AP Krugman Section 1 Problem Solutions

1. The four categories of resources are land, labor, capital, and entrepreneurship. Possible examples of resources include the property where the factory is located (land), factory workers (labor), sewing machines (capital), and the design of the assembly line (entrepreneurship).

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. On the other hand, 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. 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.

4. 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.

5. 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.

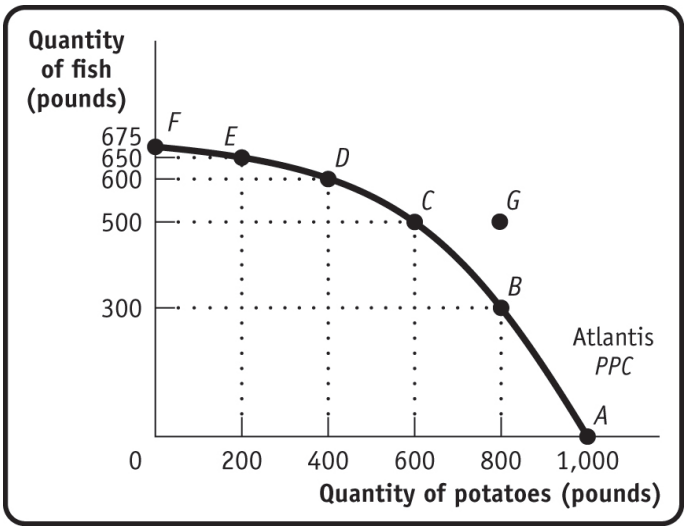
d. False. This is a positive statement. In principle, it has an answer that is either right or wrong.

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.

6. A business-cycle expansion is a period of recovery after a recession, and lasts until the next economic downturn. An expansion can occur regardless of any increase in the economy's long-term potential for production. Economic growth increases the economy's ability to produce more goods and services over the long term, and can last for several decades.

7. 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.

8. a. The accompanying diagram shows the production possibilities curve 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 possibilities curve, 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.

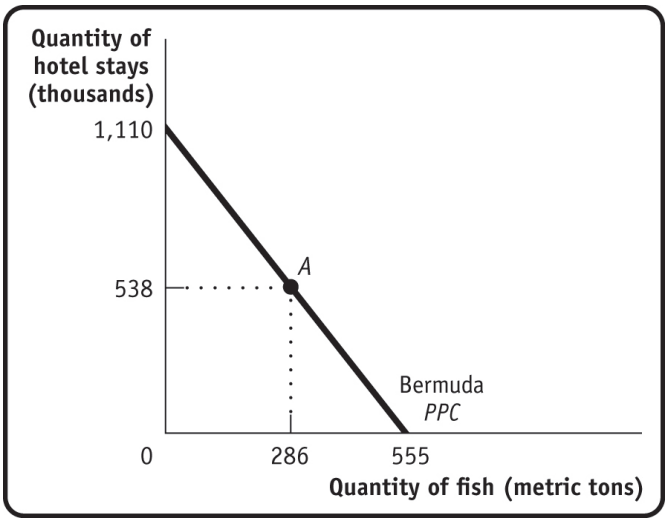
d. The opportunity cost of increasing output from 200 to 400 pounds of potatoes is 50 pounds of fish. If Atlantis increases output from 200 to 400 pounds of potatoes, it has to cut fish production from 650 pounds to 600 pounds, that is, by 50 pounds.

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 possibilities curve becomes steeper the farther you move along it to the right; that is, the production possibilities curve is bowed out. (Mathematicians call this shape concave.)

