a diagram and assume that the economy starts at potential output.

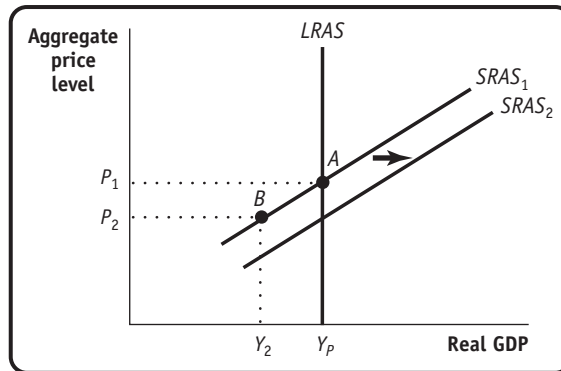
- a. In the short run, how will the quantity of aggregate output supplied respond to the fall in prices?
- b. What will happen when firms and workers renegotiate their wages?

### Solution

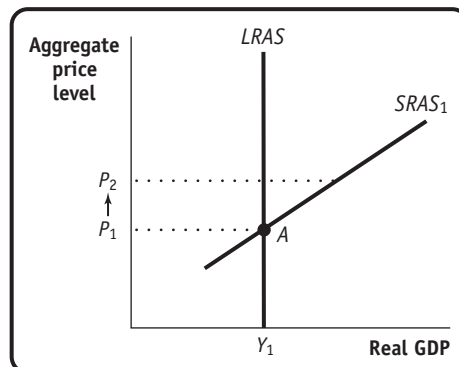
3. a. In the short run, the prices of final goods and services in Wageland fall unexpectedly but nominal wages don't change; they are fixed in the short run by the annual contract. So firms earn a lower profit per unit and reduce output. In the accompanying diagram, Wageland moves along  $SRAS_1$  from point A on January 1 to point B after the fall in prices.



- b. When firms and workers renegotiate their wages, nominal wages will decrease, shifting the short-run aggregate supply curve in the accompanying diagram rightward from  $SRAS_1$  to a curve such as  $SRAS_2$ .

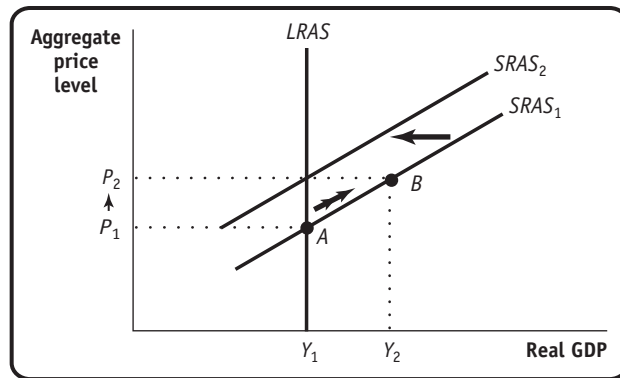


4. The economy is at point A in the accompanying diagram. Suppose that the aggregate price level rises from  $P_1$  to  $P_2$ . How will aggregate supply adjust in the short run and in the long run to the increase in the aggregate price level? Illustrate with a diagram.



## Solution

4. In the short run, as the aggregate price level rises from  $P_1$  to  $P_2$ , nominal wages will not change. So profit per unit will rise, leading to an increase in production from  $Y_1$  to  $Y_2$ . The economy will move from point  $A$  to point  $B$  in the accompanying diagram. In the long run, however, nominal wages will be renegotiated upward in reaction to low unemployment at  $Y_2$ . As nominal wages increase, the short-run aggregate supply curve will shift leftward from  $SRAS_1$  to a position such as  $SRAS_2$ . The exact position of  $SRAS_2$  depends on factors such as the aggregate demand curve.



5. Suppose that all households hold all their wealth in assets that automatically rise in value when the aggregate price level rises (an example of this is what is called an “inflation-indexed bond”—a bond whose interest rate, among other things, changes one-for-one with the inflation rate). What happens to the wealth effect of a change in the aggregate price level as a result of this allocation of assets? What happens to the slope of the aggregate demand curve? Will it still slope downward? Explain.

## Solution

5. If all households hold all their wealth in assets that automatically rise in value when the aggregate price level rises, this will eliminate the wealth effect of a change in the aggregate price level. The purchasing power of consumers’ wealth will not vary with a change in the aggregate price level, so there will be no change in consumer spending due to the change in the aggregate price level. The aggregate demand curve will still slope downward because of the interest rate effect of a change in the aggregate price level. As the aggregate price level rises, the purchasing power of households’ money holdings will decrease and they will be eager to borrow more and lend less, increasing interest rates. The increase in interest rates will discourage investment spending and consumer spending. The aggregate demand curve will be steeper because the wealth effect of a change in the aggregate price level has been eliminated. As prices rise, the amount of aggregate output demanded will fall by a smaller amount, an amount corresponding to the interest rate effect of a change in the aggregate price level.
6. Suppose that the economy is currently at potential output. Also suppose that you are an economic policy maker and that a college economics student asks you to rank, if possible, your most preferred to least preferred type of shock: positive demand shock, negative demand shock, positive supply shock, negative supply shock. How would you rank them and why?

## Solution

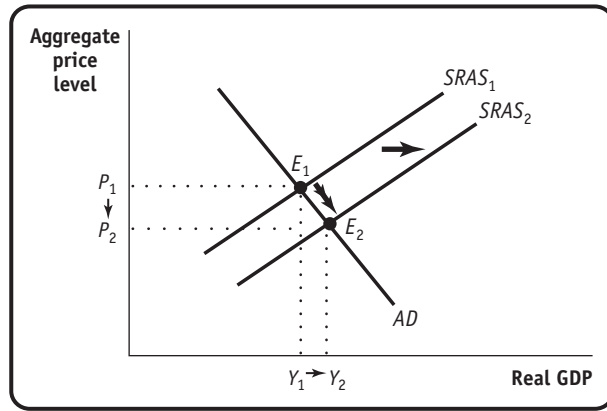
- 6.** The most preferred shock would be a positive supply shock. The economy would have higher aggregate output without the danger of inflation. The government would not need to respond with a change in policy. The least preferred shock would be a negative supply shock. The economy would experience stagflation. There would be lower aggregate output and higher inflation. There is no good policy remedy for a negative supply shock: policies to counteract the slump in aggregate output would worsen inflation, and policies to counteract inflation would further depress aggregate output. It is unclear how economic policy makers would rank positive and negative demand shocks. A positive demand shock brings a higher level of aggregate output but at a higher aggregate price level. A negative demand shock brings a lower level of aggregate output but at a lower aggregate price level. With either a positive or negative demand shock, policy makers could try to use either monetary or fiscal policy to lessen the effects of the shock.
- 7.** Explain whether the following government policies affect the aggregate demand curve or the short-run aggregate supply curve and how.
- The government reduces the minimum nominal wage.
  - The government increases Temporary Assistance to Needy Families (TANF) payments, government transfers to families with dependent children.
  - To reduce the budget deficit, the government announces that households will pay much higher taxes beginning next year.
  - The government reduces military spending.

## Solution

- 7.**
- If the government reduces the minimum nominal wage, it is similar to a fall in nominal wages. Aggregate supply will increase, and the short-run aggregate supply curve will shift to the right.
  - If the government increases TANF, consumer spending will increase because disposable income increases (disposable income equals income plus government transfers, such as TANF payments, less taxes). Aggregate demand will increase, and the aggregate demand curve will shift to the right.
  - If the government announces a large increase in taxes on households for next year, consumer spending will fall this year. Since households base their spending in part on their expectations about the future, the anticipated increase in taxes will lower their spending this year. There will be a decrease in aggregate demand, and the aggregate demand curve will shift to the left.
  - If the government reduces military spending, this will decrease aggregate demand. The amount of aggregate output demanded at any given aggregate price level will fall, and the aggregate demand curve will shift to the left.
- 8.** In Wageland, all workers sign an annual wage contract each year on January 1. In late January, a new computer operating system is introduced that increases labor productivity dramatically. Explain how Wageland will move from one short-run macroeconomic equilibrium to another. Illustrate with a diagram.

## Solution

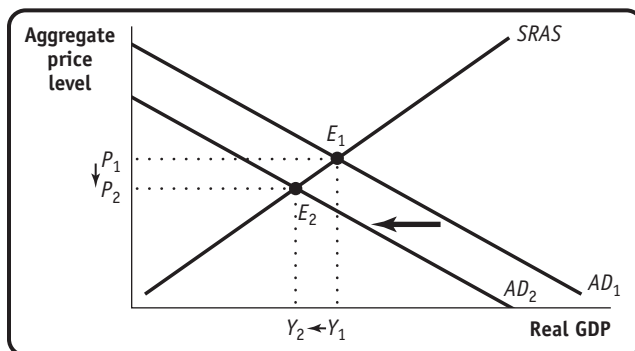
- 8.** As labor productivity increases, producers will experience a reduction in production costs and profit per unit of output will increase. Producers will respond by increasing the quantity of aggregate output supplied at any given aggregate price level. The short-run aggregate supply curve will shift to the right. Beginning at short-run equilibrium,  $E_1$  in the accompanying diagram, the short-run aggregate supply curve will shift from  $SRAS_1$  to  $SRAS_2$ . The aggregate price level will fall, and real GDP will increase in the short run.



9. The Conference Board publishes the Consumer Confidence Index (CCI) every month based on a survey of 5,000 representative U.S. households. It is used by many economists to track the state of the economy. A press release by the Board on June 28, 2011, stated: “The Conference Board Consumer Confidence Index, which had declined in May, decreased again in June. The Index now stands at 58.5 (1985 = 100), down from 61.7 in May.”
- As an economist, is this news encouraging for economic growth?
  - Explain your answer to part a with the help of the AD-AS model. Draw a typical diagram showing two equilibrium points ( $E_1$ ) and ( $E_2$ ). Label the vertical axis “Aggregate price level” and the horizontal axis “Real GDP.” Assume that all other major macroeconomic factors remain unchanged.
  - How should the government respond to this news? What are some policy measures that could be used to help neutralize the effect of falling consumer confidence?

### Solution

9. a. No. Consumers base their spending on how confident they are about the income they will have in the future. Likewise, firms base their investment spending on what they expect conditions to be like in the future. If consumers become more optimistic, spending will rise, but if consumers become more pessimistic, spending will fall. A fall in the CCI indicated that consumers were more pessimistic in June 2011 than they had been in May 2011, and since the CCI had also declined in May, they were also more pessimistic in May 2011 than they had been in April 2011.
- b. A fall in consumer confidence leads to a leftward shift of the aggregate demand curve. As shown in the accompanying diagram, other things equal, this will reduce real GDP from  $Y_1$  to  $Y_2$  and will reduce the aggregate price level from  $P_1$  to  $P_2$ .

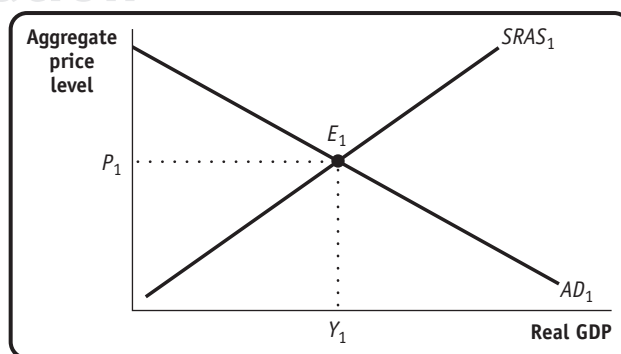




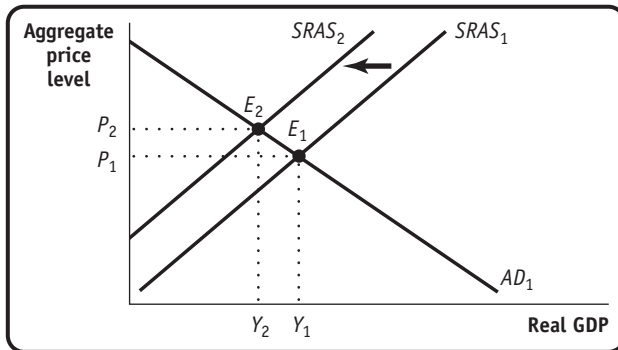
- c. The government could use expansionary monetary policy or fiscal policy to help remedy the situation. A tax break, an increase in government purchases of goods and services, or an increase in the money supply would help to improve economic performance.
10. There were two major shocks to the U.S. economy in 2007, leading to the severe recession of 2007–2009. One shock was related to oil prices; the other was the slump in the housing market. This question analyzes the effect of these two shocks on GDP using the *AD-AS* framework.
- a. Draw typical aggregate demand and short-run aggregate supply curves. Label the horizontal axis “Real GDP” and the vertical axis “Aggregate price level.” Label the equilibrium point  $E_1$ , the equilibrium quantity  $Y_1$ , and equilibrium price  $P_1$ .
- b. Data taken from the Department of Energy indicate that the average price of crude oil in the world increased from \$54.63 per barrel on January 5, 2007, to \$92.93 on December 28, 2007. Would an increase in oil prices cause a demand shock or a supply shock? Redraw the diagram from part a to illustrate the effect of this shock by shifting the appropriate curve.
- c. The Housing Price Index, published by the Office of Federal Housing Enterprise Oversight, calculates that U.S. home prices fell by an average of 3.0% in the 12 months between January 2007 and January 2008. Would the fall in home prices cause a supply shock or demand shock? Redraw the diagram from part b to illustrate the effect of this shock by shifting the appropriate curve. Label the new equilibrium point  $E_3$ , the equilibrium quantity  $Y_3$ , and equilibrium price  $P_3$ .
- d. Compare the equilibrium points  $E_1$  and  $E_3$  in your diagram for part c. What was the effect of the two shocks on real GDP and the aggregate price level (increase, decrease, or indeterminate)?

## Solution

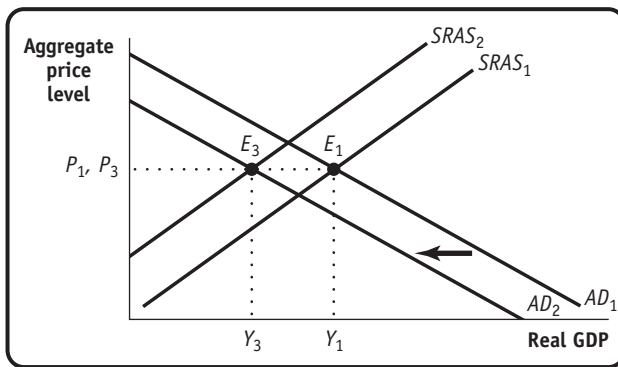
10. a.



- b. The rise in the price of oil usually causes a supply shock. The short-run aggregate supply (*SRAS*) curve shifts to the left, from  $SRAS_1$  to  $SRAS_2$ . The economy settles at a new short-run macroeconomic equilibrium at  $E_2$ , with a higher aggregate price level,  $P_2$ , and lower real GDP,  $Y_2$ .



- c. The fall in home prices would cause a demand shock because of the wealth effect. The aggregate demand ( $AD$ ) curve shifts leftward, from  $AD_1$  to  $AD_2$ . The new aggregate price level,  $P_2$ , could either be equal to, above, or below  $P_1$ . The new level of real GDP,  $Y_2$ , is below the original level,  $Y_1$ .

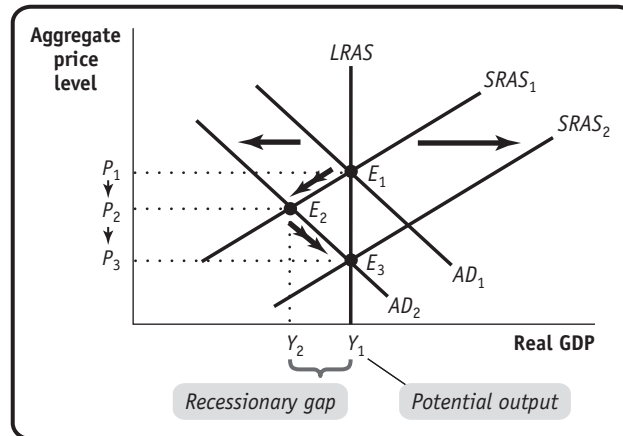


- d. The effect on the aggregate price level is indeterminate. As drawn in the diagram for part c,  $P_1$  and  $P_3$  coincide because the negative supply and demand shocks have exactly offsetting price effects. However, prices could either rise or fall when both a negative demand shock and a negative supply shock occur. The fall in real GDP is unambiguous because the two shocks reinforce their negative effects on GDP.

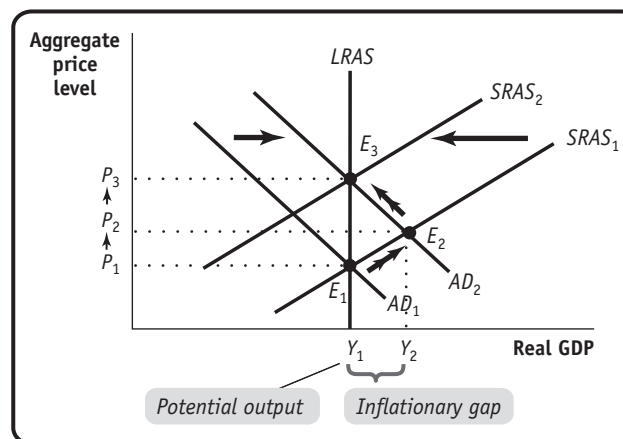
- 11.** Using aggregate demand, short-run aggregate supply, and long-run aggregate supply curves, explain the process by which each of the following economic events will move the economy from one long-run macroeconomic equilibrium to another. Illustrate with diagrams. In each case, what are the short-run and long-run effects on the aggregate price level and aggregate output?
- There is a decrease in households' wealth due to a decline in the stock market.
  - The government lowers taxes, leaving households with more disposable income, with no corresponding reduction in government purchases.

### Solution

- 11. a.** A decrease in households' wealth will reduce consumer spending. Beginning at long-run macroeconomic equilibrium,  $E_1$  in the accompanying diagram, the aggregate demand curve will shift from  $AD_1$  to  $AD_2$ . In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point  $E_2$ . The aggregate price level will be lower than at  $E_1$ , and aggregate output will be lower than potential output. The economy faces a recessionary gap. As wage contracts are renegotiated, nominal wages will fall and the short-run aggregate supply curve will shift gradually to the right over time until it reaches  $SRAS_2$  and intersects  $AD_2$  at point  $E_3$ . At  $E_3$ , the economy is back at its potential output but at a much lower aggregate price level.



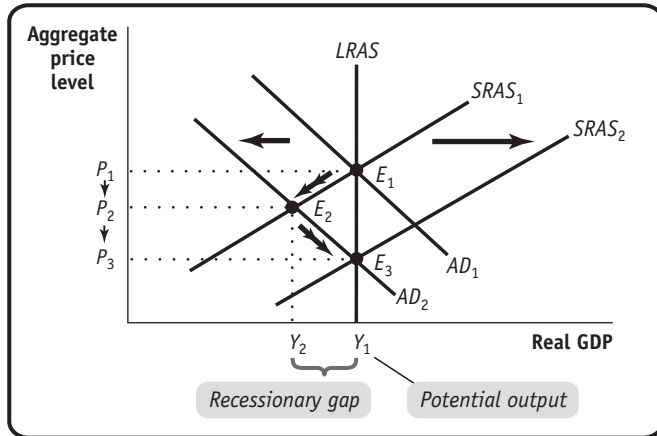
- b. An increase in disposable income will increase consumer spending; at any given aggregate price level, the aggregate demand curve will shift to the right. Beginning at long-run macroeconomic equilibrium,  $E_1$  in the accompanying diagram, the aggregate demand curve will shift from  $AD_1$  to  $AD_2$ . In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point  $E_2$ . The aggregate price level is higher than at  $E_1$ , and aggregate output will be higher than potential output. The economy faces an inflationary gap. As wage contracts are renegotiated, nominal wages will rise and the short-run aggregate supply curve will shift gradually to the left over time until it reaches  $SRAS_2$  and intersects  $AD_2$  at point  $E_3$ . At  $E_3$ , the economy is back at its potential output but at a much higher aggregate price level.



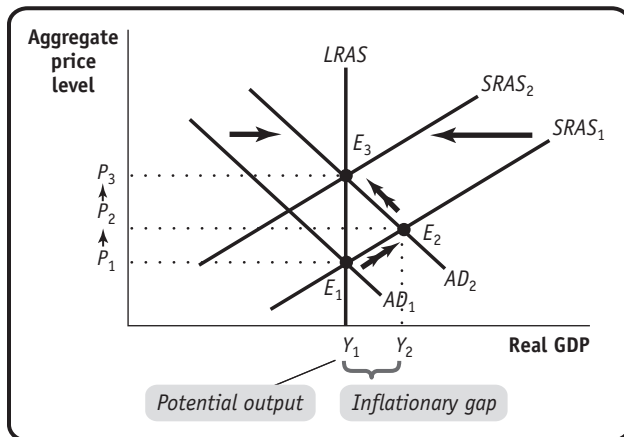
12. Using aggregate demand, short-run aggregate supply, and long-run aggregate supply curves, explain the process by which each of the following government policies will move the economy from one long-run macroeconomic equilibrium to another. Illustrate with diagrams. In each case, what are the short-run and long-run effects on the aggregate price level and aggregate output?
- There is an increase in taxes on households.
  - There is an increase in the quantity of money.
  - There is an increase in government spending.

**12. Solution**

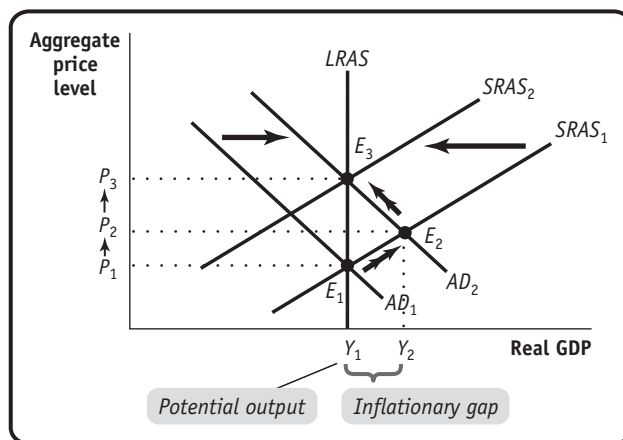
a. An increase in taxes will decrease consumer spending by households. Beginning at  $E_1$  in the accompanying diagram, the aggregate demand curve will shift leftward from  $AD_1$  to  $AD_2$ . In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point  $E_2$ . The aggregate price level is lower than at  $E_1$ , and aggregate output is lower than potential output. The economy faces a recessionary gap. As wage contracts are renegotiated, nominal wages will fall and the short-run aggregate supply curve will shift gradually to the right over time until it reaches  $SRAS_2$  and intersects  $AD_2$  at point  $E_3$ . At  $E_3$ , the economy is back at its potential output but at a much lower aggregate price level.