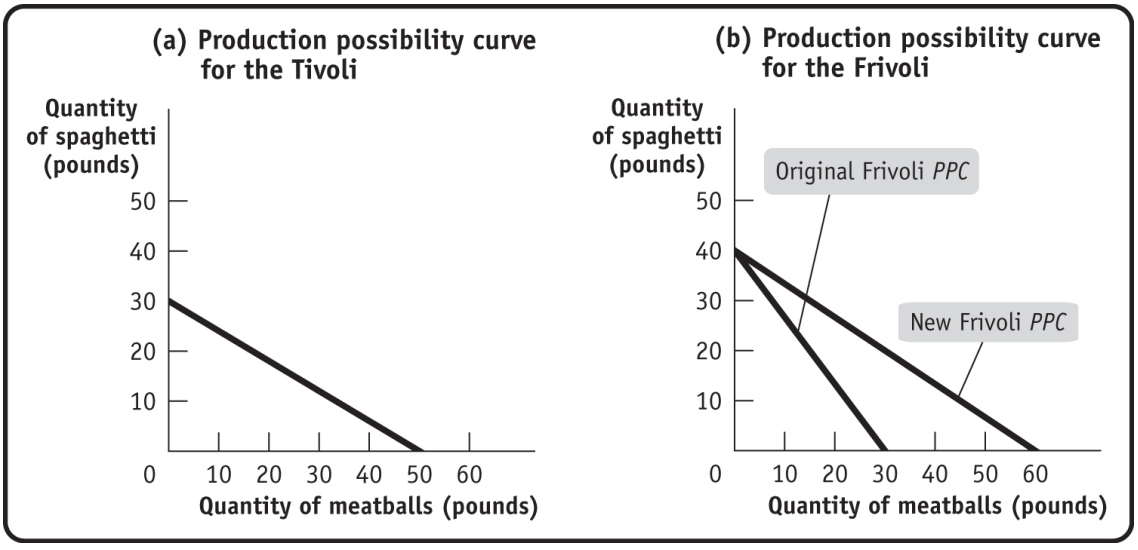
9. a. Forgoing the production of 1 metric ton of fish allows Bermuda to produce 2,000 additional hotel stays. Therefore, forgoing the production of 286 metric tons of fish allows Bermuda to produce 2,000 × 286 = 572,000 additional hotel stays. If all fishermen worked in the hotel industry, Bermuda could produce 538,000 + 572,000 = 1,110,000 hotel stays.

b. Forgoing the production of 2,000 hotel stays allows Bermuda to produce 1 additional metric ton of fish, so giving up 538,000 hotel stays allows Bermuda to produce 538,000/2,000 = 269 additional metric tons of fish. If all hotel employees worked in the fishing industry, Bermuda could produce 286 + 269 = 555 metric tons of fish.

c. The accompanying diagram shows the production possibilities curve for Bermuda. Note that it is a straight line because the opportunity cost is constant. Point A is Bermuda's actual production point.



10. a. The accompanying diagram shows the production possibilities curve for the Tivoli in panel (a) and for the Frivoli as the line labeled "Original Frivoli PPC" in panel (b).



The production possibilities curve 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 3⁄5 of a pound of spaghetti: in order to produce 1 more pound of meatballs, the Tivoli have to give up 3⁄5 of a pound of spaghetti. This means that the slope of their production possibilities curve is −3⁄5. A similar argument for the Frivoli shows that their production possibilities curve has a slope of −4⁄3.

b. For the Tivoli, the opportunity cost of 1 pound of spaghetti is 5⁄3 pounds of meatballs. For the Frivoli, the opportunity cost of 1 pound of spaghetti is 3⁄4 pound of meatballs. That is, the Frivoli have a comparative advantage in spaghetti production because their opportunity cost is lower. For the Tivoli, the opportunity cost of 1 pound of meatballs is 3⁄5 of a pound of spaghetti. For the Frivoli, the opportunity cost of 1 pound of meatballs is 4⁄3 pounds of spaghetti. That is, the Tivoli have a comparative advantage in meatball production because their opportunity cost is lower.

c. The Frivoli's new production possibilities curve is the line labeled "New Frivoli PPC" 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 4⁄6 = 2⁄3; that is, for each pound of meatballs that the Frivoli now produce, they have to give up producing 2⁄3 of a pound of spaghetti. Since the Frivoli's opportunity cost of meatballs (2⁄3) is still higher than the Tivoli's (3⁄5), the Tivoli still have the comparative advantage in meatball production. The

Frivoli's opportunity cost of spaghetti is 3⁄2 pounds of meatballs and the Tivoli's is 5⁄3 pounds of meatballs, so the Frivoli have the comparative advantage in spaghetti production.