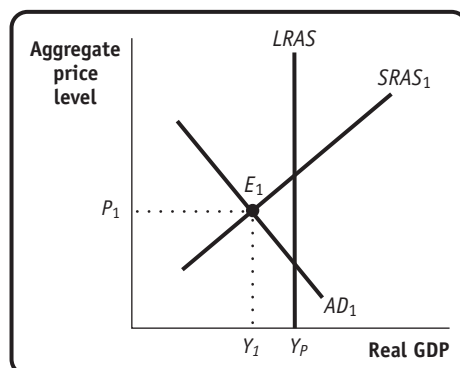
b. An increase in the quantity of money will encourage people to lend, lowering interest rates and increasing investment and consumer spending; at any given aggregate price level, the quantity of aggregate output demanded will be higher. Beginning at long-run macroeconomic equilibrium,  $E_1$  in the accompanying diagram, the aggregate demand curve will shift from  $AD_1$  to  $AD_2$ . In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point  $E_2$ . The aggregate price level is higher than at  $E_1$ , and aggregate output is higher than potential output. The economy faces an inflationary gap. As wage contracts are renegotiated, nominal wages will rise and the short-run aggregate supply curve will shift gradually to the left over time until it reaches  $SRAS_2$  and intersects  $AD_2$  at point  $E_3$ . At  $E_3$ , the economy is back at its potential output but at a much higher aggregate price level.



- c. An increase in government spending will increase aggregate demand; at any given aggregate price level, the quantity of aggregate output demanded will be higher. Beginning at long-run macroeconomic equilibrium,  $E_1$  in the accompanying diagram, the aggregate demand curve will shift from  $AD_1$  to  $AD_2$ . In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point  $E_2$ . The aggregate price level is higher than at  $E_1$ , and aggregate output is higher than potential output. The economy faces an inflationary gap. As wage contracts are renegotiated, nominal wages will rise and the short-run aggregate supply curve will shift gradually to the left over time until it reaches  $SRAS_2$  and intersects  $AD_2$  at point  $E_3$ . At  $E_3$ , the economy is back at its potential output but at a much higher aggregate price level.



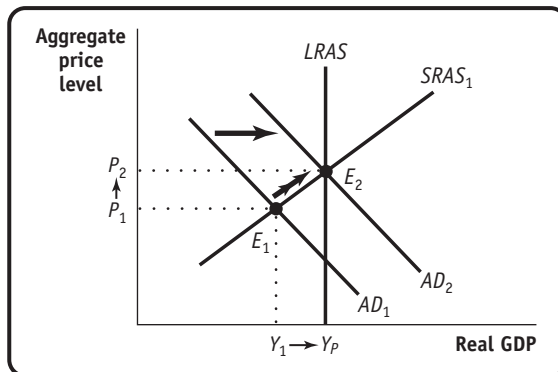
13. The economy is in short-run macroeconomic equilibrium at point  $E_1$  in the accompanying diagram. Based on the diagram, answer the following questions.



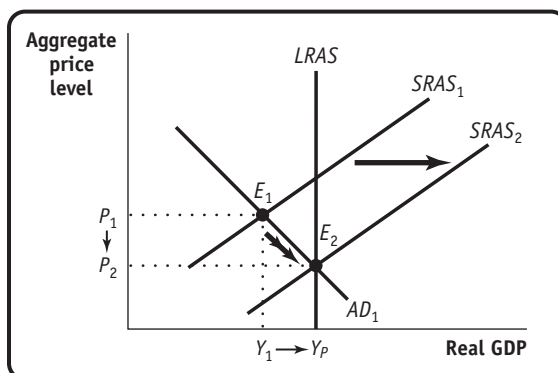
- Is the economy facing an inflationary or a recessionary gap?
- What policies can the government implement that might bring the economy back to long-run macroeconomic equilibrium? Illustrate with a diagram.
- If the government did not intervene to close this gap, would the economy return to long-run macroeconomic equilibrium? Explain and illustrate with a diagram.
- What are the advantages and disadvantages of the government implementing policies to close the gap?

## Solution

13. a. The economy is facing a recessionary gap because  $Y_1$  is less than the potential output of the economy,  $Y_P$ .
- b. The government could use either fiscal policy (increases in government spending or reductions in taxes) or monetary policy (increases in the quantity of money in circulation to reduce the interest rate) to move the aggregate demand curve from  $AD_1$  to  $AD_2$  in the accompanying diagram. This will move the economy back to potential output, and the aggregate price level will rise from  $P_1$  to  $P_2$ .

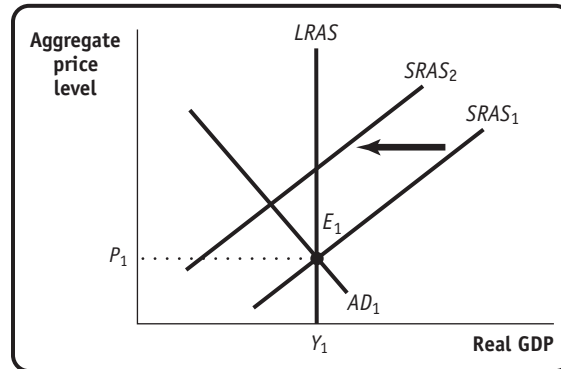


- c. If the government did not intervene to close the recessionary gap, the economy would eventually self-correct and move back to potential output on its own. Due to unemployment, nominal wages will fall in the long run. The short-run aggregate supply curve will shift to the right, and eventually it will shift from  $SRAS_1$  to  $SRAS_2$  in the accompanying diagram. The economy will be back at potential output but at a lower aggregate price level.



- d. If the government implements fiscal or monetary policies to move the economy back to long-run macroeconomic equilibrium, the recessionary gap might be eliminated faster than if the economy was left to adjust on its own. However, because policy makers aren't perfectly informed and policy effects can be unpredictable, policies to close the recessionary gap can lead to greater macroeconomic instability. Furthermore, if the government uses fiscal or monetary policies, the price level will be higher than it will be if the economy is left to return to long-run macroeconomic equilibrium by itself. In addition, a policy that increases the budget deficit might lead to lower long-run growth through crowding out.

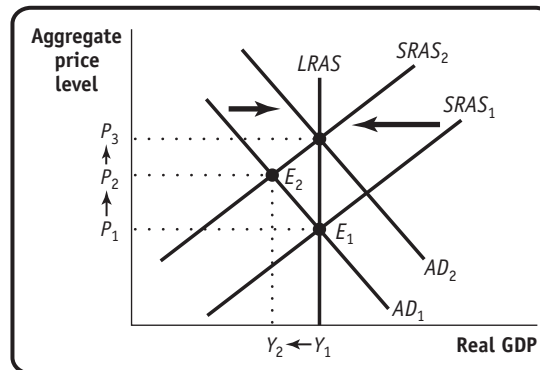
14. In the accompanying diagram, the economy is in long-run macroeconomic equilibrium at point  $E_1$  when an oil shock shifts the short-run aggregate supply curve to  $SRAS_2$ . Based on the diagram, answer the following questions.



- How do the aggregate price level and aggregate output change in the short run as a result of the oil shock? What is this phenomenon known as?
- What fiscal or monetary policies can the government use to address the effects of the supply shock? Use a diagram that shows the effect of policies chosen to address the change in real GDP. Use another diagram to show the effect of policies chosen to address the change in the aggregate price level.
- Why do supply shocks present a dilemma for government policy makers?

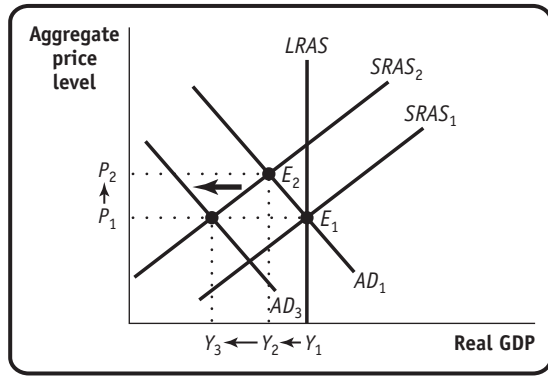
### Solution

14. a. As a result of the increase in the price of oil and the shift to the left of the short-run aggregate supply curve, real GDP decreases to  $Y_2$  (and with it unemployment rises) and the aggregate price level increases to  $P_2$  as shown in the accompanying diagram. This combined problem of inflation and unemployment is known as stagflation.



- b. The government can use fiscal and monetary policies to either increase real GDP or lower the aggregate price level, but not both. If the government increases government spending, decreases taxes, or increases the quantity of money in circulation, it can raise real GDP but it will also raise the aggregate price level. This is illustrated in the diagram accompanying part a by the rightward shift of  $AD_1$  to  $AD_2$ .

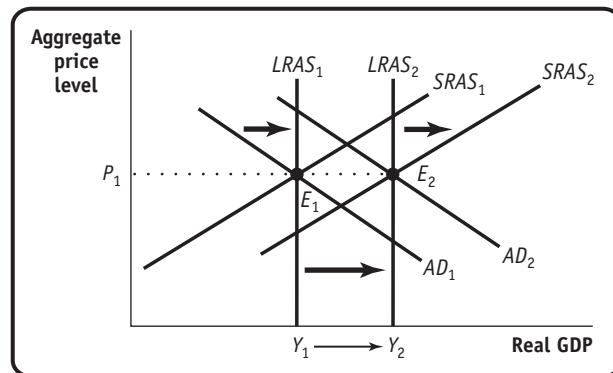
If the government decreases government spending, increases taxes, or decreases the quantity of money in circulation, it can lower the aggregate price level but it will also lower real GDP, worsening the recessionary gap. This is illustrated in the accompanying diagram by the leftward shift of  $AD_1$  to  $AD_3$ .



c. The government cannot use fiscal and monetary policies to correct for the lower real GDP and higher aggregate price level simultaneously. It can only use policies to alleviate one problem but at the expense of making the other worse.

15. The late 1990s in the United States were characterized by substantial economic growth with low inflation; that is, real GDP increased with little, if any, increase in the aggregate price level. Explain this experience using aggregate demand and aggregate supply curves. Illustrate with a diagram.

**15.** Increases in both long-run and short-run aggregate supply, along with increases in aggregate demand, can explain how real GDP grew with little if any increase in the aggregate price level. The accompanying diagram shows how the economy could move from one long-run macroeconomic equilibrium, point  $E_1$ , to another, point  $E_2$ , with an increase in real GDP and no increase in the aggregate price level. This may explain the U.S. experience during the late 1990s. During this time, increases in productivity due to increasing use of information technology may have shifted the long-run and short-run aggregate supply curves; simultaneously, increases in stock values may have led to increases in consumer spending and a shift to the right of the aggregate demand curve.





**WORK IT OUT**

Interactive, step-by-step help solving this problem is available to your students via



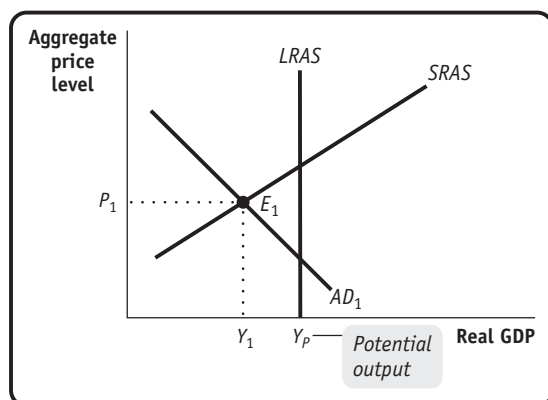
- 16.** In each of the following cases, in the short run, determine whether the events cause a shift of a curve or a movement along a curve. Determine which curve is involved and the direction of the change.
- As a result of an increase in the value of the dollar in relation to other currencies, American producers now pay less in dollar terms for foreign steel, a major commodity used in production.
  - An increase in the quantity of money by the Federal Reserve increases the quantity of money that people wish to lend, lowering interest rates.
  - Greater union activity leads to higher nominal wages.
  - A fall in the aggregate price level increases the purchasing power of households' and firms' money holdings. As a result, they borrow less and lend more.

### Solution

- 16. a.** As the value of the dollar in terms of other currencies increases and American producers pay less in dollar terms for foreign steel, producers' profit per unit increases and they are willing to supply a greater quantity of aggregate output at any given aggregate price level. The short-run aggregate supply curve will shift to the right.
- b.** As the Federal Reserve increases the quantity of money, households and firms have more money, which they are willing to lend out, and interest rates fall. The lower interest rates will increase investment spending and consumer spending, leading to a greater quantity of aggregate output demanded at any given aggregate price level. The aggregate demand curve will shift to the right.
- c.** If unions are able to negotiate higher nominal wages for a large portion of the workforce, this will increase production costs and reduce profit per unit at any given aggregate price level. The short-run aggregate supply curve will shift to the left.
- d.** As the aggregate price level falls and the purchasing power of households' and firms' money holdings increases, the public tries to reduce its money holdings by borrowing less and lending more. So interest rates fall, leading to a rise in both investment spending and consumer spending. This is the interest rate effect of a change in the aggregate price level, represented as a movement down along the aggregate demand curve.

# Fiscal Policy

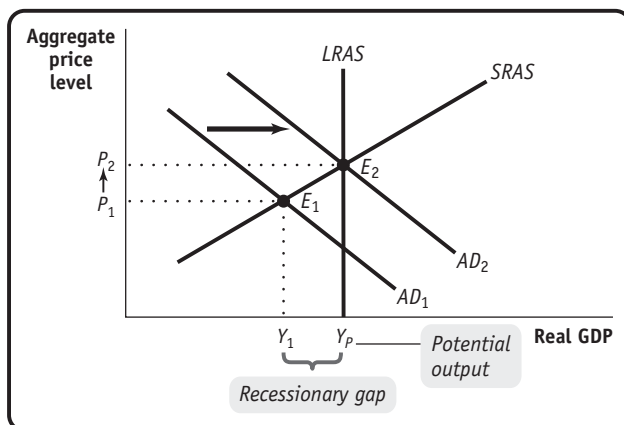
1. The accompanying diagram shows the current macroeconomic situation for the economy of Albernia. You have been hired as an economic consultant to help the economy move to potential output,  $Y_p$ .



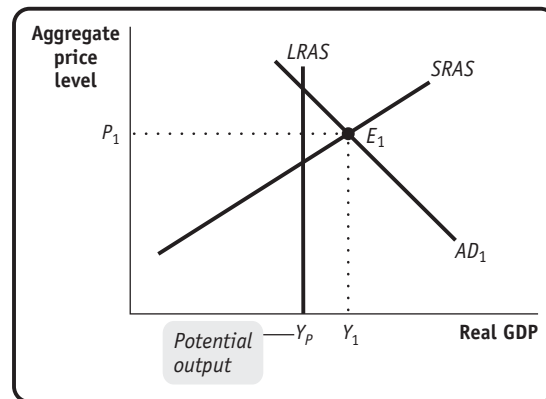
- Is Albernia facing a recessionary or inflationary gap?
- Which type of fiscal policy—expansionary or contractionary—would move the economy of Albernia to potential output,  $Y_p$ ? What are some examples of such policies?
- Illustrate the macroeconomic situation in Albernia with a diagram after the successful fiscal policy has been implemented.

## Solution

- Albernia is facing a recessionary gap;  $Y_1$  is less than  $Y_p$ .
  - Albernia could use expansionary fiscal policies to move the economy to potential output. Such policies include increasing government purchases of goods and services, increasing government transfers, and reducing taxes.
- c.



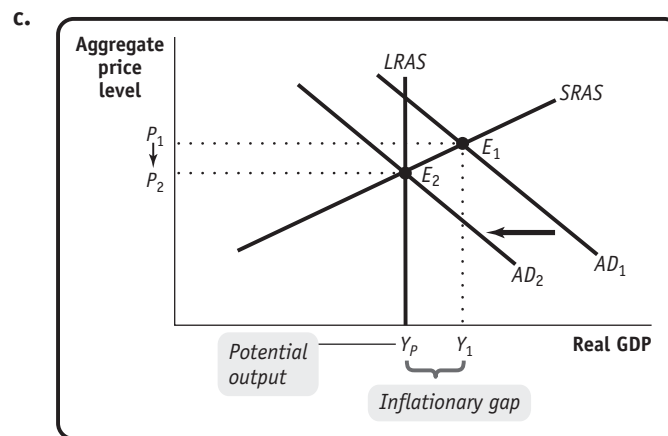
2. The accompanying diagram shows the current macroeconomic situation for the economy of Brittania; real GDP is  $Y_1$ , and the aggregate price level is  $P_1$ . You have been hired as an economic consultant to help the economy move to potential output,  $Y_P$ .



- Is Brittania facing a recessionary or inflationary gap?
- Which type of fiscal policy—expansionary or contractionary—would move the economy of Brittania to potential output,  $Y_P$ ? What are some examples of such policies?
- Illustrate the macroeconomic situation in Brittania with a diagram after the successful fiscal policy has been implemented.

## Solution

- Brittania is facing an inflationary gap;  $Y_1$  is greater than  $Y_P$ .
- Brittania could use contractionary fiscal policies to move the economy to potential output. Such policies include reducing government purchases of goods and services, lowering government transfers, and raising taxes.

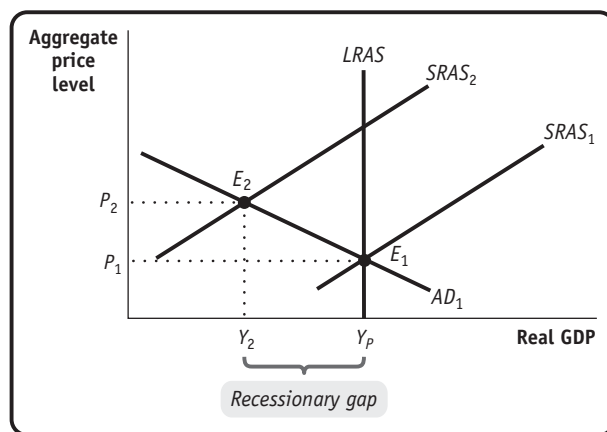


- An economy is in long-run macroeconomic equilibrium when each of the following aggregate demand shocks occurs. What kind of gap—inflationary or recessionary—will the economy face after the shock, and what type of fiscal policies would help move the economy back to potential output? How would your recommended fiscal policy shift the aggregate demand curve?
  - A stock market boom increases the value of stocks held by households.
  - Firms come to believe that a recession in the near future is likely.

- c. Anticipating the possibility of war, the government increases its purchases of military equipment.
- d. The quantity of money in the economy declines and interest rates increase.

### Solution

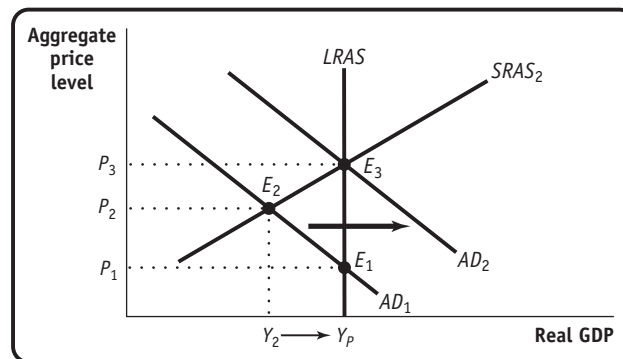
- 3.
- a. As the stock market booms and the value of stocks held by households increases, there will be an increase in consumer spending; this will shift the aggregate demand curve to the right. The economy will face an inflationary gap. Policy makers could use contractionary fiscal policies to move the economy back to potential output. This would shift the aggregate demand curve to the left.
  - b. If firms become concerned about a recession in the near future, they will decrease investment spending and aggregate demand will shift to the left. The economy will face a recessionary gap. Policy makers could use expansionary fiscal policies to move the economy back to potential output. This would shift the aggregate demand curve to the right.
  - c. If the government increases its purchases of military equipment, the aggregate demand curve will shift to the right. The economy will face an inflationary gap. Policy makers could use contractionary fiscal policies to move the economy back to potential output. The government would need to reduce its purchases of non-defense goods and services, raise taxes, or reduce transfers. This would shift the aggregate demand curve to the left.
  - d. As interest rates rise, investment spending will decrease and the aggregate demand curve will shift to the left. The economy will face a recessionary gap. Policy makers could use expansionary fiscal policies to move the economy back to potential output. This would shift the aggregate demand curve to the right.
4. During a 2008 interview, then German Finance Minister Peer Steinbrueck said, “We have to watch out that in Europe and beyond, nothing like a combination of downward economic [growth] and high inflation rates emerges—something that experts call stagflation.” Such a situation can be depicted by the movement of the short-run aggregate supply curve from its original position,  $SRAS_1$ , to its new position,  $SRAS_2$ , with the new equilibrium point  $E_2$  in the accompanying figure. In this question, we try to understand why stagflation is particularly hard to fix using fiscal policy.



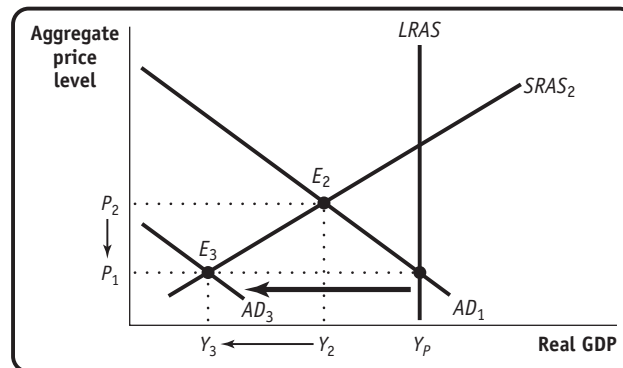
- a. What would be the appropriate fiscal policy response to this situation if the primary concern of the government was to maintain economic growth? Illustrate the effect of the policy on the equilibrium point and the aggregate price level using the diagram.
- b. What would be the appropriate fiscal policy response to this situation if the primary concern of the government was to maintain price stability? Illustrate the effect of the policy on the equilibrium point and the aggregate price level using the diagram.
- c. Discuss the effectiveness of the policies in parts a and b in fighting stagflation.

## Solution

4. a. The government should adopt expansionary fiscal policy, such as lowering taxes or increasing spending. This would shift the aggregate demand curve to the right, moving the equilibrium output back to  $Y_p$  but increasing the price to  $P_3$ .



- b. The government should adopt contractionary fiscal policy such as raising taxes or lowering government spending, causing the aggregate demand curve to shift to the left. The price level will decrease back to  $P_1$ , but the recessionary gap will increase.



- c. Although expansionary fiscal policy can help bring aggregate output back to potential output, it also raises the aggregate price level. This makes the problem of inflation worse in a situation where low economic growth is coupled with higher-than-desired inflation. Contractionary fiscal policy—reduced government purchases of goods and services, an increase in taxes, or a reduction in government transfers—can help bring down the price level. However, contractionary fiscal policy will further increase the recessionary gap.

5. Show why a \$10 billion reduction in government purchases of goods and services will have a larger effect on real GDP than a \$10 billion reduction in government transfers by completing the accompanying table for an economy with a marginal propensity to consume (*MPC*) of 0.6. The first and second rows of the table are filled in for you: on the left side of the table, in the first row, the \$10 billion reduction in government purchases decreases real GDP and disposable income, *YD*, by \$10 billion, leading to a reduction in consumer spending of \$6 billion (*MPC* × change in disposable income) in row 2. However, on the right side of the table, the \$10 billion reduction in transfers has no effect on real GDP in round 1 but does lower *YD* by \$10 billion, resulting in a decrease in consumer spending of \$6 billion in round 2.

Rounds	Decrease in <i>G</i> = -\$10 billion			Decrease in <i>TR</i> = -\$10 billion		
	Billions of dollars			Billions of dollars		
	Change in <i>G</i> or <i>C</i>	Change in real GDP	Change in <i>YD</i>	Change in <i>TR</i> or <i>C</i>	Change in real GDP	Change in <i>YD</i>
1	$\Delta G = -\$10.00$	-\$10.00	-\$10.00	$\Delta TR = -\$10.00$	\$0.00	-\$10.00
2	$\Delta C = -6.00$	-6.00	-6.00	$\Delta C = -6.00$	-6.00	-6.00
3	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
4	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
5	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
6	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
7	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
8	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
9	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?
10	$\Delta C = ?$	?	?	$\Delta C = ?$	?	?

- When government purchases decrease by \$10 billion, what is the sum of the changes in real GDP after the 10 rounds?
- When the government reduces transfers by \$10 billion, what is the sum of the changes in real GDP after the 10 rounds?
- Using the formula for the multiplier for changes in government purchases and for changes in transfers, calculate the total change in real GDP due to the \$10 billion decrease in government purchases and the \$10 billion reduction in transfers. What explains the difference? (*Hint*: The multiplier for government purchases of goods and services is  $1/(1 - MPC)$ . But since each \$1 change in government transfers only leads to an initial change in real GDP of  $MPC \times \$1$ , the multiplier for government transfers is  $MPC/(1 - MPC)$ .)

## Solution

5. Here is the completed table:

Rounds	Decrease in $G = -\$10$ billion (billions of dollars)			Decrease in $TR = -\$10$ billion (billions of dollars)		
	Change in $G$ or $C$	Change in real GDP	Change in $YD$	Change in $TR$ or $C$	Change in real GDP	Change in $YD$
1	$\Delta G = -\$10.00$	$-\$10.00$	$-\$10.00$	$\Delta TR = -\$10.00$	$\$0.00$	$-\$10.00$
2	$\Delta C = -6.00$	$-6.00$	$-6.00$	$\Delta C = -6.00$	$-6.00$	$-6.00$
3	$\Delta C = -3.60$	$-3.60$	$-3.60$	$\Delta C = -3.60$	$-3.60$	$-3.60$
4	$\Delta C = -2.16$	$-2.16$	$-2.16$	$\Delta C = -2.16$	$-2.16$	$-2.16$
5	$\Delta C = -1.30$	$-1.30$	$-1.30$	$\Delta C = -1.30$	$-1.30$	$-1.30$
6	$\Delta C = -0.78$	$-0.78$	$-0.78$	$\Delta C = -0.78$	$-0.78$	$-0.78$
7	$\Delta C = -0.47$	$-0.47$	$-0.47$	$\Delta C = -0.47$	$-0.47$	$-0.47$
8	$\Delta C = -0.28$	$-0.28$	$-0.28$	$\Delta C = -0.28$	$-0.28$	$-0.28$
9	$\Delta C = -0.17$	$-0.17$	$-0.17$	$\Delta C = -0.17$	$-0.17$	$-0.17$
10	$\Delta C = -0.10$	$-0.10$	$-0.10$	$\Delta C = -0.10$	$-0.10$	$-0.10$
...						
Sum for 10 rounds		$-\$24.86$			$-\$14.86$	

- a. When government purchases of goods and services decrease by \$10 billion, the change in real GDP is  $-\$24.86$  billion after 10 rounds.
- b. When government transfers fall by \$10 billion, the change in real GDP is  $-\$14.86$  billion after 10 rounds.
- c. When the government decreases purchases of goods and services by \$10 billion, the total change in real GDP is  $-\$25$  billion  $[(1/(1 - 0.6)) \times (-\$10 \text{ billion})]$ . When transfers fall by \$10 billion, the total change in real GDP is  $-\$15$  billion  $[(0.6/(1 - 0.6)) \times (-\$10 \text{ billion})]$ . The difference is that the \$10 billion decrease in transfers does not directly affect real GDP. All rounds except the first are the same in the table for a decrease in government purchases and a reduction in transfers; however, in the first round, real GDP falls by the same amount that government purchases declined, but real GDP is initially unaffected when transfers decline by that amount.
6. In each of the following cases, either a recessionary or inflationary gap exists. Assume that the aggregate supply curve is horizontal, so that the change in real GDP arising from a shift of the aggregate demand curve equals the size of the shift of the curve. Calculate both the change in government purchases of goods and services and the change in government transfers necessary to close the gap.
- a. Real GDP equals \$100 billion, potential output equals \$160 billion, and the marginal propensity to consume is 0.75.
- b. Real GDP equals \$250 billion, potential output equals \$200 billion, and the marginal propensity to consume is 0.5.
- c. Real GDP equals \$180 billion, potential output equals \$100 billion, and the marginal propensity to consume is 0.8.

## Solution

6. a. The economy is facing a recessionary gap; real GDP is less than potential output. Since the multiplier for a change in government purchases of goods and services is  $1/(1 - 0.75) = 4$ , an increase in government purchases of \$15 billion will increase real GDP by \$60 billion and close the recessionary gap. Each dollar of a government transfer increase will increase real GDP by  $MPC/(1 - MPC) \times \$1$ , or  $0.75/(1 - 0.75) \times \$1 = \$3$ . Since real GDP needs to increase by \$60 billion, the government should increase transfers by \$20 billion to close the recessionary gap.
- b. The economy is facing an inflationary gap; real GDP is higher than potential output. Since the multiplier for a change in government purchases of goods and services is  $1/(1 - 0.5) = 2$ , a decrease in government purchases of \$25 billion will reduce real GDP by \$50 billion and close the inflationary gap. Each dollar of a government transfer reduction will decrease real GDP by  $MPC/(1 - MPC) \times \$1$ , or  $0.5/(1 - 0.5) \times \$1 = \$1$ . Since real GDP needs to decrease by \$50 billion, the government should decrease transfers by \$50 billion to close the inflationary gap.
- c. The economy is facing an inflationary gap; real GDP is higher than potential output. Since the multiplier for a change in government purchases of goods and services is  $1/(1 - 0.8) = 5$ , a decrease in government purchases of \$16 billion will reduce real GDP by \$80 billion and close the inflationary gap. Each dollar of a government transfer reduction will reduce real GDP by  $MPC/(1 - MPC) \times \$1$ , or  $0.8/(1 - 0.8) \times \$1 = \$4$ . Since real GDP needs to decrease by \$80 billion, the government should reduce transfer payments by \$20 billion to close the inflationary gap.
7. Most macroeconomists believe it is a good thing that taxes act as automatic stabilizers and lower the size of the multiplier. However, a smaller multiplier means that the change in government purchases of goods and services, government transfers, or taxes necessary to close an inflationary or recessionary gap is larger. How can you explain this apparent inconsistency?

## Solution

7. Automatic stabilizers, such as taxes, help to dampen the business cycle. As the economy expands, taxes increase; this increase acts as a contractionary fiscal policy. In this way, any autonomous change in aggregate spending will have a smaller effect on real GDP than it would in the absence of taxes and result in a smaller inflationary or recessionary gap. Consequently, the need for discretionary fiscal policy is reduced. However, if a demand shock does occur and the government decides to use discretionary fiscal policy to help eliminate it, the smaller multiplier means that the change in government purchases of goods and services, government transfers, or taxes necessary to close the gap is larger.
8. The government's budget surplus in Macroland has risen consistently over the past five years. Two government policy makers disagree as to why this has happened. One argues that a rising budget surplus indicates a growing economy; the other argues that it shows that the government is using contractionary fiscal policy. Can you determine which policy maker is correct? If not, why not?

## Solution

8. It's impossible to determine which policy maker is correct given the information available. Other things equal, the government's budget surplus will rise either if real GDP is growing or if Macroland is using contractionary fiscal policy. When the economy grows, tax revenue rises and government transfers fall, leading to an increase in the government's budget surplus. However, if the government uses contractionary fiscal policy, then the government purchases fewer goods and services, increases taxes, or reduces government transfers. Any of those three changes will result in a temporary increase in the government's budget surplus, although the reduction in real GDP will eventually cause tax revenue to fall and government transfers to rise, which will partly reduce the budget surplus.



9. Figure 13-10 shows the actual budget deficit and the cyclically adjusted budget deficit as a percentage of GDP in the United States from 1970 to 2014. Assuming that potential output was unchanged, use this figure to determine which of the years from 1990 to 2013 the government used expansionary fiscal policy and in which years it used contractionary fiscal policy.

### Solution

9. Since the cyclically adjusted budget balance is an estimate of what the budget balance would be if real GDP were exactly equal to potential output, the effects of the business cycle on the budget has been eliminated. And since we have assumed that there are no changes in potential output, any change in the cyclically adjusted budget balance represents changes in fiscal policies. When the cyclically adjusted budget deficit falls, the government must be engaging in contractionary fiscal policies: either government purchases and transfer payments are decreasing or the government is raising taxes. When the cyclically adjusted budget deficit rises, the government must be engaging in expansionary fiscal policies: either government purchases and transfer payments are increasing or the government is lowering taxes. From Figure 13-10, we see that from 1990 to 2013, the cyclically adjusted budget deficit was falling; this indicates that the government was pursuing contractionary fiscal policies during that period. From 2001 to 2004, and 2009 to 2014, the cyclically adjusted budget deficit was rising; this indicates that the government was pursuing expansionary fiscal policies during that period. From 2007 to 2009, the cyclically adjusted budget deficit was rising, indicating that the government was pursuing expansionary fiscal policies.
10. You are an economic adviser to a candidate for national office. She asks you for a summary of the economic consequences of a balanced-budget rule for the federal government and for your recommendation on whether she should support such a rule. How do you respond?

### Solution

10. You might respond that balanced-budget rules are usually proposed because the government is running a budget deficit and many people think of deficits as bad. When the government runs a budget deficit, it adds to the public debt. If the government persists in running budget deficits, interest payments become an increasing part of government spending and the budget deficit itself. As a result, the debt-GDP ratio may rise. However, budget deficits themselves are not the problem; the problem arises when budget deficits become persistent. In the United States, there has been a strong relationship between the federal government's budget balance and the business cycle: when the economy expands, the budget moves toward surplus, and when the economy experiences a recession, the budget moves into deficit. The major disadvantage of a balanced-budget rule is that it would undermine the role of taxes and government transfers as automatic stabilizers and force the government to respond to a recessionary gap with contractionary fiscal policies. You might recommend, as most economists do, that rather than a balanced-budget rule, the government only balance its budget on average; it should run budget deficits during recessions and budget surpluses during expansions.

11. In 2014, the policy makers of the economy of Eastlandia projected the debt–GDP ratio and the ratio of the budget deficit to GDP for the economy for the next 10 years under different scenarios for growth in the government’s deficit. Real GDP is currently \$1,000 billion per year and is expected to grow by 3% per year, the public debt is \$300 billion at the beginning of the year, and the deficit is \$30 billion in 2014.

Year	Real GDP (billions of dollars)	Debt (billions of dollars)	Budget deficit (billions of dollars)	Debt (percent of real GDP)	Budget deficit (percent of real GDP)
2014	\$1,000	\$300	\$30	?	?
2015	1,030	?	?	?	?
2016	1,061	?	?	?	?
2017	1,093	?	?	?	?
2018	1,126	?	?	?	?
2019	1,159	?	?	?	?
2020	1,194	?	?	?	?
2021	1,230	?	?	?	?
2022	1,267	?	?	?	?
2023	1,305	?	?	?	?
2024	1,344	?	?	?	?

- Complete the accompanying table to show the debt–GDP ratio and the ratio of the budget deficit to GDP for the economy if the government’s budget deficit remains constant at \$30 billion over the next 10 years. (Remember that the government’s debt will grow by the previous year’s deficit.)
- Redo the table to show the debt–GDP ratio and the ratio of the budget deficit to GDP for the economy if the government’s budget deficit grows by 3% per year over the next 10 years.
- Redo the table again to show the debt–GDP ratio and the ratio of the budget deficit to GDP for the economy if the government’s budget deficit grows by 20% per year over the next 10 years.
- What happens to the debt–GDP ratio and the ratio of the budget deficit to GDP for the economy over time under the three different scenarios?

### Solution

11. a. Here is the completed table (numbers are rounded):

Year	Real GDP (billions of dollars)	Debt (billions of dollars)	Budget deficit (billions of dollars)	Debt (percent of real GDP)	Budget deficit (percent of real GDP)
2014	\$1,000	\$300	\$30	30.0%	3.0%
2015	1,030	330	30	32.0	2.9
2016	1,061	360	30	33.9	2.8
2017	1,093	390	30	35.7	2.7
2018	1,126	420	30	37.3	2.7
2019	1,159	450	30	38.8	2.6
2020	1,194	480	30	40.2	2.5
2021	1,230	510	30	41.5	2.4
2022	1,267	540	30	42.6	2.4
2023	1,305	570	30	43.7	2.3
2024	1,344	600	30	44.6	2.2

b. Here is the table redone (numbers are rounded):

Year	Real GDP (billions of dollars)	Debt (billions of dollars)	Budget deficit (billions of dollars)	Debt (percent of real GDP)	Budget deficit (percent of real GDP)
2014	\$1,000	\$300	\$30	30.0%	3.0%
2015	1,030	330	31	32.0	3.0
2016	1,061	361	32	34.0	3.0
2017	1,093	393	33	35.9	3.0
2018	1,126	426	34	37.8	3.0
2019	1,159	459	35	39.6	3.0
2020	1,194	494	36	41.4	3.0
2021	1,230	530	37	43.1	3.0
2022	1,267	567	38	44.7	3.0
2023	1,305	605	39	46.3	3.0
2024	1,344	644	40	47.9	3.0

c. And here is the table again (numbers are rounded):

Year	Real GDP (billions of dollars)	Debt (billions of dollars)	Budget deficit (billions of dollars)	Debt (percent of real GDP)	Budget deficit (percent of real GDP)
2014	\$1,000	\$300	\$30	30.0%	3.0%
2015	1,030	330	36	32.0	3.5
2016	1,061	366	43	34.5	4.1
2017	1,093	409	52	37.4	4.7
2018	1,126	461	62	40.9	5.5
2019	1,159	523	75	45.1	6.4
2020	1,194	598	90	50.1	7.5
2021	1,230	687	107	55.9	8.7
2022	1,267	795	129	62.7	10.2
2023	1,305	924	155	70.8	11.9
2024	1,344	1,079	186	80.3	13.8

d. When the deficit remains constant at \$30 billion, the ratio of the budget deficit to GDP declines but the debt–GDP ratio continues to increase because debt is rising faster than GDP. When the deficit grows by 3% per year, the same rate at which real GDP grows, the ratio of the budget deficit to GDP remains constant at 3% and the debt–GDP ratio continues to increase. When the deficit grows by 20% per year, the ratio of the budget deficit to GDP rises from 3.0% to 13.8% in 10 years and the debt–GDP ratio more than doubles from 30% to more than 80%.

- 12.** Your study partner argues that the distinction between the government's budget deficit and debt is similar to the distinction between consumer savings and wealth. He also argues that if you have large budget deficits, you must have a large debt. In what ways is your study partner correct and in what ways is he incorrect?

**12.** Your study partner is correct that the distinction between the government's budget deficit and debt is similar to the distinction between consumer savings and wealth. Savings and deficits refer to actions that take place over time. When the government spends more than it receives in tax revenue in a particular time period, it is running a budget deficit. When consumers spend less than their disposable income in a particular time period, they are saving. However, both debt and wealth are measured at one point in time. When the government runs a budget deficit, the deficit is almost always financed by borrowing, which adds to its debt. Similarly, consumers accumulate wealth by saving. Your study partner is wrong in that the government can run a large budget deficit and have a small debt if it hasn't run large deficits in the past.

- 13.** In which of the following cases does the size of the government's debt and the size of the budget deficit indicate potential problems for the economy?
- The government's debt is relatively low, but the government is running a large budget deficit as it builds a high-speed rail system to connect the major cities of the nation.
  - The government's debt is relatively high due to a recently ended deficit-financed war, but the government is now running only a small budget deficit.
  - The government's debt is relatively low, but the government is running a budget deficit to finance the interest payments on the debt.

**13.** **a.** If the government has relatively little debt but is running a large budget deficit as it builds a high-speed rail system, this should not indicate potential problems for the economy. Like funding a war effort, it is difficult, if not impossible, to finance major improvements in a nation's infrastructure without borrowing. As long as the budget deficit ends with the building project, this should not create long-term problems.

**b.** If the government's debt is relatively high but the government has reduced its budget deficit, this should not indicate potential problems for the economy. However, the government needs to be careful that the deficits do not become persistent.

**c.** Even if the government's debt is relatively low, if it is running a budget deficit to finance the interest payments on that debt, this portends potential problems for the future. Without any changes, the government's debt will grow over time and with it the size of the government's budget deficit because of increasing interest payments. If GDP growth does not keep up with the growth in the government's debt, the debt-GDP ratio will rise.

- 14.** How did or would the following affect the current public debt and implicit liabilities of the U.S. government?
- In 2003, Congress passed and President Bush signed the Medicare Modernization Act, which provides seniors and individuals with disabilities with a prescription drug benefit. Some of the benefits under this law took effect immediately, but others will not begin until sometime in the future.
  - The age at which retired persons can receive full Social Security benefits is raised to age 70 for future retirees.
  - Social Security benefits for future retirees are limited to those with low incomes.
  - Because the cost of health care is increasing faster than the overall inflation rate, annual increases in Social Security benefits are increased by the annual increase in health care costs rather than the overall inflation rate.

### Solution

- 14.**
- Because of its immediate impact on government spending, the Medicare Modernization Act increased the current public debt; implicit liabilities also rose because the act commits the government to a higher level of spending in the future.
  - If the age at which future retirees can receive full Social Security benefits is raised to age 70, implicit liabilities fall because government transfers will be lower in the future. There is no effect on the current public debt.
  - If Social Security benefits for future retirees are limited to those with low incomes, implicit liabilities fall because government transfers will be lower in the future. There is no effect on the current public debt because the change occurs in the future.
  - If annual increases in Social Security benefits are increased by the annual increase in health care costs rather than the overall inflation rate, implicit liabilities will rise. The current public debt will rise as soon as the rule is implemented.
- 15.** Unlike households, governments are often able to sustain large debts. For example, in 2013, the U.S. government's total debt reached \$17.3 trillion, approximately equal to 101.6% of GDP. At the time, according to the U.S. Treasury, the average interest rate paid by the government on its debt was 2.0%. However, running budget deficits becomes hard when very large debts are outstanding.
- Calculate the dollar cost of the annual interest on the government's total debt assuming the interest rate and debt figures cited above.
  - If the government operates on a balanced budget before interest payments are taken into account, at what rate must GDP grow in order for the debt-GDP ratio to remain unchanged?
  - Calculate the total increase in national debt if the government incurs a deficit of \$600 billion in 2014.
  - At what rate would GDP have to grow in order for the debt-GDP ratio to remain unchanged when the deficit in 2014 is \$600 billion?
  - Why is the debt-GDP ratio the preferred measure of a country's debt rather than the dollar value of the debt? Why is it important for a government to keep this number under control?

**Solution**

- 15.** a. The annual interest on the debt is 2.0% of \$17.8 trillion, or \$356 billion.  
 b. U.S. GDP must grow at 2.0% so that the debt–GDP ratio remains unchanged. This is because the total debt and GDP would grow at the same rate.  
 c. The total debt increases by \$612 billion, the \$600 billion budget deficit plus the \$12 billion interest payment.  
 d. \$612 billion is 3.44% of the government’s total debt, \$17.8 trillion. So, in order for the debt–GDP ratio to remain constant, GDP must also grow by 3.44%.  
 e. GDP measures the size of the economy, which determines the ability of the government to repay the debt through taxes. A falling debt–GDP ratio indicates a decreasing debt burden, and vice versa. To prevent the debt burden from becoming overwhelming, a government should keep the debt–GDP ratio in check.
- 16.** The accompanying table shows how consumers’ marginal propensities to consume in a particular economy are related to their level of income.

Income range	Marginal propensity to consume
\$0–\$20,000	0.9
\$20,001–\$40,000	0.8
\$40,001–\$60,000	0.7
\$60,001–\$80,000	0.6
Above \$80,000	0.5

- a. Suppose the government engages in increased purchases of goods and services. For each of the income groups in the table, what is the value of the multiplier—that is, what is the “bang for the buck” from each dollar the government spends on government purchases of goods and services in each income group?  
 b. If the government needed to close a recessionary or inflationary gap, at which group should it primarily aim its fiscal policy of changes in government purchases of goods and services?

**WORK IT OUT**  
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**Solution**

- 16.** a. The accompanying table shows the “bang for the buck” for an additional \$1 of government purchases of goods and services for a consumer in each income range. It is calculated as  $1/(1 - MPC)$ .

Income range	Marginal propensity to consume	“Bang for the buck”
\$0–\$20,000	0.9	10
\$20,001–\$40,000	0.8	5
\$40,001–\$60,000	0.7	3.33
\$60,001–\$80,000	0.6	2.5
Above \$80,000	0.5	2

- b. Since the “bang for the buck” is highest for the lowest income group, fiscal policies aimed at that income group would require the smallest change in government purchases of goods and services to close a recessionary or inflationary gap.



# Money, Banking, and the Federal Reserve System

1. For each of the following transactions, what is the initial effect (increase or decrease) on M1? On M2?
  - a. You sell a few shares of stock and put the proceeds into your savings account.
  - b. You sell a few shares of stock and put the proceeds into your checking account.
  - c. You transfer money from your savings account to your checking account.
  - d. You discover \$0.25 under the floor mat in your car and deposit it in your checking account.
  - e. You discover \$0.25 under the floor mat in your car and deposit it in your savings account.

## Solution

1.
  - a. Shares of stock are not a component of either M1 or M2, so holding fewer shares does not decrease either M1 or M2. However, depositing the money into your savings account increases M2, since savings accounts are part of M2 (but not part of M1). M1 does not change.
  - b. Shares of stock are not a component of either M1 or M2, and so holding fewer shares does not decrease either M1 or M2. However, depositing the money into your checking account increases M1, since checking accounts are part of M1. It also increases M2, since M1 is part of M2.
  - c. Moving money from savings to checking has no effect on M2, since both savings accounts and checking accounts are included in M2. However, since savings accounts are not part of M1, moving money from savings to checking does increase M1.
  - d. Depositing cash into a checking account does not change M1 or M2. You are simply transferring money from one component of M1 (currency in circulation) to another component of M1 (checkable deposits).
  - e. Depositing \$0.25 into your savings account has no effect on M2, since both savings accounts and currency in circulation are in M2. However, since savings accounts are not part of M1, depositing the \$0.25 into your savings account reduces M1.
2. There are three types of money: commodity money, commodity-backed money, and fiat money. Which type of money is used in each of the following situations?
  - a. Bottles of rum were used to pay for goods in colonial Australia.
  - b. Salt was used in many European countries as a medium of exchange.
  - c. For a brief time, Germany used paper money (the “Rye Mark”) that could be redeemed for a certain amount of rye, a type of grain.
  - d. The town of Ithaca, New York, prints its own currency, the Ithaca HOURS, which can be used to purchase local goods and services.