11. a. 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.

b. 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 one more bushel of wheat must be higher than 1.7 bushels of corn.

c. This new production point is feasible and efficient in production. Along the production possibilities curve, the economy must forgo 0.666 bushels 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 × 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

12. 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.

13. 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 this data which country has an absolute advantage in either of these goods.

14. 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.

AP Krugman Section 2 Problem Solutions

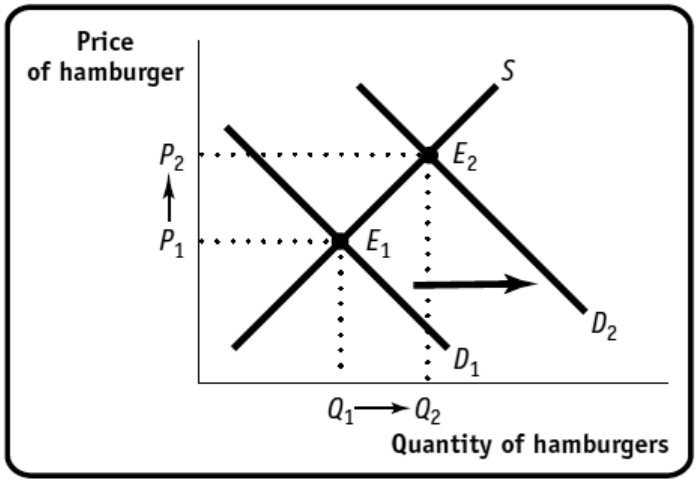
1. a. By reducing their herds, dairy farmers reduce the supply of cream, a leftward shift of the supply curve for cream. As a result, the market price of cream rises, raising the cost of producing a unit of chocolate ice cream. This results in a leftward shift of the supply curve for chocolate ice cream 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.

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.

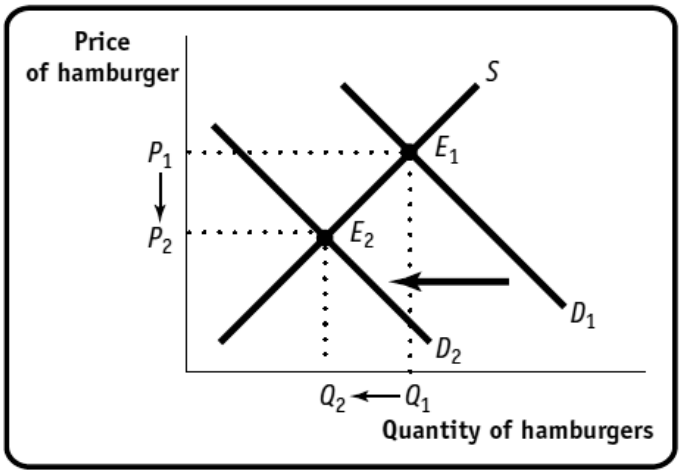
c. The price of a substitute (vanilla ice cream) has fallen, leading consumers to substitute it for chocolate ice cream. The demand for chocolate ice cream decreases, represented by a leftward shift of the demand curve. Both equilibrium price and quantity fall.

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.