## Solution

2. a. A bottle of rum is commodity money since the rum has other uses.  
 b. Salt is commodity money since it has other uses.  
 c. The “Rye Mark” is commodity-backed money since its ultimate value is guaranteed by a promise that it can be converted into valuable goods (rye grain).  
 d. Ithaca HOURS are fiat money because their value derives entirely from their status as a means of payment in Ithaca.
3. The following table shows the components of M1 and M2 in billions of dollars for the month of December in the years 2003 to 2013 reported by the Federal Reserve Bank of St. Louis. Complete the table by calculating M1, M2, currency in circulation as a percentage of M1, and currency in circulation as a percentage of M2. What trends or patterns about M1, M2, currency in circulation as a percentage of M1, and currency in circulation as a percentage of M2 do you see? What might account for these trends?

Year	Currency in circulation	Traveler's checks	Checkable deposits	Savings deposits	Time deposits	Money market funds	M1	M2	Currency in circulation as a percentage of M1	Currency in circulation as a percentage of M2
2003	\$662.5	\$7.6	\$635.9	\$3,159.0	\$818.1	\$752.8	?	?	?	?
2004	697.8	7.5	670.6	3,506.5	828.4	677.6	?	?	?	?
2005	724.6	7.2	643.0	3,601.6	993.7	682.4	?	?	?	?
2006	750.2	6.7	610.6	3,691.8	1,206.0	776.6	?	?	?	?
2007	760.6	6.3	608.1	3,864.1	1,276.0	930.6	?	?	?	?
2008	816.2	5.5	782.0	4,085.6	1,457.6	1,021.6	?	?	?	?
2009	863.7	5.1	825.3	4,809.3	1,183.1	781.2	?	?	?	?
2010	918.7	4.7	912.7	5,329.6	927.9	675.7	?	?	?	?
2011	1,001.2	4.3	1,154.3	6,032.8	767.0	663.7	?	?	?	?
2012	1,090.0	3.8	1,353.5	6,687.5	633.0	642.0	?	?	?	?
2013	1,159.5	3.5	1,475.8	7,133.0	555.6	640.9	?	?	?	?

Source: Federal Reserve Bank of St. Louis.

## Solution

3. In the completed table that follows, M1 consists of currency in circulation, traveler's checks, and checkable deposits. M2 consists of M1 plus money market funds, time deposits, and savings deposits. From 2003 to 2013, M1 more than doubled. M2 almost doubled from 2003 to 2013. Currency as a percentage of M1 was relatively stable, at around 50%, with a rise during the economic boom years until 2007 and subsequent fall. Currency as a percentage of M2 was almost constant at between 10% and 11%. The increase in currency as a percentage of M1 during the mid-2000s could reflect increased use of credit cards, with a corresponding reduction in the importance of traveler's checks and checkable deposits. Yet, since currency as a percentage of M2 did not change, it could also reflect a shift from checkable deposits to money market funds, time deposits, and savings deposits.

Year	Currency in circulation	Traveler's checks	Checkable deposits	Savings deposits	Time deposits	Money market funds	M1	M2	Currency in circulation as a percentage of M1	Currency in circulation as a percentage of M2
2003	\$662.5	\$7.6	\$635.9	\$3,159.0	\$818.1	\$752.8	\$1,306.0	\$6,035.9	51%	11%
2004	697.8	7.5	670.6	3,506.5	828.4	677.6	1,375.9	6,388.4	51%	11%
2005	724.6	7.2	643.0	3,601.6	993.7	682.4	1,374.8	6,652.5	53%	11%
2006	750.2	6.7	610.6	3,691.8	1,206.0	776.6	1,367.5	7,041.9	55%	11%
2007	760.6	6.3	608.1	3,864.1	1,276.0	930.6	1,375.0	7,445.7	55%	10%
2008	816.2	5.5	782.0	4,085.6	1,457.6	1,021.6	1,603.7	8,168.5	51%	10%
2009	863.7	5.1	825.3	4,809.3	1,183.1	781.2	1,694.1	8,467.7	51%	10%
2010	918.7	4.7	912.7	5,329.6	927.9	675.7	1,836.1	8,793.3	50%	10%
2011	1,001.2	4.3	1,154.3	6,032.8	767.0	663.7	2,159.8	9,623.3	46%	10%
2012	1,090.0	3.8	1,353.5	6,687.5	633.0	642.0	2,447.3	10,409.8	45%	10%
2013	1,159.5	3.5	1,475.8	7,133.0	555.6	640.9	2,638.8	10,968.3	44%	11%

Source: Federal Reserve Bank of St. Louis.

4. Indicate whether each of the following is part of M1, M2, or neither:
- \$95 on your campus meal card
  - \$0.55 in the change cup of your car
  - \$1,663 in your savings account
  - \$459 in your checking account
  - 100 shares of stock worth \$4,000
  - A \$1,000 line of credit on your Sears credit card

### Solution

4. a. \$95 on your campus meal card is similar to a gift certificate. Because it can only be used for one purpose, it is not part of either M1 or M2.
- b. \$0.55 in the change cup of your car is part of currency in circulation; it is part of both M1 and M2.
- c. \$1,663 in your savings account isn't directly usable as a medium of exchange, so it is not part of M1; but because it can readily be converted into cash or checkable deposits, it is part of M2.
- d. A \$459 balance in your checking account is part of both M1 and M2; it represents a checkable deposit.
- e. 100 shares of stock are not part of either M1 or M2. Although an asset, stock is not a highly liquid asset.
- f. A \$1,000 line of credit on your Sears credit card is not part of either M1 or M2 because it does not represent an asset.
5. Tracy Williams deposits \$500 that was in her sock drawer into a checking account at the local bank.
- How does the deposit initially change the T-account of the local bank? How does it change the money supply?
  - If the bank maintains a reserve ratio of 10%, how will it respond to the new deposit?

- c. If every time the bank makes a loan, the loan results in a new checkable bank deposit in a different bank equal to the amount of the loan, by how much could the total money supply in the economy expand in response to Tracy's initial cash deposit of \$500?
- d. If every time the bank makes a loan, the loan results in a new checkable bank deposit in a different bank equal to the amount of the loan and the bank maintains a reserve ratio of 5%, by how much could the money supply expand in response to Tracy's initial cash deposit of \$500?

## Solution

5. a. Initially, the bank's reserves rise by \$500, as do its checkable deposits. There is no initial change in the money supply; currency in circulation has fallen by \$500 but checkable deposits have increased by \$500.

Assets		Liabilities	
Reserves	+\$500	Checkable deposits	+\$500

- b. The bank will hold \$50 as reserves against the new deposit and make additional loans equal to \$450.
- c. The money supply can expand by \$4,500. When Tracy deposits \$500, the bank now holds \$450 in excess reserves. This will ultimately lead to an increase in the money supply of  $\$450/0.1 = \$4,500$ .
- d. The money supply can expand by \$9,500. When Tracy deposits \$500, the bank now holds \$475 in excess reserves. This will ultimately increase the money supply by  $\$475/0.05 = \$9,500$ .
6. Ryan Cozzens withdraws \$400 from his checking account at the local bank and keeps it in his wallet.
- a. How will the withdrawal change the T-account of the local bank and the money supply?
- b. If the bank maintains a reserve ratio of 10%, how will it respond to the withdrawal? Assume that the bank responds to insufficient reserves by reducing the amount of deposits it holds until its level of reserves satisfies its required reserve ratio. The bank reduces its deposits by calling in some of its loans, forcing borrowers to pay back these loans by taking cash from their checking deposits (at the same bank) to make repayment.
- c. If every time the bank decreases its loans, checkable bank deposits fall by the amount of the loan, by how much will the money supply in the economy contract in response to Ryan's withdrawal of \$400?
- d. If every time the bank decreases its loans, checkable bank deposits fall by the amount of the loan and the bank maintains a reserve ratio of 20%, by how much will the money supply contract in response to a withdrawal of \$400?

## Solution

6. a. Initially, the bank's reserves fall by \$400, as do its checkable deposits. There is no initial change in the money supply; currency in circulation has risen by \$400 but checkable deposits have decreased by \$400.

Assets		Liabilities	
Reserves	-\$400	Checkable deposits	-\$400

- b. Assuming that the bank has other checkable deposits, the bank will be holding insufficient reserves. The bank was holding \$40 of the \$400 withdrawal as required reserves for the \$400 deposit; however, the remaining \$360 was being held as required reserves for other deposits. The bank will have to reduce its deposits by  $\$360/0.1 = \$3,600$  to reduce its required reserves by \$360 (10% of \$3,600) in order to maintain the required reserve ratio of 10%.
- c. The money supply will contract by  $(\$400/0.1) - \$400 = \$3,600$ . Checkable deposits fall by \$4,000, but only \$3,600 represents a decrease in the money supply because \$400 of the \$4,000 fall in checkable deposits has been converted into cash in Ryan's wallet.
- d. The money supply will decrease by  $(\$400/0.2) - \$400 = \$1,600$ . Checkable deposits fall by \$2,000, but only \$1,600 represents a decrease in the money supply.
7. The government of Eastlandia uses measures of monetary aggregates similar to those used by the United States, and the central bank of Eastlandia imposes a required reserve ratio of 10%. Given the following information, answer the questions below.
- Bank deposits at the central bank = \$200 million  
 Currency held by public = \$150 million  
 Currency in bank vaults = \$100 million  
 Checkable bank deposits = \$500 million  
 Traveler's checks = \$10 million
- a. What is M1?  
 b. What is the monetary base?  
 c. Are the commercial banks holding excess reserves?  
 d. Can the commercial banks increase checkable bank deposits? If yes, by how much can checkable bank deposits increase?

## Solution

7. a. M1 equals the sum of currency held by the public (\$150 million), checkable deposits (\$500 million), and traveler's checks (\$10 million), or \$660 million.
- b. The monetary base is the sum of currency held by the public (\$150 million) and the reserves of the commercial banks [currency in bank vaults (\$100 million) and bank deposits at the central bank (\$200 million)]. The monetary base is \$450 million.
- c. Required reserves are \$50 million (10% of \$500 million). Because total reserves are \$300 million [currency in bank vaults (\$100 million) plus bank deposits at the central bank (\$200 million)], the commercial banks are holding \$250 million (\$300 million - \$50 million) in excess reserves.
- d. Since the commercial banks are holding excess reserves, they can increase deposits. With a required reserve ratio of 10%, reserves of \$300 million can support a total of  $\$300 \text{ million}/0.1 = \$3,000 \text{ million}$  in deposits. Commercial banks can increase deposits by an additional \$2,500 million.

8. In Westlandia, the public holds 50% of M1 in the form of currency, and the required reserve ratio is 20%. Estimate how much the money supply will increase in response to a new cash deposit of \$500 by completing the accompanying table. (*Hint:* The first row shows that the bank must hold \$100 in minimum reserves—20% of the \$500 deposit—against this deposit, leaving \$400 in excess reserves that can be loaned out. However, since the public wants to hold 50% of the loan in currency, only  $\$400 \times 0.5 = \$200$  of the loan will be deposited in round 2 from the loan granted in round 1.) How does your answer compare to an economy in which the total amount of the loan is deposited in the banking system and the public doesn't hold any of the loan in currency? What does this imply about the relationship between the public's desire for holding currency and the money multiplier?

Round	Deposits	Required reserves	Excess reserves	Loans	Held as currency
1	\$500.00	\$100.00	\$400.00	\$400.00	\$200.00
2	200.00	?	?	?	?
3	?	?	?	?	?
4	?	?	?	?	?
5	?	?	?	?	?
6	?	?	?	?	?
7	?	?	?	?	?
8	?	?	?	?	?
9	?	?	?	?	?
10	?	?	?	?	?
Total after 10 rounds	?	?	?	?	?

8. As shown in the accompanying table, after 10 rounds, loans can expand by \$666.60; this is also the increase in the money supply at this point. (Although deposits increase by \$833.25, currency held by the public falls by \$166.70—it initially fell by \$500 and eventually rose again by \$333.30.) If the total amount of each loan is deposited in the banking system (that is, the public does not hold any of the loans in currency), the money supply would increase by  $(\$500/0.2) - \$500 = \$2,000$ ; deposits would increase by \$2,500. The money multiplier decreases in size as the public holds a greater percentage of loans in currency.

Round	Deposits	Required reserves	Excess reserves	Loans	Held as currency
1	\$500.00	\$100.00	\$400.00	\$400.00	\$200.00
2	200.00	40.00	160.00	160.00	80.00
3	80.00	16.00	64.00	64.00	32.00
4	32.00	6.40	25.60	25.60	12.80
5	12.80	2.56	10.24	10.24	5.12
6	5.12	1.02	4.10	4.10	2.05
7	2.05	0.41	1.64	1.64	0.82
8	0.82	0.16	0.66	0.66	0.33
9	0.33	0.07	0.26	0.26	0.13
10	0.13	0.03	0.10	0.10	0.05
Total after 10 rounds	\$833.25	\$166.65	\$666.60	\$666.60	\$333.30

9. What will happen to the money supply under the following circumstances in a checkable-deposits-only system?
- The required reserve ratio is 25%, and a depositor withdraws \$700 from his checkable bank deposit.
  - The required reserve ratio is 5%, and a depositor withdraws \$700 from his checkable bank deposit.
  - The required reserve ratio is 20%, and a customer deposits \$750 to her checkable bank deposit.
  - The required reserve ratio is 10%, and a customer deposits \$600 to her checkable bank deposit.

### Solution

9. a. Checkable deposits contract by \$2,800, but \$700 is converted into currency held by the public. The money supply contracts by \$2,100.
- b. Checkable deposits contract by \$14,000, but \$700 is converted into currency held by the public. The money supply contracts by \$13,300.
- c. Checkable deposits expand by \$3,750, but currency in circulation falls by \$750. The money supply expands by \$3,000.
- d. Checkable deposits expand by \$6,000, but currency in circulation falls by \$600. The money supply expands by \$5,400.
10. Although the U.S. Federal Reserve doesn't use changes in reserve requirements to manage the money supply, the central bank of Albernia does. The commercial banks of Albernia have \$100 million in reserves and \$1,000 million in checkable deposits; the initial required reserve ratio is 10%. The commercial banks follow a policy of holding no excess reserves. The public holds no currency, only checkable deposits in the banking system.
- How will the money supply change if the required reserve ratio falls to 5%?
  - How will the money supply change if the required reserve ratio rises to 25%?

### Solution

10. a. If the required reserve ratio falls to 5%, the commercial banks of Albernia will be holding \$50 million in excess reserves. Since the banks follow a policy of holding no excess reserves, the banks will expand deposits by making loans. The banks' reserves of \$100 million will support \$2,000 million in deposits at a reserve ratio of 5%. The bank will expand loans and deposits by \$1,000 million, so the money supply expands by \$1,000 million.
- b. If the required reserve ratio rises to 25%, the commercial banks of Albernia will not be holding enough reserves to support \$1,000 million in deposits. The banks' reserves will only support \$400 million in deposits. The commercial banks will have to decrease loans and deposits by \$600 million, so the money supply will contract by \$600 million.
11. Using Figure 14-6, find the Federal Reserve district in which you live. Go to [www.federalreserve.gov/bios/pres.htm](http://www.federalreserve.gov/bios/pres.htm) and click on your district to identify the president of the Federal Reserve Bank in your district. Go to [www.federalreserve.gov/fomc/](http://www.federalreserve.gov/fomc/) and determine if the president of the regional Federal Reserve bank in your district is currently a voting member of the Federal Open Market Committee (FOMC).

## Solution

- 11.** Answers will vary depending on where you live and when you look up your answer. For example, if you lived in Reedley, California, in December 2014, you were in the San Francisco district of the Federal Reserve system. John C. Williams was the president of the Federal Reserve Bank of San Francisco and an alternate (nonvoting) member of the FOMC at that time.
- 12.** Show the changes to the T-accounts for the Federal Reserve and for commercial banks when the Federal Reserve sells \$30 million in U.S. Treasury bills. If the public holds a fixed amount of currency (so that all new loans create an equal amount of checkable bank deposits in the banking system) and the minimum reserve ratio is 5%, by how much will checkable bank deposits in the commercial banks change? By how much will the money supply change? Show the final changes to the T-account for the commercial banks when the money supply changes by this amount.

## Solution

- 12.** When the Federal Reserve sells \$30 million in Treasury bills to commercial banks, its assets decrease by \$30 million (it now owns \$30 million less in Treasury bills), but its liabilities also decrease by \$30 million as the banks pay the Federal Reserve for the Treasury bills from their accounts at the Fed (part of the monetary base). From the perspective of commercial banks, their assets rise by \$30 million because they buy the Treasury bills from the Fed, but their assets also fall by \$30 million when they pay for the Treasury bills from their deposits at the Fed (their reserves).

Initial changes to the T-account of the Federal Reserve immediately after the Fed sale of \$30 million in Treasury bills:

Assets		Liabilities	
Treasury bills	-\$30 million	Monetary base	-\$30 million

Initial changes to the T-account of commercial banks immediately after the Fed sale of \$30 million in Treasury bills:

Assets		Liabilities	
Treasury bills	+\$30 million	No change	
Reserves	-\$30 million		

After the Federal Reserve sells \$30 million in Treasury bills, the banks are no longer holding enough reserves to support their deposits. The banks will need to reduce loans and deposits by \$600 million—the amount of deposits that were supported by the \$30 million in reserves used to buy the Treasury bills. So the money supply will also decrease by \$600 million.

All changes to the T-account of commercial banks after the Fed sale of \$30 million in Treasury bills:

Assets		Liabilities	
Treasury bills	+\$30 million	Checkable deposits	-\$600 million
Reserves	-\$30 million		
Loans	-\$600 million		

- 13.** The Congressional Research Service estimates that at least \$45 million of counterfeit U.S. \$100 notes produced by the North Korean government are in circulation.
- Why do U.S. taxpayers lose because of North Korea's counterfeiting?
  - As of December 2014, the interest rate earned on one-year U.S. Treasury bills was 0.13%. At a 0.13% rate of interest, what is the amount of money U.S. taxpayers are losing per year because of these \$45 million in counterfeit notes?

### Solution

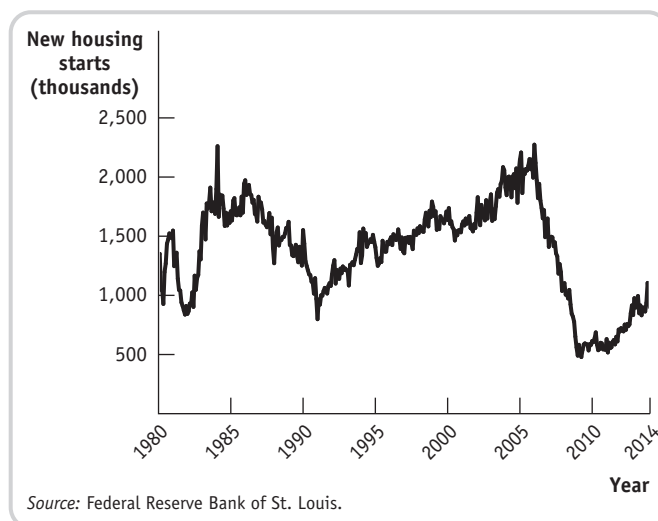
- 13.**
- When North Korea circulates fake currency, the Federal Reserve does not hold any assets, and the U.S. government does not get the interest from the Treasury bills it would have gotten if it had printed the notes. The cost of counterfeiting is the interest forgone on U.S. Treasury bills that the U.S. government would receive from legally printed \$100 notes. U.S. taxpayers lose because the government does not get this interest.
  - The amount of interest forgone per year is  $0.13\% \times \$45 \text{ million} = \$58,500$ .
- 14.** As shown in Figure 14-9, the portion of the Federal Reserve's assets made up of U.S. Treasury bills has declined since 2007. Go to [www.federalreserve.gov](http://www.federalreserve.gov). Under "Select Statistical Releases," click on "View All." Under the heading "Money Stock and Reserve Balances," click on "Factors Affecting Reserve Balances." Click on the date of the current release.
- Under "Statement of Condition of Federal Reserve Bank," look in the "Total" column. What is the amount displayed next to "Total assets"? What is the amount displayed next to "U.S. Treasury securities"? What percentage of the Federal Reserve's total assets are currently made up of U.S. Treasury bills?
  - Do the Federal Reserve's assets consist primarily of U.S. Treasury securities, as they did in January 2007, the beginning of the graph in Figure 14-9, or does the Fed still own a large number of other assets, as it did in mid-2013, the end of the graph in Figure 14-9?

### Solution

- 14.**
- Answers will vary. As of data released on November 28, 2014, the Fed's assets were \$4,445,550 million, and U.S. Treasury holdings were \$2,461,645 million;  $(\$2,461,645 / \$4,445,550) \times 100 = 55.4\%$  of the Fed's total assets were made up of U.S. Treasury securities.
  - As of November 28, 2014, the Federal Reserve still owned a large number of other assets, and the Fed's balance sheet had not yet returned to normal.



- 15.** The accompanying figure shows new U.S. housing starts, in thousands of units per month, between January 1980 and January 2014. The graph shows a large drop in new housing starts in 1984–1991 and 2006–2009. New housing starts are related to the availability of mortgages.



- What caused the drop in new housing starts in 1984–1991?
- What caused the drop in new housing starts in 2006–2009?
- How could better regulation of financial institutions have prevented these two instances?

## Solution

- 15.**
- The drop in new housing starts in 1984–1991 was caused by the unavailability of easy mortgage financing resulting from the Savings and Loans (S&L) crisis. S&Ls had invested in overly risky real estate assets, and many of them failed. As the government closed over 1,000 S&Ls, mortgages became less easily available, and new housing starts dropped dramatically.
  - The drop in new housing starts in 2006–2009 was caused by the unavailability of easy mortgage financing that precipitated the 2008 financial crisis. When many homeowners who had financed their homes at subprime lending rates defaulted on their mortgages, those financial institutions that had invested in securitized subprime loans got into financial trouble and restricted—or stopped—lending.
  - Better regulation of the S&Ls could have prevented them from investing in risky real estate assets, preventing their collapse. Similarly, better regulation of financial institutions that purchased securitized subprime loans could have prevented those institutions from failing.

16. Show the changes to the T-accounts for the Federal Reserve and for commercial banks when the Federal Reserve buys \$50 million in U.S. Treasury bills. If the public holds a fixed amount of currency (so that all loans create an equal amount of deposits in the banking system), the minimum reserve ratio is 10%, and banks hold no excess reserves, by how much will deposits in the commercial banks change? By how much will the money supply change? Show the final changes to the T-account for commercial banks when the money supply changes by this amount.

**WORK IT OUT**

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LaunchPad

- 16.** When the Federal Reserve buys \$50 million in Treasury bills from commercial banks, its assets increase by \$50 million (it now owns \$50 million in Treasury bills) but its liabilities also increase by \$50 million as it credits the banks' accounts at the Federal Reserve, part of the monetary base. From the perspective of commercial banks, their assets fall by \$50 million because they sell Treasury bills to the Fed, but their assets also rise by \$50 million when their deposits at the Fed (reserves) are credited with \$50 million.

Initial changes to the T-account of the Federal Reserve immediately after the Fed purchase of \$50 million in Treasury bills:

Assets		Liabilities	
Treasury bills	+\$50 million	Monetary base	+\$50 million

Initial changes to the T-account of commercial banks immediately after the Fed purchase of \$50 million in Treasury bills:

Assets		Liabilities	
Treasury bills	-\$50 million	No change	
Reserves	+\$50 million		

After the Federal Reserve buys \$50 million from commercial banks, the banks are holding \$50 million in excess reserves. Since the banks do not want to hold any excess reserves, they will increase loans and deposits by \$500 million, the maximum amount that \$50 million in reserves can support. Therefore, the money supply will also increase by \$500 million.

Total changes to the T-account of commercial banks after the Fed purchase of \$50 million in Treasury bills:

Assets		Liabilities	
Treasury bills	-\$50 million	Checkable deposits	+\$500 million
Reserves	+\$50 million		
Loans	+\$500 million		



# Monetary Policy

1. Go to the FOMC page of the Federal Reserve Board's website ([www.federalreserve.gov/FOMC/](http://www.federalreserve.gov/FOMC/)) to find the statement issued after the most recent FOMC meeting. (Click on "Meeting calendars and information" and then click on the most recent statement listed in the calendar.)
  - a. What is the target federal funds rate?
  - b. Is the target federal funds rate different from the target federal funds rate in the previous FOMC statement? If yes, by how much does it differ?
  - c. Does the statement comment on current macroeconomic conditions in the United States? How does it describe the U.S. economy?

## Solution

1. Answers will vary depending on when you look up the information. As of November 2014, the latest statement was issued October 29, after the October 28–29 FOMC meeting.
  - a. On October 26, 2014, the Fed announced that it had kept the target range for the federal funds rate unchanged at 0% to 0.25%.
  - b. No, the target rate remained the same. In fact, on October 26, 2014, the FOMC anticipated that the federal funds rate would remain between 0% to 0.25% for "a considerable time following the end of its asset purchase program this month."
  - c. Yes, the statement comments on current macroeconomic conditions. It states that "economic activity is expanding at a moderate pace. Labor market conditions improved somewhat further, with solid job gains and a lower unemployment rate. On balance, a range of labor market indicators suggests that underutilization of labor resources is gradually diminishing. Household spending is rising moderately and business fixed investment is advancing, while the recovery in the housing sector remains slow. Inflation has continued to run below the Committee's longer-run objective. Market-based measures of inflation compensation have declined somewhat; survey-based measures of longer-term inflation expectations have remained stable."
2. How will the following events affect the demand for money? In each case, specify whether there is a shift of the demand curve or a movement along the demand curve and its direction.
  - a. There is a fall in the interest rate from 12% to 10%.
  - b. Thanksgiving arrives and, with it, the beginning of the holiday shopping season.
  - c. McDonald's and other fast-food restaurants begin to accept credit cards.
  - d. The Fed engages in an open-market purchase of U.S. Treasury bills.

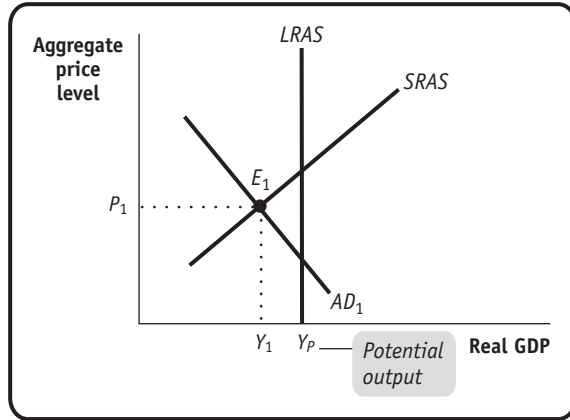
## Solution

2.
  - a. Any decrease in the interest rate will lead to an increase in the quantity of money demanded (a movement down the money demand curve) but no shift in the money demand curve.
  - b. When the holiday shopping season starts, consumers anticipate an increase in expenditures and so, at each income level, increase the demand for money. The money demand curve shifts to the right.

- c. As McDonald's and other fast-food restaurants begin to accept credit cards, it reduces the demand for money, assuming that households put more money in savings and funds in checking accounts, instead of holding currency. The money demand curve shifts to the left.
- d. When the Fed engages in open-market operations, it will change the money supply (the money supply curve will shift). This will affect the interest rate and consequently the quantity of money demanded. An open-market purchase of U.S. Treasury bills by the Fed will increase the money supply, lowering the interest rate and increasing the quantity of money demanded. This is a downward movement along the money demand curve.
3. a. Go to [www.treasurydirect.gov](http://www.treasurydirect.gov). Under "Individuals," go to "Treasury Securities & Programs." Click on "Treasury bills." Under "at a glance," click on "rates in recent auctions." What is the investment rate for the most recently issued 26-week T-bills?
- b. Go to the website of your favorite bank. What is the interest rate for six-month CDs?
- c. Why are the rates for six-month CDs higher than for 26-week Treasury bills?
- Solution**
3. a. Answers will vary. On December 2, 2014, the investment rate for the most recently issued 26-week T-bills was 0.076%.
- b. Answers will vary. At [discoverbank.com](http://discoverbank.com), the interest rate for six-month CDs on December 2, 2014, was 0.65%.
- c. Treasury bills generally pay a lower interest rate than other short-term assets because they are considered especially safe. This makes investors willing to buy them even if they offer a somewhat lower return than other assets. Normally, the difference in rates is small. But when investors become nervous, the difference between U.S. government debt and other types of debt rises.
4. Go to [www.treasurydirect.gov](http://www.treasurydirect.gov). Under "Individuals," go to "Treasury Securities & Programs." Click on "Treasury notes." Under "at a glance," click on "rates in recent auctions." Use the list of Recent Note, Bond, and TIPS Auction Results to answer the following questions.
- a. What are the interest rates on 2-year and 10-year notes?
- b. How do the interest rates on the 2-year and 10-year notes relate to each other? Why is the interest rate on the 10-year note higher (or lower) than the interest rate on the 2-year note?

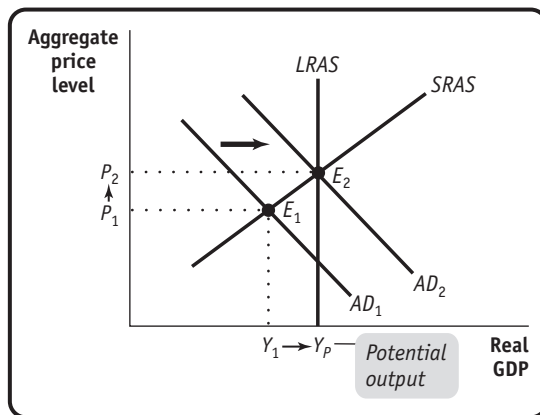
- Solution**
4. a. Answers will vary. On December 2, 2014, the interest rate on the most recently issued 2-year note was 0.5% and the interest rate on the most recently issued 10-year note was 2.25%.
- b. The interest rate on the 10-year note is higher than the interest rate on the 2-year note. Long-term interest rates reflect the average expectation in the market about what's going to happen in the future to rates that have a shorter term, like 2 years. When a 10-year note rate is higher than a 2-year note rate, the market is signaling that it expects rates with terms less than 10 years to increase in the future. When a 10-year note rate is lower than a 2-year note rate, the market is signaling that it expects rates with terms less than 10 years to fall in the future.

5. An economy is facing the recessionary gap shown in the accompanying diagram. To eliminate the gap, should the central bank use expansionary or contractionary monetary policy? How will the interest rate, investment spending, consumer spending, real GDP, and the aggregate price level change as monetary policy closes the recessionary gap?

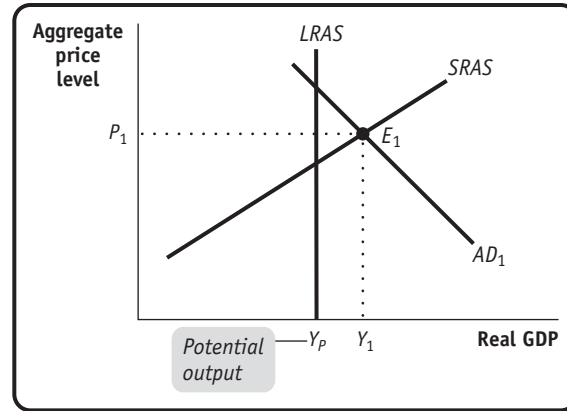


### Solution

5. The central bank can use expansionary monetary policy to eliminate the recessionary gap. The central bank could engage in an open-market purchase of U.S. Treasury bills. This would increase the money supply, lower the interest rate, and encourage an increase in investment spending. The increase in investment spending will kick off the multiplier process, leading consumers to increase their spending. The final situation is illustrated in the accompanying diagram by the movement of the AD curve from its initial position,  $AD_1$ , to its new location,  $AD_2$ . Real GDP and the aggregate price level will rise.

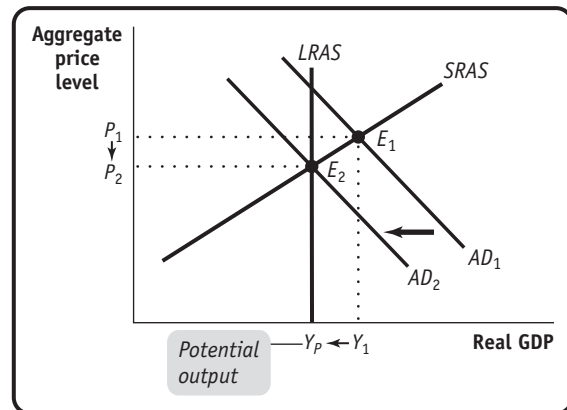


6. An economy is facing the inflationary gap shown in the accompanying diagram. To eliminate the gap, should the central bank use expansionary or contractionary monetary policy? How will the interest rate, investment spending, consumer spending, real GDP, and the aggregate price level change as monetary policy closes the inflationary gap?

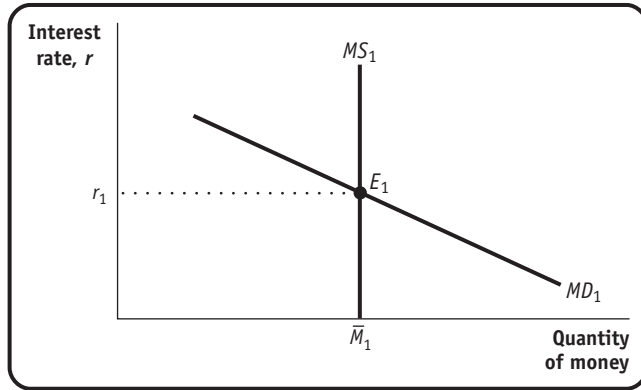


### Solution

6. The central bank can use contractionary monetary policy to eliminate the inflationary gap. The central bank could engage in an open-market sale of U.S. Treasury bills. This would reduce the supply of money, raise the interest rate, and reduce investment spending. The reduction in investment spending will lead consumers to reduce their spending. The final situation is illustrated in the accompanying diagram by the movement of the  $AD$  curve from its initial position,  $AD_1$ , to its new location,  $AD_2$ . Real GDP and the aggregate price level will fall.



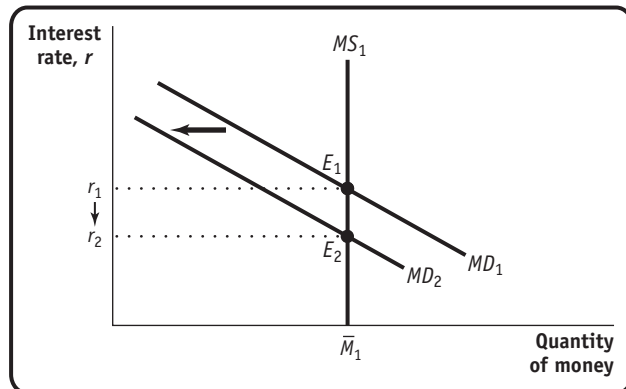
7. In the economy of Eastlandia, the money market is initially in equilibrium when the economy begins to slide into a recession.
- a. Using the accompanying diagram, explain what will happen to the interest rate if the central bank of Eastlandia keeps the money supply constant at  $\bar{M}_1$ .



- b. If the central bank is instead committed to maintaining an interest rate target of  $r_1$ , then as the economy slides into recession, how should the central bank react? Using your diagram from part a, demonstrate the central bank's reaction.

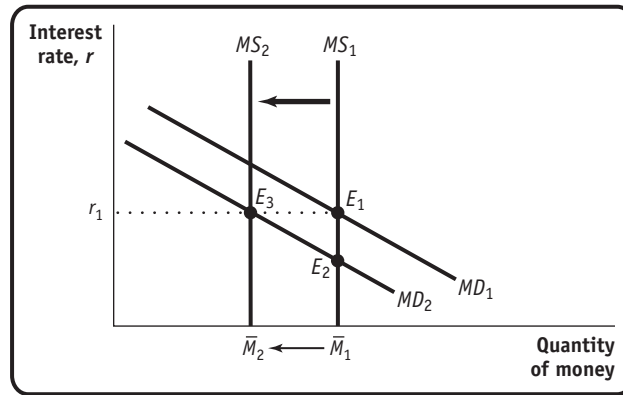
### Solution

7. a. Beginning at equilibrium point  $E_1$  in the accompanying money market diagram, when the economy of Eastlandia goes into recession, aggregate spending will fall and the money demand curve will shift to the left, from  $MD_1$  to  $MD_2$ , moving the money market from its initial equilibrium,  $E_1$ , to a new equilibrium at  $E_2$ . If the central bank keeps the quantity of money constant, the interest rate will decrease to  $r_2$ , shown at the new equilibrium point,  $E_2$ .





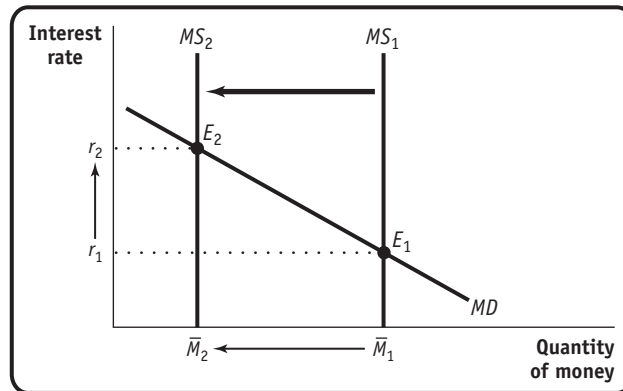
- b. If the central bank is committed to maintaining an interest rate target of  $r_1$ , then the central bank will reduce the money supply as the economy goes into recession, from  $MS_1$  to  $MS_2$  in the accompanying diagram, eliminating the potential for interest rates to fall. The new equilibrium in the money market is at  $E_3$ , with the interest rate at its target rate,  $r_1$ .



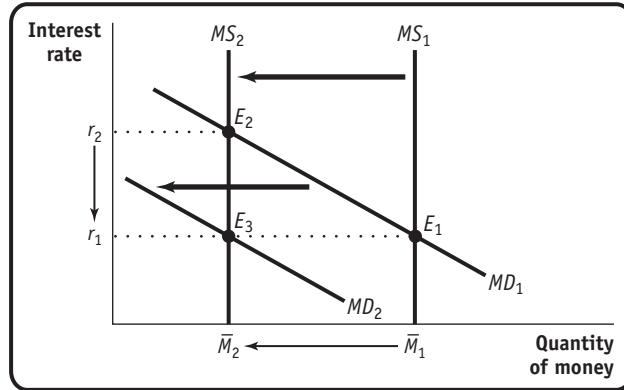
8. Suppose that the money market in Westlandia is initially in equilibrium and the central bank decides to decrease the money supply.
- Using a diagram like the one in Problem 7, explain what will happen to the interest rate in the short run.
  - What will happen to the interest rate in the long run?

### Solution

8. a. In the short run, the money supply curve will shift to the left, to  $MS_2$ , and the interest rate will rise from  $r_1$  to  $r_2$ .



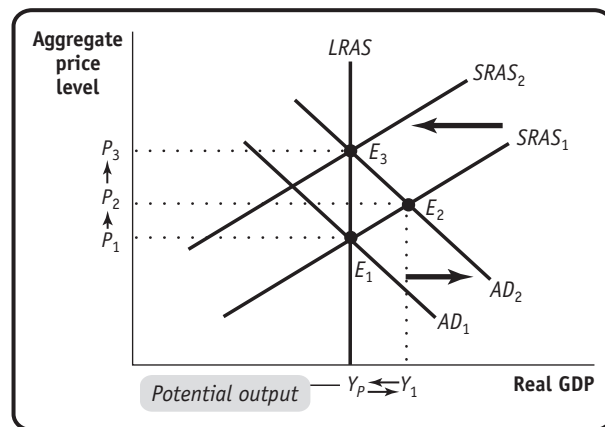
- b. Over time, the aggregate price level will fall. This will reduce money demand, shifting the money demand curve left from  $MD_1$  to  $MD_2$ , which causes the equilibrium interest rate to fall again.



9. An economy is in long-run macroeconomic equilibrium with an unemployment rate of 5% when the government passes a law requiring the central bank to use monetary policy to lower the unemployment rate to 3% and keep it there. How could the central bank achieve this goal in the short run? What would happen in the long run? Illustrate with a diagram.

### Solution

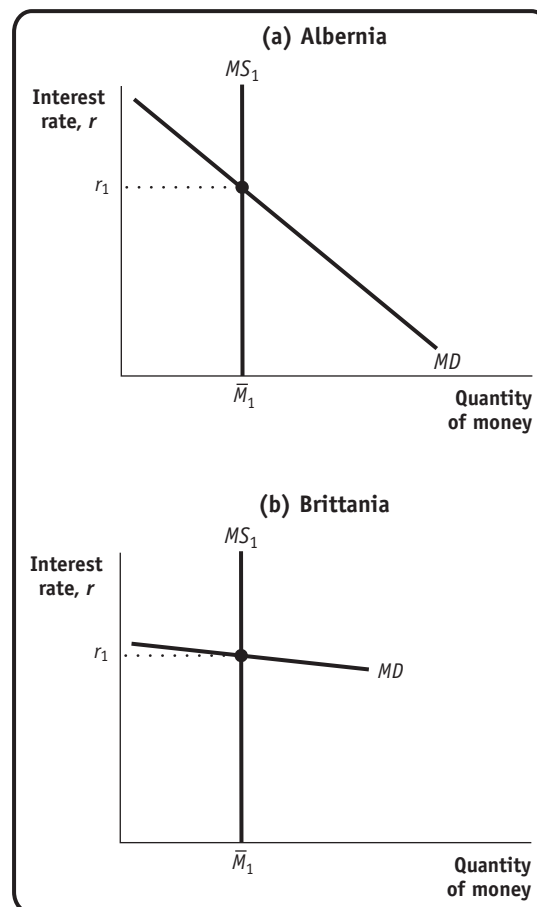
9. If the economy is in long-run macroeconomic equilibrium with an unemployment rate of 5%, then the long-run aggregate supply curve must be vertical at a real GDP that is associated with a 5% unemployment rate. This long-run macroeconomic equilibrium is  $E_1$  in the accompanying diagram. In the short run, the central bank can engage in expansionary monetary policy to shift the aggregate demand curve to the right (from  $AD_1$  to  $AD_2$ ) and reduce the unemployment rate to 3%. Over time, because real GDP exceeds potential output, the short-run aggregate supply curve will shift to the left (from  $SRAS_1$  to  $SRAS_2$ ). However, the central bank cannot keep the unemployment rate at 3% in the long run, since, in the long run, money is neutral. In the long run, output will return to its potential level and the unemployment rate will return to 5%.



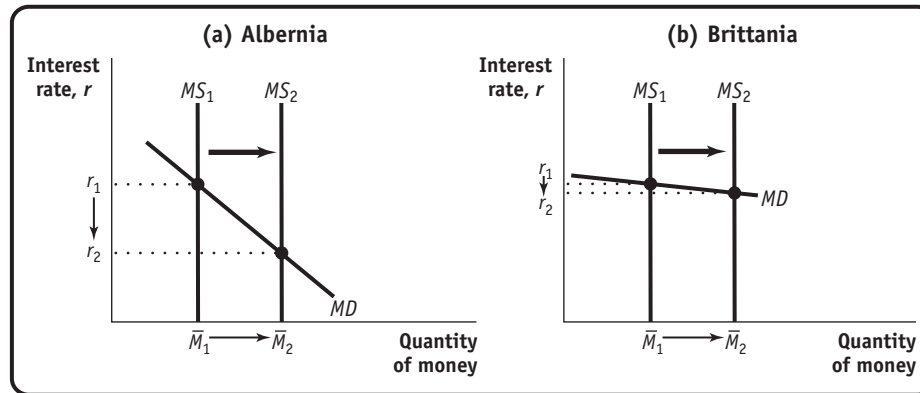
10. According to the European Central Bank website, the treaty establishing the European Community “makes clear that ensuring price stability is the most important contribution that monetary policy can make to achieve a favourable economic environment and a high level of employment.” If price stability is the only goal of monetary policy, explain how monetary policy would be conducted during recessions. Analyze both the case of a recession that is the result of a demand shock and the case of a recession that is the result of a supply shock.

**10.** If price stability is the only goal of monetary policy, then during recessions resulting from a leftward shift of the aggregate demand curve, as the aggregate price level falls, the central bank would engage in expansionary monetary policy. This would lower interest rates, encourage investment spending, and eliminate the recessionary pressure while keeping a low but non-zero inflation rate. However, if the recession is the result of a leftward shift of the short-run aggregate supply curve, the recession would be accompanied by increases in the aggregate price level and the central bank would engage in contractionary monetary policy. The contractionary monetary policy would raise interest rates and discourage investment spending, shifting the aggregate demand curve to the left. Although the policy would keep inflation low, it would be at the expense of a deeper recession in the short run.

11. The effectiveness of monetary policy depends on how easy it is for changes in the money supply to change interest rates. By changing interest rates, monetary policy affects investment spending and the aggregate demand curve. The economies of Albernia and Britannia have very different money demand curves, as shown in the accompanying diagram. In which economy will changes in the money supply be a more effective policy tool? Why?



- 11.** According to the accompanying diagram, monetary policy will be more effective in Albernia and less effective in Brittania. In Albernia a relatively small change in the money supply will lead to a large change in the interest rate, but in Brittania a relatively large change in the money supply will lead to only a small change in the interest rate.



- 12.** During the Great Depression, businesspeople in the United States were very pessimistic about the future of economic growth and reluctant to increase investment spending even when interest rates fell. How did this limit the potential for monetary policy to help alleviate the Depression?

- 12.** Monetary policy is effective when changes in the money supply change the interest rate and, in turn, the change in the interest rate changes investment spending. If businesspeople are very pessimistic about the future of economic growth and reluctant to increase investment spending when interest rates decrease, monetary policy will not be very effective in shifting the aggregate demand curve to the right. Since this was the situation during the Great Depression, monetary policy had little to offer policy makers trying to resuscitate the economy.

- 13.** Because of the economic slowdown associated with the 2007–2009 recession, the Federal Open Market Committee of the Federal Reserve, between September 18, 2007, and December 16, 2008, lowered the federal funds rate in a series of steps from a high of 5.25% to a rate between zero and 0.25%. The idea was to provide a boost to the economy by increasing aggregate demand.
- Use the liquidity preference model to explain how the Federal Open Market Committee lowers the interest rate in the short run. Draw a typical graph that illustrates the mechanism. Label the vertical axis “Interest rate” and the horizontal axis “Quantity of money.” Your graph should show two interest rates,  $r_1$  and  $r_2$ .
  - Explain why the reduction in the interest rate causes aggregate demand to increase in the short run.
  - Suppose that in 2015 the economy is at potential output but that this is somehow overlooked by the Fed, which continues its monetary expansion. Demonstrate the effect of the policy measure on the AD curve. Use the LRAS curve to show that the effect of this policy measure on the AD curve, other things equal, causes the aggregate price level to rise in the long run. Label the vertical axis “Aggregate price level” and the horizontal axis “Real GDP.”