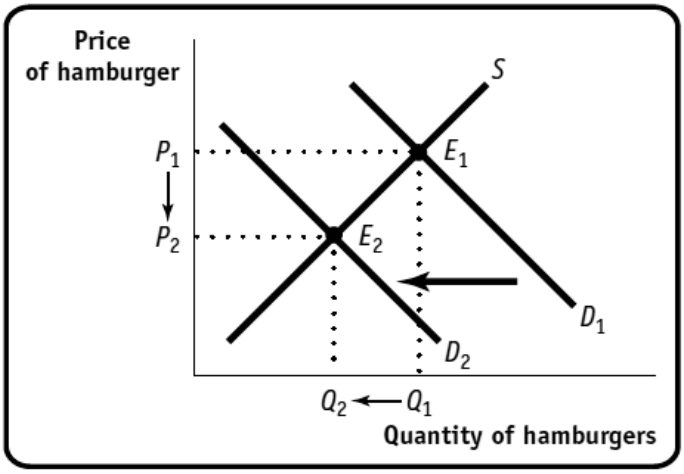
2. a. A rise in the price of a substitute (tacos) causes the demand for hamburgers to increase. This represents a rightward shift of the demand curve from D_1 to D_2 and results in a rise in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



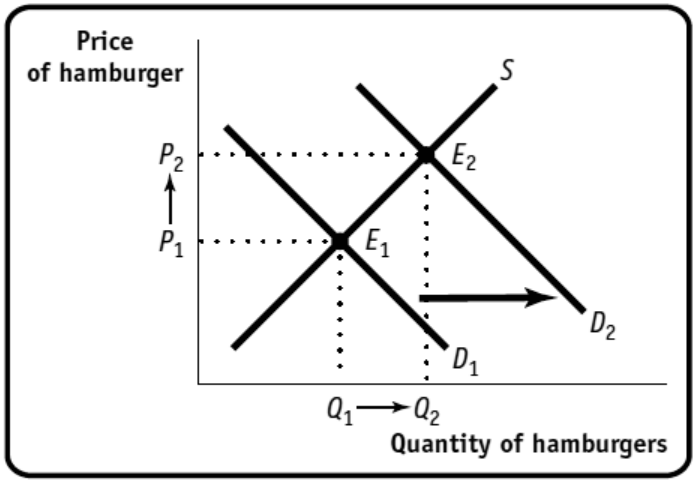
b. A rise in the price of a complement (french fries) causes the demand for hamburgers to decrease. This represents a leftward shift of the demand curve from D_1 to D_2 and results in a fall in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



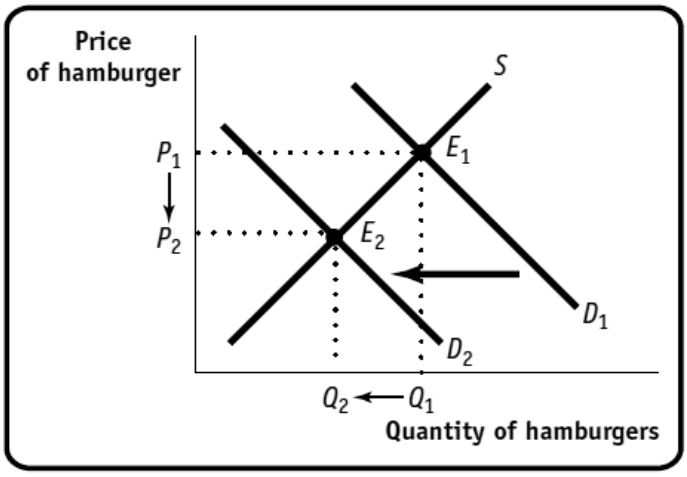
c. A fall in income causes the demand for a normal good (hamburgers) to decrease. This represents a leftward shift of the demand curve from D_1 to D_2 and results in a fall in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