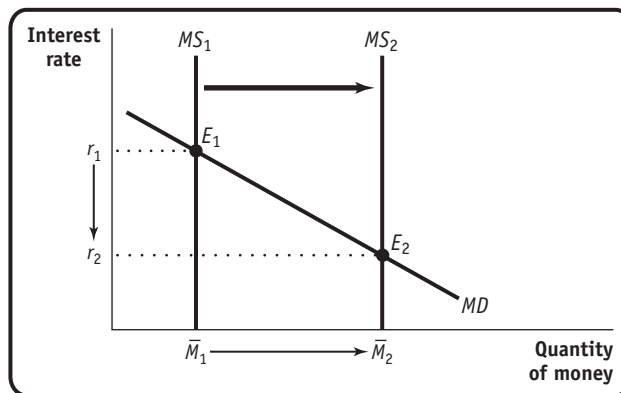
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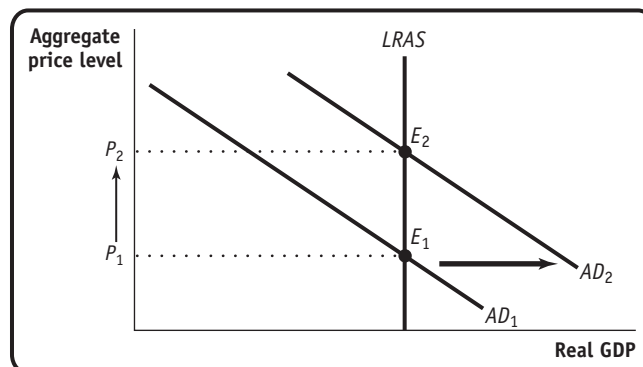


**Solution**

13. a. The Federal Reserve Open Market Committee increases the money supply, which shifts the money supply curve to the right, from  $MS_1$  to  $MS_2$ . An increase in the money supply drives the interest rate down, from  $r_1$  to  $r_2$ .

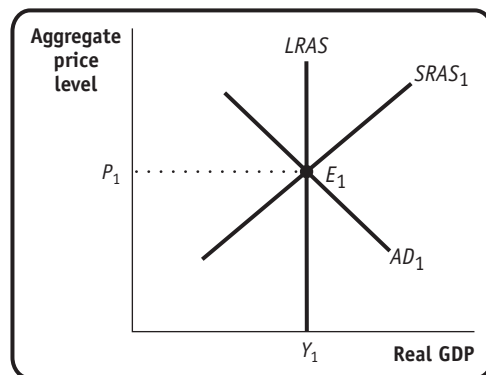


- b. Because aggregate prices are sticky in the short run, a fall in the interest rate leads to a rise in investment and consumer spending. This increase in investment and consumer spending leads to a rightward shift of the aggregate demand curve.
- c. Although in the short run a rise in the interest rate leads to an increase in the quantity of goods and services demanded, in the long run nominal wages will rise. This will cause the economy to end up at  $E_2$ , at a higher price level.



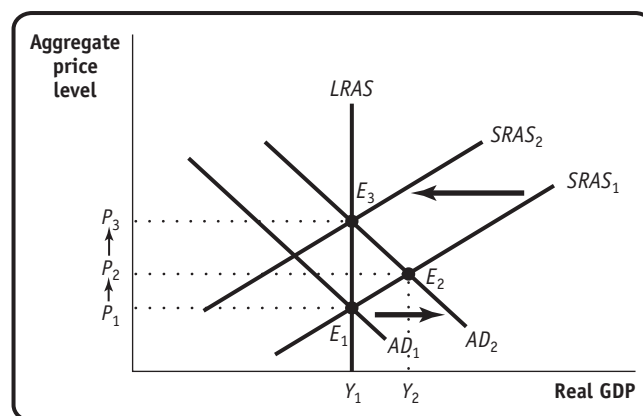
# Inflation, Disinflation, and Deflation

1. In the economy of Scottopia, policy makers want to lower the unemployment rate and raise real GDP by using monetary policy. Using the accompanying diagram, show why this policy will ultimately result in a higher aggregate price level but no change in real GDP.



## Solution

1. In the accompanying diagram, the economy of Scottopia is in long-run macroeconomic equilibrium at  $E_1$ . If policy makers want to lower the unemployment rate and raise real GDP, they will engage in expansionary monetary policy, which will shift  $AD_1$  rightward to  $AD_2$ . In the short run, equilibrium moves to  $E_2$ ; real GDP is higher and unemployment is lower. However, the aggregate price level has risen and over time, as workers are able to renegotiate wages,  $SRAS_1$  will shift leftward to  $SRAS_2$ . In the long run, equilibrium moves to  $E_3$  and the aggregate price level rises to  $P_3$ . The only result is that the increase in the money supply leads to an equal-percentage increase in the aggregate price level but no change in real GDP.



2. In the following examples, would the classical model of the price level be relevant?
- There is a great deal of unemployment in the economy and no history of inflation.
  - The economy has just experienced five years of hyperinflation.

- c. Although the economy experienced inflation in the 10% to 20% range three years ago, prices have recently been stable and the unemployment rate has approximated the natural rate of unemployment.

## Solution

2. a. The classical model of the price level is not well suited to an economy with a great deal of unemployment and no history of inflation. Increases in aggregate output can occur without an immediate change in the aggregate price level because it takes some time for workers and firms to react to changes in the aggregate price level by increasing nominal wages and the prices of some intermediate goods.
- b. When an economy has just experienced five years of hyperinflation, firms and workers will be very sensitive to any increase in the aggregate price level, so there would be little if any trade-off between inflation and unemployment. The classical model would be relevant.
- c. If the economy has some history of inflation but prices have recently been stable and the unemployment rate has approximated the natural rate, there may be a trade-off between inflation and unemployment; it would be short lived, however, because people would quickly adjust their expectations of inflation given their not-too-distant experiences of inflation. The classical model would be relevant.
3. The Federal Reserve regularly releases data on the U.S. monetary base. You can access that data at various websites, including the website for the Federal Reserve Bank of St. Louis. Go to <http://research.stlouisfed.org/fred2/> and click on “Categories,” then on “Money, Banking, & Finance,” then on “Monetary Data,” then on “Monetary Base,” and then on “Monetary Base; Total” for the latest report. Then click on “View Data.”
- a. The last two numbers in the column show the levels of the monetary base in the last year. How much did it change?
- b. How did this help in the government’s efforts to finance its deficit?
- c. Why is it important for the central bank to be independent from the part of the government responsible for spending?

## Solution

3. Answers will vary depending on when you look up the information.
- a. From September 2013 to September 2014, the monetary base grew from \$3,486.920 billion to \$4,049.181 billion, an increase of \$562.261 billion.
- b. This \$562.261 billion increase in the monetary base was created by the Fed and used to buy government securities—in effect paying off that amount of government debt by printing money.
- c. It is important for the central bank to be independent from the part of the government responsible for spending because it might be tempted to have the central bank print more money (creating inflation) whenever the government runs a budget deficit.
4. Answer the following questions about the (real) inflation tax, assuming that the price level starts at 1.
- a. Maria Moneybags keeps \$1,000 in her sock drawer for a year. Over the year, the inflation rate is 10%. What is the real inflation tax paid by Maria for this year?
- b. Maria continues to keep the \$1,000 in her drawer for a second year. What is the real value of this \$1,000 at the beginning of the second year? Over the year, the inflation rate is again 10%. What is the real inflation tax paid by Maria for the second year?

- c. For a third year, Maria keeps the \$1,000 in the drawer. What is the real value of this \$1,000 at the beginning of the third year? Over the year, the inflation rate is again 10%. What is the real inflation tax paid by Maria for the third year?
- d. After three years, what is the cumulative real inflation tax paid?
- e. Redo parts a through d with an inflation rate of 25%. Why is hyperinflation such a problem?

### Solution

4. a. The real inflation tax paid is \$100 ( $\$1,000 \times 0.10$ ).
- b. The price level at the end of the first year will be  $1 \times 1.10 = 1.10$ . The real value of \$1,000 at the beginning of the second year is  $\$1,000/1.10 = \$909.09$ . So the real inflation tax paid for the second year is \$90.91 ( $\$909.09 \times 0.10$ ).
- c. The price level at the end of the second year will be  $1.10 \times 1.10 = 1.21$ . The real value of \$1,000 at the beginning of the third year is  $\$1,000/1.21 = \$826.45$ . So the real inflation tax paid for the third year is \$82.65 ( $\$826.45 \times 0.10$ ).
- d. The cumulative real inflation tax paid for the three years is  $\$100 + \$90.91 + \$82.65 = \$273.56$ .
- e. If the inflation rate is 25% and the aggregate price level equals 1 in year 1, the real inflation tax paid for the first year is \$250 ( $\$1,000 \times 0.25$ ). At the beginning of the second year, the real value of \$1,000 is  $\$1,000/1.25 = \$800$ . For the second year, the real inflation tax paid is \$200 ( $\$800 \times 0.25$ ); and for the third year, it is \$160 ( $[\$1,000/(1.25)^2] \times 0.25$ ). The cumulative real inflation tax paid for the three years is  $\$250 + \$200 + \$160 = \$610$ . Hyperinflation is such a big problem because it can quickly erode the purchasing power of money. In our examples, in just three years, an inflation rate of 10% created a real inflation tax of \$273.56 on \$1,000, but an inflation rate of 25% created a real inflation tax of \$610 on \$1,000.

5. The inflation tax is often used as a significant source of revenue in developing countries where the tax collection and reporting system is not well developed and tax evasion may be high.
- a. Use the numbers in the accompanying table to calculate the inflation tax in the United States and India (Rp = rupees).

	Inflation in 2013	Money supply in 2013 (billions)	Central government receipts in 2013 (billions)
India	9.48%	Rp19,118	Rp10,726
United States	1.46%	\$2,832	\$3,113

Sources: Bureau of Economic Analysis; Controller General of Accounts (India); Reserve Bank of India; International Monetary Fund; The World Bank.

- b. How large is the inflation tax for the two countries when calculated as a percentage of government receipts?

### Solution

5. a. The inflation tax is equal to: Inflation rate  $\times$  Money supply. For India, this is  $0.0948 \times \text{Rp}19,118 = \text{Rp}1,812$  billion. For the United States, it is  $0.0146 \times \$2,832$  billion = \$41.3 billion, as shown in the accompanying table.

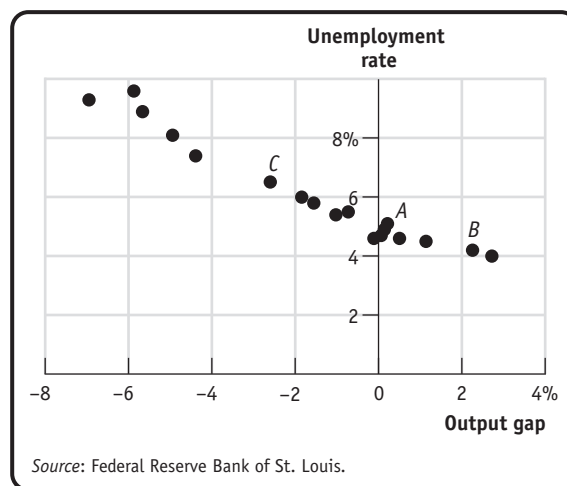
	Inflation tax (billions)
India	Rp1,812
United States	\$41.3



- b. The inflation tax as a percentage of government receipts is 16.9% in India  $[(Rp1,812/Rp10,729) \times 100]$ . It is only 1.3% in the United States  $[(\$41.3/\$3,113) \times 100]$ . The inflation tax accounts for a much larger portion of government revenues in India, which is consistent with India having a less well-developed tax collection and reporting system than the United States.
6. Concerned about the crowding-out effects of government borrowing on private investment spending, a candidate for president argues that the United States should just print money to cover the government's budget deficit. What are the advantages and disadvantages of such a plan?

### Solution

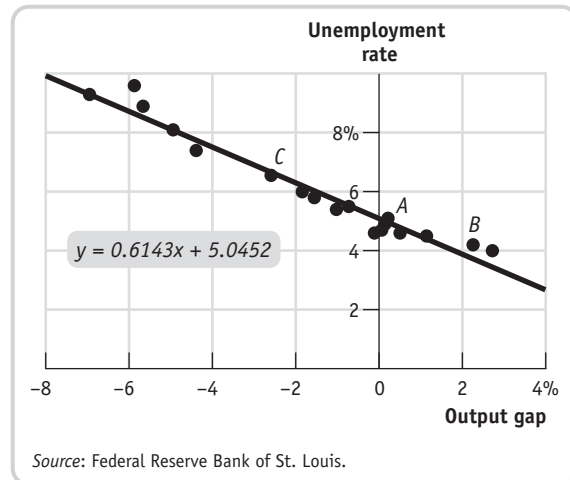
6. The main advantage to printing money to cover the deficit is to avoid the crowding-out effects—the reduction in private investment spending that occurs due to higher interest rates arising from government borrowing. However, the main disadvantage to printing money to cover the deficit is that it will result in inflation, and individuals who currently hold money will pay an inflation tax (a reduction in the value of money held by the public). Rather than financing the budget deficit with an increase in actual taxes, printing money imposes an inflation tax.
7. The accompanying scatter diagram shows the relationship between the unemployment rate and the output gap in the United States from 1996 to 2013. Draw a straight line through the scatter of dots in the figure. Assume that this line represents Okun's law:  
 Unemployment rate =  $b - (m \times \text{Output gap})$   
 where  $b$  is the vertical intercept and  $-m$  is the slope



What is the unemployment rate when aggregate output equals potential output? What would the unemployment rate be if the output gap were 2%? What if the output gap were -3%? What do these results tell us about the coefficient  $m$  in Okun's law?

## Solution

7. The accompanying figure shows a line drawn through the dots relating the unemployment rate and the output gap for the United States from 1996 to 2013. Your line may be slightly different from the one drawn here. The line passes through the vertical axis at an unemployment rate of about 5%, as indicated by point A. So the unemployment rate when output equals potential output is 5%. At an output gap of 2%, the predicted unemployment rate is about 4%, as shown by point B. At an output gap of -3%, the predicted unemployment rate is about 6.5%, as shown by point C. The pattern of all three points fits Okun's law with a coefficient  $m$  approximately equal to 0.5:  $\text{Unemployment rate} = 5\% - (0.5 \times \text{Output gap})$ .



8. After experiencing a recession for the past two years, the residents of Albernia were looking forward to a decrease in the unemployment rate. Yet after six months of strong positive economic growth, the unemployment rate has fallen only slightly below what it was at the end of the recession. How can you explain why the unemployment rate did not fall as much although the economy was experiencing strong economic growth?

## Solution

8. There are two primary reasons why Albernia is experiencing a jobless recovery, a recovery in which the unemployment rate falls only slowly, if at all. The first reason is that a company that experiences a sudden increase in demand for its products may cope by having its workers put in longer hours rather than by hiring more workers. The second reason is that the number of workers looking for jobs is affected by the availability of jobs. As the economy adds jobs, some people who had not been actively looking for work during the recession may begin doing so.
9. a. Go to [www.bls.gov](http://www.bls.gov). Click on link "Subjects"; on the left, under "Inflation & Prices," click on the link "Consumer Price Index." Scroll down to the section "CPI Tables," and find the link "Consumer Price Index Detailed Report, Tables Annual Averages 2009 (PDF)." What is the value of the percent change in the CPI from 2008 to 2009?
- b. Now go to [www.treasury.gov](http://www.treasury.gov) and click on "Resource Center." From there, click on "Data and Charts Center." Then click on "Interest Rate Statistics." In the scroll-down windows, select "Daily Treasury Bill Rates" and "2009." Examine the data in "4 Weeks Bank Discount." What is the maximum? The minimum? Then do the same for 2007. How do the data for 2009 and 2007 compare? How would you relate this to your answer in part (a)? From the data on Treasury bill interest rates, what would you infer about the level of the inflation rate in 2007 compared to 2009? (You can check your answer by going back to the [www.bls.gov](http://www.bls.gov) website to find the percent change in the CPI from 2006 to 2007.)
- c. How would you characterize the change in the U.S. economy from 2007 to 2009?

**Solution**

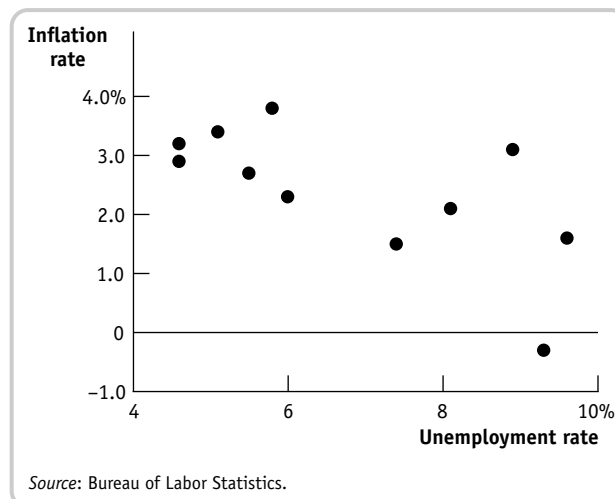
9. a. The percent change in the CPI from 2008 to 2009 was  $-0.4\%$ .
- b. In 2009, the Treasury bill 4-week bank discount was very low, with a maximum of  $0.26\%$  and a low of  $0.01\%$ —virtually zero. In 2007, the equivalent rate was much higher, with a high of  $5.15\%$  and a low of  $2.34\%$ . The very low Treasury bill rates in 2009 are consistent with the very low inflation rate for 2009. Given that the rates in 2007 were well above zero, one should expect that the 2007 inflation rate was also above zero. Indeed, it was, at  $2.8\%$ .
- c. From the data, it appears that the United States experienced a fall in inflation from 2007 to 2009 as the inflation rate fell. It was also a period of a severe fall in GDP. In 2009, the United States was in liquidity trap territory.
10. The accompanying table provides data from the United States on the average annual rates of unemployment and inflation. Use the numbers to construct a scatter plot similar to Figure 16-5. Discuss why, in the short run, the unemployment rate rises when inflation falls.

Year	Unemployment rate	Inflation rate
2003	6.0%	2.3%
2004	5.5	2.7
2005	5.1	3.4
2006	4.6	3.2
2007	4.6	2.9
2008	5.8	3.8
2009	9.3	$-0.4$
2010	9.6	1.6
2011	8.9	3.1
2012	8.1	2.1
2013	7.4	1.5

Source: Bureau of Labor Statistics.

**Solution**

10. The accompanying figure shows a negative relationship between the unemployment rate and the inflation rate: when the unemployment rate rises, the inflation rate falls. This should come as no surprise: the short-run aggregate supply curve says that as the aggregate price level rises (that is, as there is inflation), aggregate output rises. And from Okun's law we know that as aggregate output rises above potential output (that is, as the output gap increases), unemployment falls. In other words, as inflation rises, unemployment falls. So there is a negative relationship between the inflation rate and the unemployment rate.



Source: Bureau of Labor Statistics.

- 11.** The economy of Britannia has been suffering from high inflation with an unemployment rate equal to its natural rate. Policy makers would like to disinflate the economy with the lowest economic cost possible. Assume that the state of the economy is not the result of a negative supply shock. How can they try to minimize the unemployment cost of disinflation? Is it possible for there to be no cost of disinflation?

### Solution

- 11.** A major obstacle to achieving disinflation is that the public has come to expect continuing inflation. To reduce inflation, it is often necessary to keep the unemployment rate above the natural rate for an extended period of time so that the public can adjust its expectations to a lower inflation rate. The harder it is to change the public's expectations, the higher the unemployment cost associated with disinflation. To minimize the cost of disinflation, the public must believe that policy makers are committed to a lower inflation rate and will do what is necessary to achieve a lower rate. Policy makers in Britannia can announce their policy to reduce inflation in advance, in time for firms and workers to build lower inflation expectations into their wage contracts. As long as policy makers are perceived as credible, the cost of disinflation will be minimized. It is possible but unlikely for policy makers to reduce inflation without increasing unemployment; it would require that they be seen as absolutely committed and able to disinflate the economy. If this were the case, expectations would adjust and inflation would fall immediately upon announcement of the policy.
- 12.** Who are the winners and losers when a mortgage company lends \$100,000 to the Miller family to buy a house worth \$105,000 and during the first year prices unexpectedly fall by 10%? What would you expect to happen if the deflation continued over the next few years? How would continuing deflation affect borrowers and lenders throughout the economy as a whole?

### Solution

- 12.** Over the first year, as prices fall 10%, the value of the Millers' house will fall from \$105,000 to \$94,500. Since they borrowed \$100,000 to buy it, the value of the house is now less than the amount they owe. If they sold the house, they would not be able to pay off their mortgage. The Millers are worse off. The mortgage company is better off because as the Millers pay off their mortgage, the mortgage company will be able to lend to more potential homeowners. As the deflation continues, it will become harder and harder for the Millers to pay off their mortgage. Assuming wages are falling with deflation, the Millers will have to work more hours to pay off the mortgage. The Millers will cut back on their consumer spending. At some point, the Millers will decide to walk away from the house and default on the mortgage. Both the Millers and the mortgage company will lose, as will the economy. The Millers will find it difficult to borrow at all because they defaulted on the mortgage, and the mortgage company will be reluctant to lend for fear that the borrower will default. Continuing deflation would be extremely detrimental to the economy. Individuals and firms will be reluctant to borrow, fearing that the value of their assets will fall even though the value of their debt remains fixed, and lenders will be reluctant to lend, fearing that the borrowers will default and they will own assets whose value is less than the amount they lent.

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- 13.** Due to historical differences, countries often differ in how quickly a change in actual inflation is incorporated into a change in expected inflation. In a country such as Japan, which has had very little inflation in recent memory, it will take longer for a change in the actual inflation rate to be reflected in a corresponding change in the expected inflation rate. In contrast, in a country such as Zimbabwe, which has recently had very high inflation, a change in the actual inflation rate will immediately be reflected in a corresponding change in the expected inflation rate. What does this imply about the short-run and long-run Phillips curves in these two types of countries? What does this imply about the effectiveness of monetary and fiscal policy to reduce the unemployment rate?

- 13. Solution** Countries such as Japan will find that they can sustain an unemployment rate lower than the NAIRU for longer periods of time before the expected rate of inflation increases than can countries such as Zimbabwe. So Japanese monetary and fiscal policy will be more effective than Zimbabwean monetary and fiscal policy in reducing unemployment below the NAIRU. However, given a sufficiently long period of higher-than-expected inflation, the Japanese people will revise their expected rate of inflation upward, and the Japanese short-run Phillips curve will shift upward. So the long-run Japanese Phillips curve is still vertical. In contrast, Zimbabwe will find that its short-run Phillips curve is practically vertical: because people are primed to quickly revise their inflationary expectations, an unemployment rate below the NAIRU will quickly cause an acceleration of inflation. So Zimbabwean monetary and fiscal policy are largely ineffective even in the short run in reducing unemployment below the NAIRU.

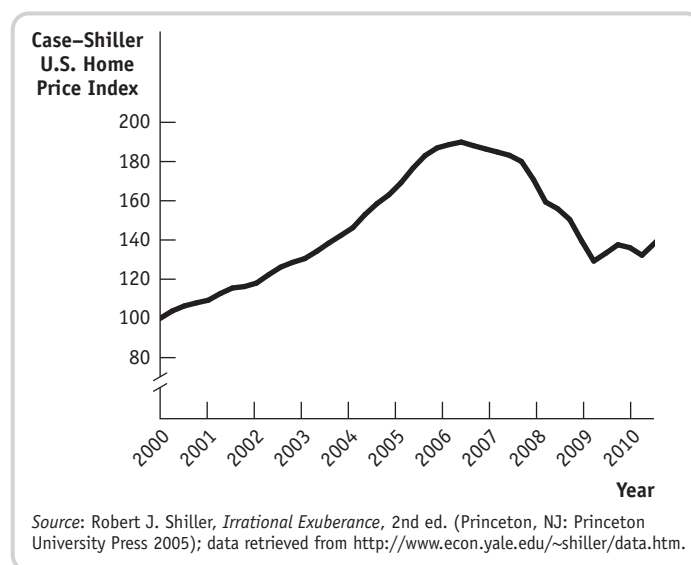
# Crises and Consequences

## CHAPTER 17

1. Which of the following are *not* examples of a vicious cycle of deleveraging? Explain.
  - a. Your university decides to sell several commercial buildings in the middle of town in order to upgrade buildings on campus.
  - b. A company decides to sell its large and valuable art collection because other asset prices on its balance sheet have fallen below a critical level, forcing creditors to call in their loans to the company because of provisions written into the original loan contract.
  - c. A company decides to issue more stock in order to voluntarily pay off some of its debt.
  - d. A shadow bank must sell its holdings of corporate bonds because falling asset prices have led to a default on the terms of its loans with some creditors.

### Solution

1.
  - a. This is not an example of a vicious cycle of deleveraging. The university is voluntarily selling its commercial buildings in order to improve its campus.
  - b. This is an example of a vicious cycle of deleveraging. If a company sells a large holding of valuable art, this is likely to depress art prices elsewhere, leading to balance sheet effects on other firms that hold art and possibly forcing them to sell other assets in order to meet the terms of their creditors.
  - c. This is not an example of a vicious cycle of deleveraging. The company is voluntarily issuing more stock because it wants to lower the amount of debt that it owes.
  - d. This is an example of a vicious cycle of deleveraging. The shadow bank must sell its assets (corporate bonds) because losses due to falling asset prices have led to a default on the terms of its loans from some creditors.
2. In the following figure showing the Case-Shiller U.S. Home Price Index from 2000 to 2010, did housing prices peak before or after the financial crisis in the United States? Explain your answer.



## Solution

2. In the United States, housing prices peaked in 2006, two years before the height of the financial crisis in October 2008. As in Sweden, Japan, and Finland, the fall in housing prices caused many borrowers to default on their mortgages. This led to massive losses in the financial sector and precipitated the financial crisis of 2008.
3. Figure 17-2 tracks the unemployment rate in the years before and after the Panic of 1893 in the United States, the banking crisis of 1991 in Sweden, and the American financial crisis of 2008.
  - a. In Figure 17-2, how many years after the Panic of 1893 did unemployment peak in the United States?
  - b. In Figure 17-2, how many years after the banking crisis of 1991 did unemployment peak in Sweden?
  - c. In Figure 17-2, how many years after the banking crisis of 2008 did unemployment peak in the United States?

## Solution

3.
  - a. From the figure, it appears that unemployment peaked in 1894, one year after the panic. However, although unemployment dropped in 1895, it went up again in 1896 and peaked at levels very close to 1894 levels.
  - b. From the figure, unemployment reached one peak in 1994, three years after the banking crisis. However, although unemployment decreased in 1995, it again continued to increase five and six years after the crisis, in 1996 and 1997.
  - c. From the figure, unemployment reached a peak in 2010, two years after the financial crisis. Unemployment has decreased continually since 2010.
4. In 2007–2009, the Federal Reserve, acting as a lender of last resort, stepped in to provide funds when private markets were unable to do so. The Fed also took over many banks. In 2007, it seized 3 banks; in 2008, it seized 25 banks; and in 2009, it seized 140 banks. Go to [www.fdic.gov](http://www.fdic.gov); under “Bank Closing Information,” click on “Complete Failed Bank List.” Then count the number of banks that the Federal Reserve has seized so far this year. Have bank failures decreased since the crisis in 2009?

## Solution

4. Answers will vary. The rate of bank failures continued to rise in 2010, with 157 failures. However, since then, the rate of bank failures has decreased. Only 17 banks failed in 2014.
5. During the financial crisis in October 2008, the federal government could borrow at a rate of 2.73% (the yield on five-year Treasury securities). During October 2008, though, Baa borrowers (corporate borrowers rated by Moody’s as not being completely reliable) had to pay 8.88%.
  - a. What was the difference in borrowing costs for these corporate borrowers and the federal government?
  - b. Go to [research.stlouisfed.org/fred2/categories/22](http://research.stlouisfed.org/fred2/categories/22). Click on the link for “Treasury constant maturity” and find the most recent interest rate on 10-year U.S. Treasury bonds. Then click back to the original web page on the link for “Corporate bonds,” then “Moody’s,” and find the rate for Baa corporate bonds. What is the current difference in borrowing costs between corporate borrowers and the U.S. government?
  - c. Has this difference in borrowing costs increased or decreased since the height of the financial crisis in October of 2008? Why?

## Solution

5. a. The difference in borrowing costs between Baa borrowers and the federal government was  $8.88\% - 3.81\% = 5.17$  percentage points.
- b. At the time of this writing (December 2014), the yield on ten-year Treasury securities was 2.35% and the yield on Baa securities was 4.69%. So the difference in borrowing costs between Baa borrowers and the federal government was  $4.69\% - 2.35\% = 2.34$  percentage points.
- c. The difference in borrowing costs as of December 2014 had decreased because the credit crunch that resulted in sharply higher interest rates for medium-grade borrowers during the height of the financial crisis had eased.
6. Go to [www.federalreserve.gov](http://www.federalreserve.gov) and click on the tab “Banking Information & Regulation.” Then select the links “Banking Data” followed by “Large Commercial Banks.” Once there, choose the latest release of quarterly data.
- a. Which bank has the largest consolidated assets?
- b. Which bank has the largest domestic assets?
- c. What percent of U.S. GDP are the domestic assets of the bank listed in part b? (*Hint:* You can find U.S. GDP at <http://research.stlouisfed.org/fred2/series/GDP?cid=106> using the links “Gross Domestic Product (GDP)” and then “Current-dollar and ‘real’ GDP.”)

## Solution

6. a. On June 30, 2014, JP Morgan Chase was the bank with the largest consolidated assets.
- b. On June 30, 2014, Wells Fargo was the bank with the largest domestic assets.
- c. For the second quarter of 2014, annual GDP in current dollars was estimated to be 17,328 billion U.S. dollars. On June 30, 2014, the domestic assets of Wells Fargo were 1,395 billion U.S. dollars. So the domestic assets were  $(1,395/17,328) \times 100 = 8.1\%$  of U.S. GDP.
7. Go to [www.fdic.gov](http://www.fdic.gov) and click on the tab “Industry Analysis” and then on the link “Research & Analysis.” Select “The First Fifty Years: A History of the FDIC 1933–1983.” Open Chapter 3, “Establishment of the FDIC,” and scroll down to the section entitled “The Banking Crisis of 1933” and the section entitled “Federal Deposit Insurance Legislation.” Read the section and then answer these questions.
- a. President Roosevelt was sworn in on March 4, 1933. What was one of his first official acts in response to the banking crisis?
- b. How many banks suspended operations during 1933?
- c. Who was the chief proponent of federal deposit insurance in Congress?
- d. How much coverage did the temporary fund for federal deposit insurance provide?

## Solution

7. a. President Roosevelt declared a national bank holiday that was to begin on March 6 and last for four days. This holiday was subsequently extended in order to give officials time to reopen the banks.
- b. About 4,000 banks suspended operations during 1933, never reopening after the bank holiday.
- c. Henry B. Steagall was one of the chief proponents of deposit insurance in Congress.
- d. The temporary fund provided federal deposit insurance coverage up to \$2,500 for each depositor.



- 8.** The U.S. Government Accountability Office (GAO) does research to support congressional decision making. After the Long Term Capital Management (LTCM) crisis, the GAO produced a summary of the events of the crisis located at [www.gao.gov/products/GGD-00-3](http://www.gao.gov/products/GGD-00-3). Read the summary and then answer the following questions.
- How much of its capital did LTCM lose in 1998?
  - Why did the GAO conclude that LTCM was able to establish leveraged trading positions of a size that posed systemic risk to the banking system?
  - What was the recommendation of the President's Working Group regarding the Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC)?

### Solution

- 8.**
- LTCM lost more than 90% of its capital in 1998.
  - The GAO concluded that LTCM was able to establish extraordinarily large trading positions because large banks and securities and futures firms failed to follow sound risk management practices in providing LTCM credit.
  - The President's Working Group recommended that Congress provide the SEC and the CFTC with expanded authority to obtain and verify information from unregistered affiliates of firms that they regulate, many of which were hedge funds.
- 9.** Which of the following are examples of debt overhang? Which examples are likely to lead to a cutback in spending? Explain.
- Your uncle starts a restaurant, borrowing to fund his investment. The restaurant fails, and your uncle must shut down but still must pay his debt.
  - Your parents take out a loan to buy a house. Your father is transferred to a new city, and now your parents must sell the house. The value of the house has gone up during the time your family has lived there.
  - Your friend's parents take out a loan to buy her a condo to live in while she is at college. Meanwhile, the housing market plummets. By the time your friend leaves college, the condo is worth significantly less than the value of the loan.
  - You finish college with an honors degree in a field with many good job prospects and with \$25,000 in student loans that you must repay.

### Solution

- 9.**
- This is an example of debt overhang because your uncle is left with high debt and diminished assets. Your uncle will likely cut back on his spending in order to repay the debt from the failed restaurant and to rebuild his assets.
  - This is not an example of debt overhang because your parents can sell the house and still have money left over after repaying the loan. It is likely that they will feel wealthier and increase spending.
  - This is an example of debt overhang because your friend's parents are left with a loan that is worth more than the value of the condo. They will likely cut back on spending in order to repay the loan and rebuild their assets.
  - This is not an example of debt overhang. Although you leave college with a large amount of debt, you also leave with an honors degree, which is a valuable asset. It is unlikely that you will cut back on spending because it is very likely that you will now have a job.

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1. Since the crash of its stock market in 1989, the Japanese economy has seen little economic growth and some deflation. The accompanying table from the Organization for Economic Cooperation and Development (OECD) shows some key macroeconomic data for Japan for 1991 (a “normal” year) and 1995–2003.

Year	Real GDP annual growth rate	Short-term interest rate	Government debt (percent of GDP)	Government budget deficit (percent of GDP)
1991	3.4%	7.38%	64.8%	−1.81%
1995	1.9	1.23	87.1	4.71
1996	3.4	0.59	93.9	5.07
1997	1.9	0.60	100.3	3.79
1998	−1.1	0.72	112.2	5.51
1999	0.1	0.25	125.7	7.23
2000	2.8	0.25	134.1	7.48
2001	0.4	0.12	142.3	6.13
2002	−0.3	0.06	149.3	7.88
2003	2.5	0.04	157.5	7.67

- a. From the data, determine the type of policies Japan’s policy makers undertook at that time to promote growth.
- b. We can safely consider a short-term interest rate that is less than 0.1% to effectively be a 0% interest rate. What is this situation called? What does it imply about the effectiveness of monetary policy? Of fiscal policy?

## Solution

1. a. From the annual real GDP growth rate, we can see the slow growth of the Japanese economy: the economy actually contracted in 1998 and 2002, with minimal growth in 1999 and 2001. We can also see that policy makers used expansionary monetary policy to spur the economy: short-term interest rates fell from 7.38% in 1991 to 0.04% in 2003. Finally, since government debt as a percentage of GDP rose from 64.8% in 1991 to 157.5% in 2003 and the government deficit as a percentage of GDP rose from −1.81% to 7.67%, we can conclude that they were also using expansionary fiscal policy.
- b. During 2002 and 2003, the short-term interest rate in Japan was effectively 0%, a situation known as a liquidity trap. In this case, monetary policy is ineffective since the interest rate cannot be driven any lower by expansionary monetary policy. In a case of a liquidity trap, the only effective tool is expansionary fiscal policy—that is, Keynesian policy.

- 2.** The National Bureau of Economic Research (NBER) maintains the official chronology of past U.S. business cycles. Go to its website at [www.nber.org/cycles/cyclesmain.html](http://www.nber.org/cycles/cyclesmain.html) to answer the following questions.
- How many business cycles have occurred since the end of World War II in 1945?
  - What was the average duration of a business cycle when measured from the end of one expansion (its peak) to the end of the next? That is, what was the average duration of a business cycle in the period from 1945 to 2001?
  - When was the last announcement by the NBER's Business Cycle Dating Committee, and what was it?

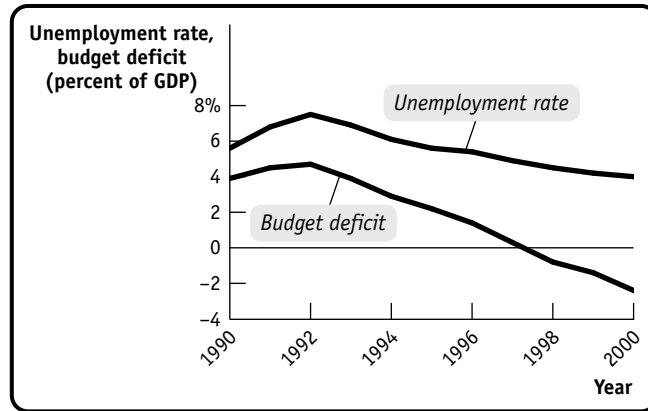
## Solution

- 2.**
- Answers will vary. But as of December 2014, there had been 11 business cycles since the end of 1945. This includes the recession that began in December 2007 and, at the time of writing, still continued.
  - As of December 2014, the average duration of a business cycle for the period 1945–2009, when measured from the end of one expansion (peak) to the next, was 68.5.
  - As of December 2014, the last NBER Business Cycle Dating Committee announcement was of the NBER's Determination of the December 2007 Peak in Economic Activity, on December 11, 2008.
- 3.** The fall of its military rival, the Soviet Union, in 1989 allowed the United States to significantly reduce its defense spending in subsequent years. Using the data in the following table from the Economic Report of the President, replicate Figure 18-3 for the 1990–2000 period. Given the strong economic growth in the United States during the late 1990s, why would a Keynesian see the reduction in defense spending during the 1990s as a good thing?

Year	Budget deficit (percent of GDP)	Unemployment rate
1990	3.9%	5.6%
1991	4.5	6.8
1992	4.7	7.5
1993	3.9	6.9
1994	2.9	6.1
1995	2.2	5.6
1996	1.4	5.4
1997	0.3	4.9
1998	−0.8	4.5
1999	−1.4	4.2
2000	−2.4	4.0

**Solution**

3. The accompanying diagram replicates Figure 18-3 for the 1990–2000 period. It was fortunate that defense spending fell and the budget deficit declined during this period because additional spending at a time of strong growth (and low unemployment rates) would likely have created inflationary pressure.



4. In the modern world, central banks are free to increase or reduce the money supply as they see fit. However, some people harken back to the “good old days” of the gold standard. Under the gold standard, the money supply could expand only when the amount of available gold increased.
- Under the gold standard, if the velocity of money was stable when the economy was expanding, what would have had to happen to keep prices stable?
  - Why would modern macroeconomists consider the gold standard a bad idea?

**Solution**

4. a. For prices to remain stable when the economy was expanding and the velocity of money was stable, the stock of gold would have had to grow at the same rate as real GDP.
- b. Under the gold standard there is no room for activist monetary policy, which modern macroeconomists favor.
5. The chapter explains that Kenneth Rogoff proclaimed Richard Nixon “the all-time hero of political business cycles.” Using the table of data below from the Economic Report of the President, explain why Nixon may have earned that title. (Note: Nixon entered office in January 1969 and was reelected in November 1972. He resigned in August 1974.)

Year	Government receipts (billions of dollars)	Government spending (billions of dollars)	Government budget balance (billions of dollars)	M1 growth	M2 growth	3-month Treasury bill rate
1969	\$186.9	\$183.6	\$3.2	3.3%	3.7%	6.68%
1970	192.8	195.6	-2.8	5.1	6.6	6.46
1971	187.1	210.2	-23.0	6.5	13.4	4.35
1972	207.3	230.7	-23.4	9.2	13.0	4.07
1973	230.8	245.7	-14.9	5.5	6.6	7.04

## Solution

5. The data indicate that President Nixon may have used fiscal and monetary policy to aid his reelection efforts. From his first year in office, 1969, to his reelection year, 1972, federal spending grew by 27% but federal receipts grew by only 11%. Overall, the federal budget balance went from a \$3.2 billion surplus to a \$23.4 billion deficit as a result of these expansionary fiscal policies. Nixon also used expansionary monetary policy to increase his popularity. Both M1 and M2 grew increasingly rapidly from 1969 to 1972. In response, the three-month Treasury bill rate (a short-term interest rate) fell from 6.68% to 4.07% during this same time period. After his reelection, these expansionary policies were reversed and the budget deficit shrank by \$8.5 billion, or by more than a third; the growth of M1 fell 3.7 percentage points, the growth of M2 fell 6.4 percentage points, and the three-month Treasury bill rate rose to 7.04%.
6. The economy of Albernia is facing a recessionary gap, and the leader of that nation calls together five of its best economists representing the classical, Keynesian, monetarist, real business cycle, and Great Moderation consensus views of the macroeconomy. Explain what policies each economist would recommend and why.

## Solution

6. In response to a recessionary gap in Albernia, the economists representing the different views of the macroeconomy would make the following suggestions.
- Classical:* Do nothing. The recessionary gap will exist only in the short run, and the only focus for policy makers is the long run.
- Keynesian:* The best policies to alleviate the recessionary gap are fiscal policies. Although expansionary monetary policies can be effective in promoting economic growth, they will not be very effective when the economy is in a deep recession or depression, when the economy may face a liquidity trap.
- Monetarist:* The government should not engage in discretionary fiscal or monetary policies because such policies can worsen economic fluctuations. GDP will grow steadily without inflationary pressure if the money supply grows steadily.
- Real business cycle:* The government should engage in policies that increase total factor productivity. Changes in monetary or fiscal policy that simply stimulate demand will have no effect on the economy because the aggregate supply curve is vertical.
- Great Moderation consensus:* Both monetary and fiscal policies can reduce a recessionary gap, although if a liquidity trap exists, it will reduce or eliminate the effectiveness of monetary policy. Discretionary monetary policy is generally preferred over discretionary fiscal policy.
7. Which of the following policy recommendations are consistent with the classical, Keynesian, monetarist, and/or Great Moderation consensus views of the macroeconomy?
- Since the long-run growth of GDP is 2%, the money supply should grow at 2%.
  - Decrease government spending in order to decrease inflationary pressure.
  - Increase the money supply in order to alleviate a recessionary gap.
  - Always maintain a balanced budget.
  - Decrease the budget deficit as a percent of GDP when facing a recessionary gap.

## Solution

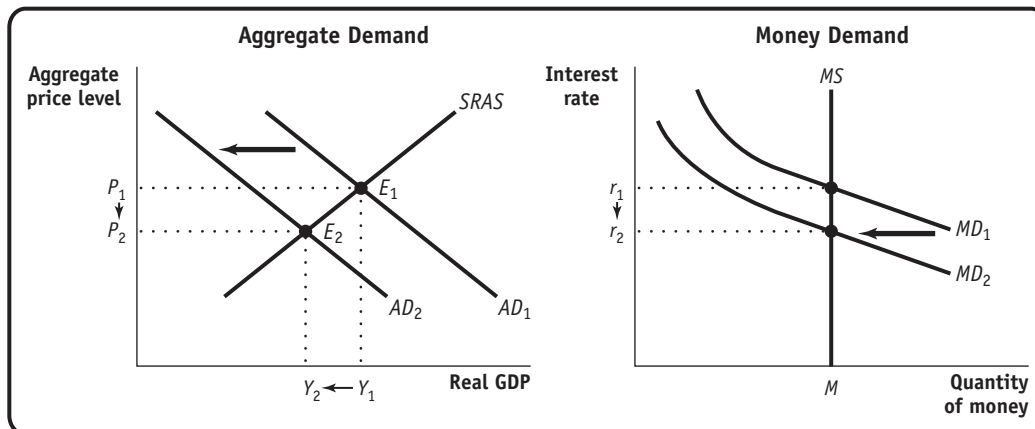
7. a. Monetarists would support such a policy; they believe in a monetary policy rule that allows the money supply to grow at the same rate as GDP. Since classical economists focus on long-term policies, they would also recommend such a policy. Keynesians and followers of the Great Moderation consensus believe that discretionary monetary policy can be useful in addressing short-run problems and would not recommend a monetary policy rule.

- b. Classical economists would see the inflationary pressure as a short-run problem and would not advocate any policy; their view would be that the inflationary pressure will not exist in the long run. Monetarists would also be reluctant to endorse fiscal policy in the short run; they believe discretionary fiscal policy actually makes the economy worse. Contractionary fiscal policy, such as a decrease in government spending, would definitely be recommended by Keynesians and, *only* in very unusual circumstances, by followers of the Great Moderation consensus.
- c. Classical economists would see a recessionary gap as a short-run problem and would not advocate any policy; their view would be that the recessionary gap will not exist in the long run. Monetarists would also be reluctant to endorse a short-run discretionary monetary policy because they believe it will make the economy worse. Expansionary monetary policy, such as an increase in the money supply, would be recommended by Keynesians and by followers of the Great Moderation consensus if the economy is not suffering from a liquidity trap.
- d. Keynesians and followers of the Great Moderation consensus would disagree with this policy recommendation. A balanced-budget rule would eliminate the possibility of using discretionary fiscal policy whenever a recessionary or expansionary gap exists. In fact, a balanced-budget rule would require that the government employ contractionary fiscal policy during recessions (making the recession worse). Monetarists would be sympathetic to a balanced-budget rule because of the problem of crowding out. Given classical economists' focus on the long run, they would probably favor such fiscal conservatism.
- e. No one would agree with this policy recommendation. Decreasing the budget deficit as a percent of GDP when facing a recessionary gap would be using contractionary fiscal policy (a decrease in government spending or an increase in taxes)—and that would make the recession worse.

8. Using a graph like Figure 18-4, show how a monetarist can argue that a contractionary fiscal policy need not lead to a fall in real GDP given a fixed money supply. Explain.

### Solution

8. As you can see in the accompanying figure, contractionary fiscal policy shifts the aggregate demand curve leftward, from  $AD_1$  to  $AD_2$ , in panel (a). Correspondingly, there is a decrease in money demand, and the money demand curve shifts leftward, from  $MD_1$  to  $MD_2$ , in panel (b). This leads to a fall in the interest rate from  $r_1$  to  $r_2$ , which has the effect of increasing investment spending and expanding the economy. If the increase in investment spending is sufficient to counteract the effect on real GDP of the contractionary fiscal policy, then the monetarist is indeed correct.



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9. Monetarists believed for a period of time that the velocity of money was stable within a country. However, with financial innovation, the velocity began shifting around erratically after 1980. As would be expected, the velocity of money is different across countries depending upon the sophistication of their financial systems—velocity of money tends to be higher in countries with developed financial systems. The accompanying table provides money supply and GDP information in 2013 for six countries.

Country	National currency	M1 (billions in national currency)	Nominal GDP (billions in national currency)
Egypt	Egyptian pounds	431	1,753
South Korea	Korean won	515,643	1,428,294
Thailand	Thai baht	1,608	11,898
United States	U.S. dollars	2,832	16,800
Kenya	Kenyan pounds	967	3,797
India	Indian rupees	19,118	113,550

Source: World Bank.

- a. Calculate the velocity of money for each of the countries. The accompanying table shows GDP per capita for each of these countries in 2013 in U.S. dollars.

Country	Nominal GDP per capita (U.S. dollars)
Egypt	\$3,225
South Korea	24,328
Thailand	5,674
United States	53,101
Kenya	1,016
India	1,504

Source: IMF.

- b. Rank the countries in descending order of per capita income and velocity of money. Do wealthy countries or poor countries tend to “turn over” their money more times per year? Would you expect wealthy countries to have more sophisticated financial systems?

## Solution

9. a. The velocity of money is defined as nominal GDP divided by the quantity of money. For example, the velocity of money in Egypt is  $1,753/431 = 4.1$ . The velocity of money for each of the countries is shown in the accompanying table.

Country	Velocity of money
Egypt	4.1
South Korea	2.8
Thailand	7.4
United States	5.9
Kenya	3.9
India	5.9

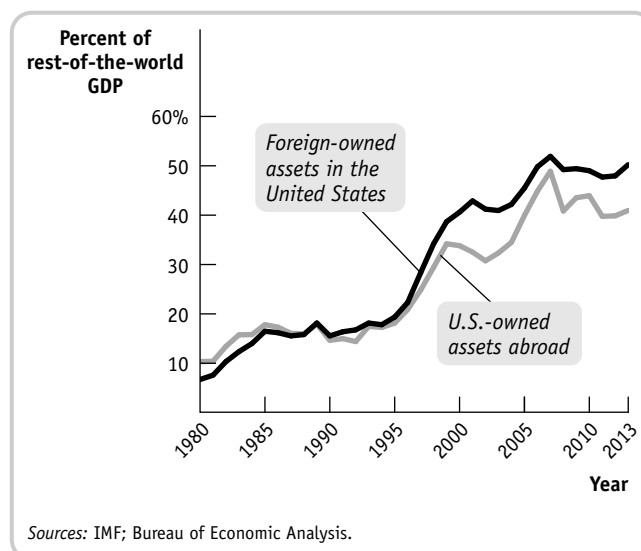
- b. Rank in descending order of velocity: South Korea, United States, Thailand, Kenya, Egypt, India. Rank in descending order of per capita income: United States, South Korea, Thailand, Egypt, India, Kenya. According to the above rankings, wealthy countries tend to have a higher velocity of money than do poor countries, but the relationship is not exact. One would expect wealthy countries to have more sophisticated financial systems.

# Open-Economy Macroeconomics

1. How would the following transactions be categorized in the U.S. balance of payments accounts? Would they be entered in the current account (as a payment to or from a foreigner) or the financial account (as a sale of assets to or purchase of assets from a foreigner)? How will the balance of payments on the current and financial accounts change?
  - a. A French importer buys a case of California wine for \$500.
  - b. An American who works for a French company deposits her paycheck, drawn on a Paris bank, into her San Francisco bank.
  - c. An American buys a bond from a Japanese company for \$10,000.
  - d. An American charity sends \$100,000 to Africa to help local residents buy food after a harvest shortfall.

## Solution

1.
  - a. When the French importer buys the California wine, the transaction is entered as a payment from foreigners in the current account. The balance of payments on the U.S. current account will rise.
  - b. When the American is paid by the French company, she is receiving factor income in exchange for export of her labor services. It is entered in the U.S. current account as an export. The balance of payments on the U.S. current account will rise.
  - c. When an American buys a Japanese bond, the transaction is entered in the U.S. financial account as a purchase of a Japanese asset by an American. The balance of payments on the U.S. financial account will fall.
  - d. When an American charity sends a gift to Africa, it is entered as a transfer payment to a foreigner in the U.S. current account. The balance on the U.S. current account will fall.
2. The accompanying diagram shows foreign-owned assets in the United States and U.S.-owned assets abroad, both as a percentage of foreign GDP. As you can see from the diagram, both increased around fivefold from 1980 to 2013.





- a. As U.S.-owned assets abroad increased as a percentage of foreign GDP, does this mean that the United States, over the period, experienced net capital outflows?
- b. Does this diagram indicate that world economies were more tightly linked in 2013 than they were in 1980?

## Solution

2. a. No, the diagram does not indicate that the United States experienced net capital outflows. Over the same period, foreign-owned assets also flowed into the United States, increasing them as a percentage of U.S. GDP. In fact, between 1996 and 2013, the United States moved into massive deficit on its current account, which meant that it became the recipient of huge net capital inflows from the rest of the world.
  - b. Yes, the diagram indicates that world economies were more tightly linked in 2013 than they were in 1980. Because the United States has more assets abroad and other countries own more assets in the United States, “financial contagion” has become a possibility—a financial crisis in one country is more likely to lead to a financial crisis in another country.
3. In the economy of Scottopia in 2014, exports equaled \$400 billion of goods and \$300 billion of services, imports equaled \$500 billion of goods and \$350 billion of services, and the rest of the world purchased \$250 billion of Scottopia’s assets. What was the merchandise trade balance for Scottopia? What was the balance of payments on current account in Scottopia? What was the balance of payments on financial account? What was the value of Scottopia’s purchases of assets from the rest of the world?

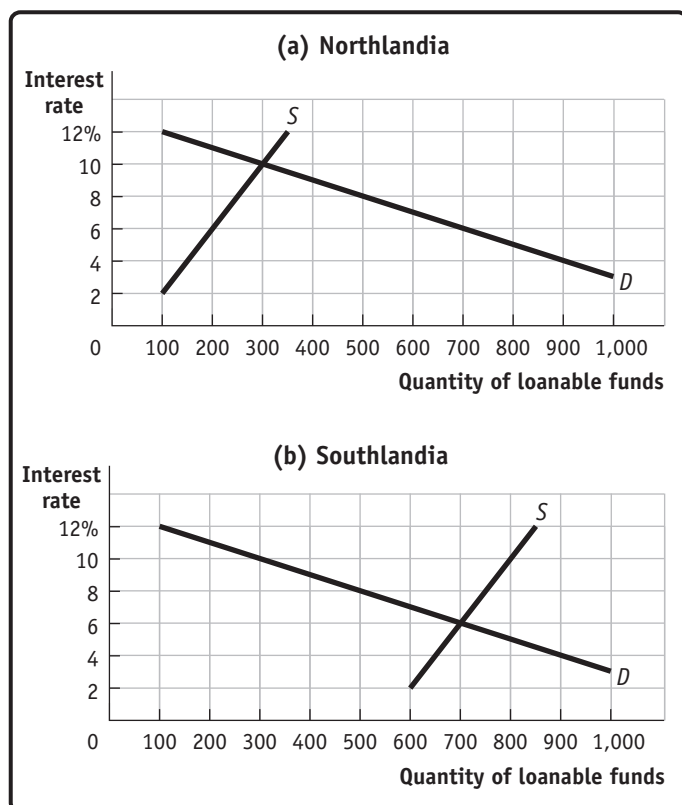
## Solution

3. In 2014, the merchandise trade balance was  $-\$100$  billion ( $\$400$  billion  $-$   $\$500$  billion). The balance of payments on current account was  $-\$150$  billion [ $(\$400$  billion  $+$   $\$300$  billion)  $-$  ( $\$500$  billion  $+$   $\$350$  billion)]. Since the balance of payments on financial account plus the balance of payments on current account must sum to zero, the balance of payments on financial account must have been  $+\$150$  billion. If the rest of the world bought  $\$250$  billion of Scottopia’s assets, Scottopia must have bought  $\$100$  billion of assets from the rest of the world.
4. In the economy of Popania in 2014, total Popanian purchases of assets in the rest of the world equaled  $\$300$  billion, purchases of Popanian assets by the rest of the world equaled  $\$400$  billion, and Popania exported goods and services equal to  $\$350$  billion. What was Popania’s balance of payments on financial account in 2014? What was its balance of payments on current account? What was the value of its imports?

## Solution

4. In 2014, Popania’s balance of payments on financial account was  $+\$100$  billion ( $\$400$  billion  $-$   $\$300$  billion). Since the balance of payments on financial account plus the balance of payments on current account must sum to zero, the balance of payments on current account must have been  $-\$100$  billion. If Popania exported  $\$350$  billion of goods and services, it must have imported  $\$450$  billion of goods and services.

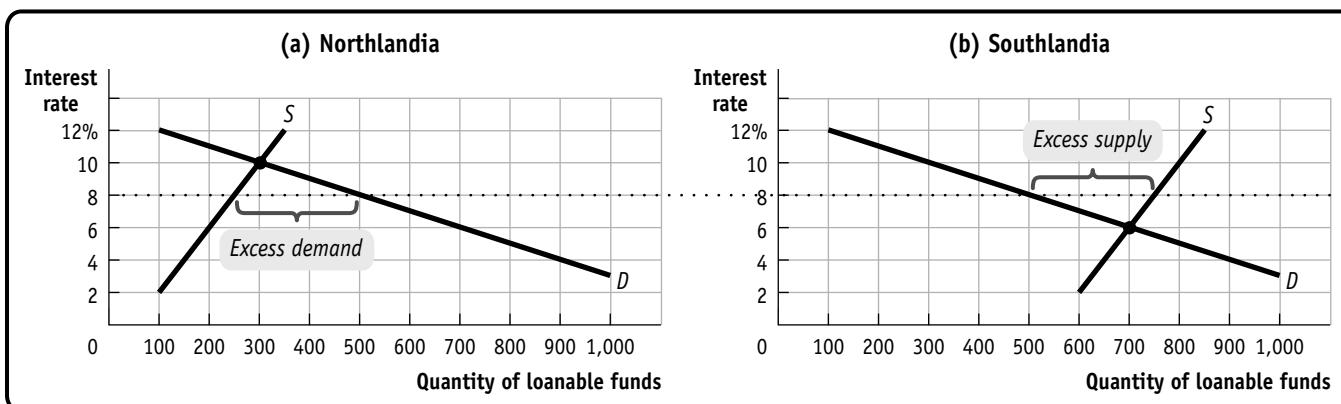
5. Suppose that Northlandia and Southlandia are the only two trading countries in the world, that each nation runs a balance of payments on both current and financial accounts equal to zero, and that each nation sees the other's assets as identical to its own. Using the accompanying diagrams, explain how the demand and supply of loanable funds, the interest rate, and the balance of payments on current and financial accounts will change in each country if international capital flows are possible.



### Solution

5. Since the interest rate is 10% in Northlandia and 6% in Southlandia, demanders of loanable funds in Northlandia will want to borrow in Southlandia and suppliers of loanable funds in Southlandia will want to lend in Northlandia. As the supply of loanable funds falls in Southlandia, the interest rate in Southlandia will rise; as the supply of loanable funds rises in Northlandia, the interest rate in Northlandia will fall. This will narrow the gap between interest rates in the two countries. Since no one distinguishes between the assets in the two countries, interest rates will change in both countries until they are equal; as a result, there is no additional incentive for suppliers of loanable funds in Southlandia to lend in Northlandia and for demanders of loanable funds in Northlandia to borrow in Southlandia. In the accompanying diagrams, you can see that at an interest rate of 8% there is an excess supply of loanable funds in Southlandia equal to 250 and an excess demand for loanable funds in

Northlandia equal to 250. So the two countries will both end up with an interest rate of 8%. Northlandia will run a surplus of 250 in the financial account and a deficit of 250 in the current account; Southlandia will run a deficit of 250 in the financial account and a surplus of 250 in the current account.



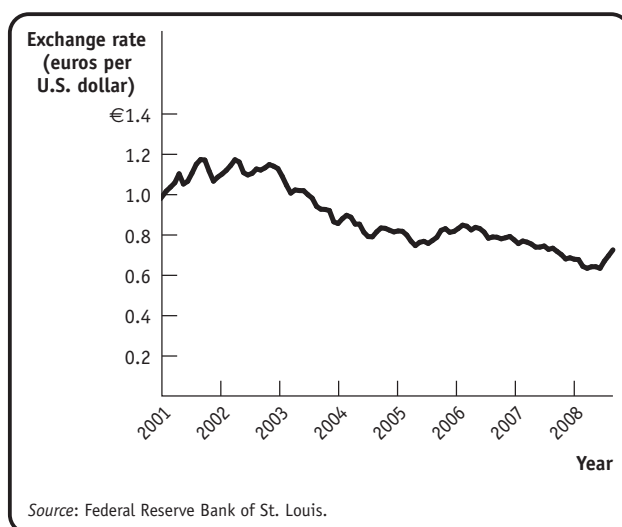
6. Based on the exchange rates for the first trading days of 2013 and 2014 shown in the accompanying table, did the U.S. dollar appreciate or depreciate during 2014? Did the movement in the value of the U.S. dollar make American goods and services more or less attractive to foreigners?

October 1, 2013	October 1, 2014
US\$1.62 to buy 1 British pound sterling	US\$1.62 to buy 1 British pound sterling
29.51 Taiwan dollars to buy US\$1	30.43 Taiwan dollars to buy US\$1
US\$0.97 to buy 1 Canadian dollar	US\$0.89 to buy 1 Canadian dollar
98.04 Japanese yen to buy US\$1	109.31 Japanese yen to buy US\$1
US\$1.35 to buy 1 euro	US\$1.26 to buy 1 euro
0.91 Swiss francs to buy US\$1	0.96 Swiss franc to buy US\$1

- 6.** The U.S. dollar appreciated against the Taiwanese dollar, Canadian dollar, Japanese yen, the euro, and the Swiss franc. And it stayed the same against the British pound. When the U.S. dollar appreciates, foreign goods are more attractive to American buyers and American goods are less attractive to foreign buyers, other things equal. The opposite is true when the U.S. dollar depreciates.
- 7.** Go to <http://fx.sauder.ubc.ca>. Using the table labeled “The Most Recent Cross-Rates of Major Currencies,” determine whether the British pound (GBP), the Canadian dollar (CAD), the Japanese yen (JPY), the euro (EUR), and the Swiss franc (CHF) have appreciated or depreciated against the U.S. dollar (USD) since October 1, 2014. The exchange rates on October 1, 2014, are listed in the table in Problem 6.

- 7.** Answers will vary. On December 3, 2014, the exchange was US\$1.57 per British pound, \$1.23 per euro, \$0.88 per Canadian dollar, 119.82 Japanese yen per U.S. dollar, 31.15 Taiwanese dollars per U.S. dollar, and 0.98 Swiss franc per U.S. dollar. The U.S. dollar appreciated against the British pound, Taiwanese dollar, Japanese yen, the euro, and Swiss franc. The U.S. dollar depreciated against the Canadian dollar.

8. From January 1, 2001, to June 2003, the U.S. federal funds rate decreased from 6.5% to 1%. During the same period, the marginal lending facility rate at the European Central Bank decreased from 5.75% to 3%.
- Considering the change in interest rates over the period and using the loanable funds model, would you have expected funds to flow from the United States to Europe or from Europe to the United States over this period?
  - The accompanying diagram shows the exchange rate between the euro and the U.S. dollar from January 1, 2001, through September 2008. Is the movement of the exchange rate over the period January 2001 to June 2003 consistent with the movement in funds predicted in part a?



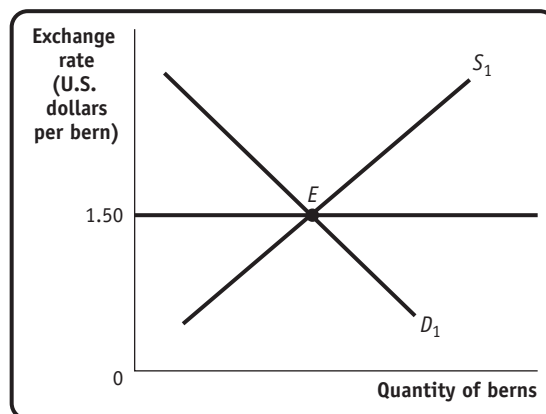
- 8. a.** The federal funds rate and the marginal lending facility rate suggest that interest rates in the United States went from being higher than European rates at the beginning of the period to lower than European rates at the end of the period. The loanable funds model suggests that U.S. lenders, attracted by relatively increasing interest rates in Europe, would have sent some of their loanable funds to Europe.
- b.** During this period, the dollar depreciated against the euro. This depreciation is consistent with funds moving out of the United States and into Europe.
9. In each of the following scenarios, suppose that the two nations are the only trading nations in the world. Given inflation and the change in the nominal exchange rate, which nation's goods become more attractive?
- Inflation is 10% in the United States and 5% in Japan; the U.S. dollar–Japanese yen exchange rate remains the same.
  - Inflation is 3% in the United States and 8% in Mexico; the price of the U.S. dollar falls from 12.50 to 10.25 Mexican pesos.
  - Inflation is 5% in the United States and 3% in the euro area; the price of the euro falls from \$1.30 to \$1.20.
  - Inflation is 8% in the United States and 4% in Canada; the price of the Canadian dollar rises from US\$0.60 to US\$0.75.

## Solution

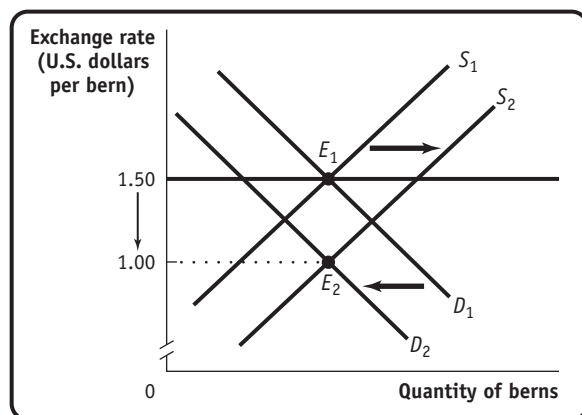
9. a. If inflation is 10% in the United States and 5% in Japan, and the U.S. dollar–Japanese yen exchange rate remains the same, Japanese goods and services will be more attractive than U.S. ones.
- b. If inflation is 3% in the United States and 8% in Mexico, and the price of the U.S. dollar falls from 12.50 to 10.25 Mexican pesos, both the lower inflation and the depreciation of the dollar (appreciation of the peso) make American goods more attractive.
- c. If inflation is 5% in the United States and 3% in the euro area, and the price of the euro falls from \$1.30 to \$1.20, both the lower inflation in the euro area and the appreciation of the dollar (depreciation of the euro) make euro area goods more attractive.
- d. If inflation in the United States is higher than in Canada, this makes Canadian goods more attractive. However, if the U.S. dollar depreciates against the Canadian dollar, this makes American goods more attractive. In this case, the depreciation of the U.S. dollar is so dramatic that it overwhelms the difference in inflation rates. American goods are more attractive.
10. Starting from a position of equilibrium in the foreign exchange market under a fixed exchange rate regime, how must a government react to an increase in the demand for the nation's goods and services by the rest of the world to keep the exchange rate at its fixed value?

## Solution

10. If there is an increase in the demand for that nation's goods and services, there will also be an increase in the demand for its currency, putting upward pressure on the value of the currency. There are three ways in which the central bank can keep the exchange rate at its fixed value. First, it can increase supply of the domestic currency by purchasing foreign assets. Second, it can decrease interest rates, which would discourage foreign investors from buying domestic assets (decreasing the demand for the domestic currency) and encourage domestic residents to buy foreign assets (increasing the supply of the domestic currency). Third, it can impose foreign exchange controls that limit the ability of foreigners to buy the domestic currency.
11. Suppose that Albernia's central bank has fixed the value of its currency, the bern, to the U.S. dollar (at a rate of US\$1.50 to 1 bern) and is committed to that exchange rate. Initially, the foreign exchange market for the bern is also in equilibrium, as shown in the accompanying diagram. However, both Albernians and Americans begin to believe that there are big risks in holding Albernian assets; as a result, they become unwilling to hold Albernian assets unless they receive a higher rate of return on them than they do on U.S. assets. How would this affect the diagram? If the Albernian central bank tries to keep the exchange rate fixed using monetary policy, how will this affect the Albernian economy?



- 11.** If both Albernians and Americans begin to believe that the Albernian assets are risky, this will reduce the demand for the bern (from  $D_1$  to  $D_2$  in the accompanying diagram), as Americans become less willing to buy Albernian assets, and increase the supply of the bern (from  $S_1$  to  $S_2$ ), as Albernians become more willing to buy American assets. Both the decrease in demand and the increase in supply will put downward pressure on the bern; in the diagram, the equilibrium value of the bern falls to \$1.00. Since the central bank is committed to a value of \$1.50 for the bern, it must act to make Albernian assets more attractive by raising the interest rate. This will have a contractionary effect on the Albernian economy.



- 12.** Your study partner asks you, “If central banks lose the ability to use discretionary monetary policy under fixed exchange rates, why would nations agree to a fixed exchange rate system?” How do you respond?

- 12.** You would respond by explaining the advantages of a fixed exchange rate. First, it reduces some uncertainty that might make businesses reluctant to undertake international transactions. In particular, it eliminates any uncertainty about the value of the currency. When businesses enter into a contract that calls for payment in a foreign currency at some time in the future, they know exactly how much it will cost them in the domestic currency. Also, by committing to a fixed exchange rate, the country eliminates any possibility that it will engage in inflationary policies.

- 13.** Suppose the United States and Japan are the only two trading countries in the world. What will happen to the value of the U.S. dollar if the following occur, other things equal?
- Japan relaxes some of its import restrictions.
  - The United States imposes some import tariffs on Japanese goods.
  - Interest rates in the United States rise dramatically.
  - A report indicates that Japanese cars last much longer than previously thought, especially compared with American cars.

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### Solution

- 13.**
- a.** If Japan relaxes import restrictions, Japanese residents will demand more U.S. goods and more U.S. dollars to buy those goods. The U.S. dollar will appreciate due to the increase in the demand for U.S. dollars.
  - b.** If the United States imposes import restrictions, Americans will buy fewer Japanese goods. Americans will want to exchange fewer U.S. dollars for yen, so the supply of U.S. dollars will decrease and the U.S. dollar will appreciate.
  - c.** A dramatic rise in U.S. interest rates will attract Japanese buyers of American assets as well as discourage Americans from buying Japanese assets. There will be an increase in the demand for U.S. dollars and a decrease in the supply of U.S. dollars; the U.S. dollar will appreciate.
  - d.** A report indicating that Japanese cars last much longer than previously thought, especially when compared with American cars, will increase the demand for Japanese cars and the demand for Japanese yen. The yen will appreciate and the U.S. dollar will depreciate.