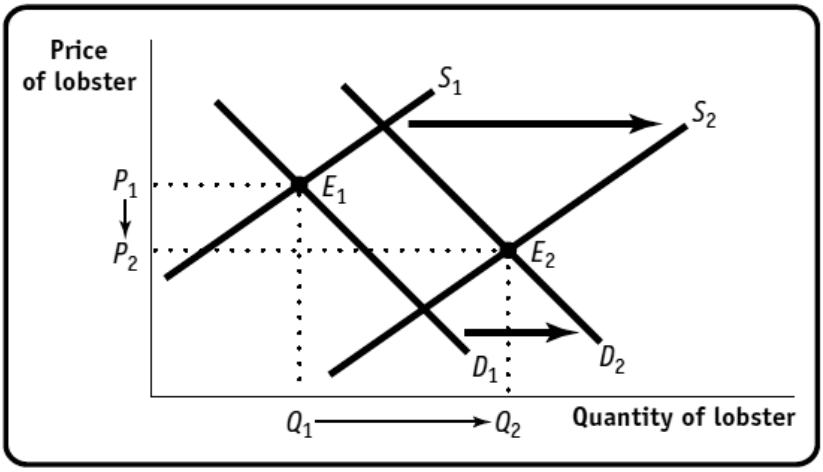
d. A fall in income causes the demand for an inferior good (hamburgers) to increase. This represents a rightward shift of the demand curve from D_1 to D_2 and results in a rise in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



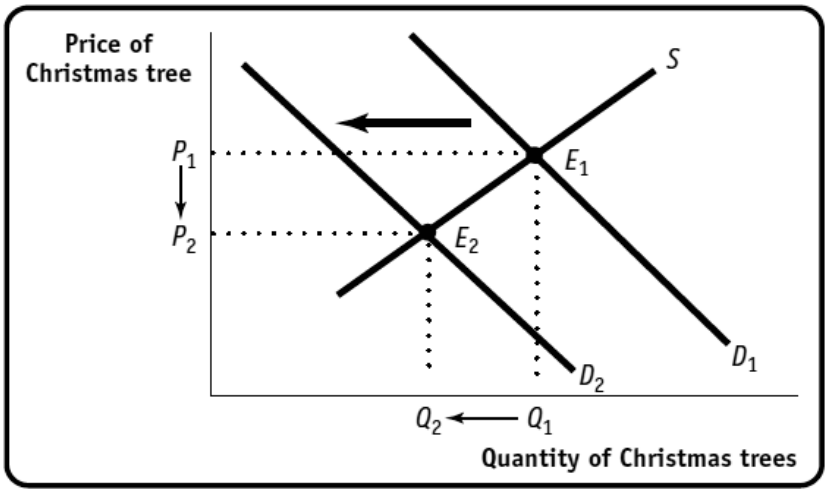
e. A fall in the price of a substitute (hot dogs) causes demand for hamburgers to decrease. This is represented by a leftward shift of the demand curve from D_1 to D_2 and results in a fall in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



3. a. There is a rightward shift of the demand curve from D_1 to D_2 during the summer, as 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.

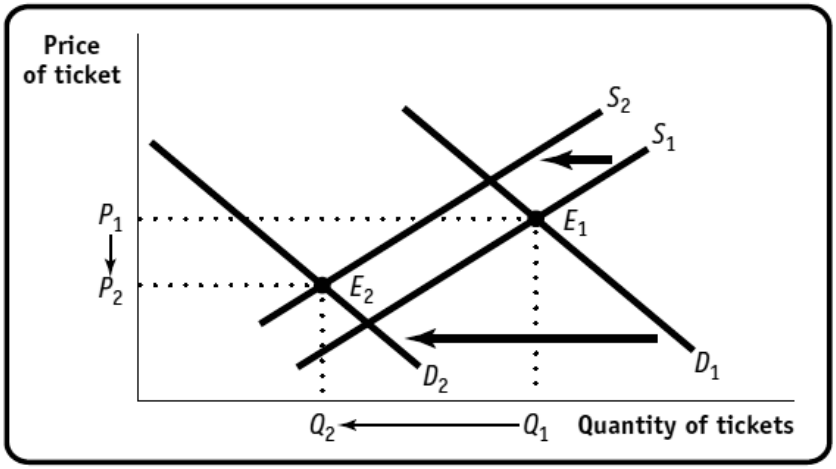


b. There is a leftward shift of the demand curve for Christmas trees after Christmas from D_1 to D_2, as fewer consumers want Christmas trees at any given price. The supply curve does not shift; the reduction in the quantity of trees supplied is a movement along the supply curve. This leads to a fall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

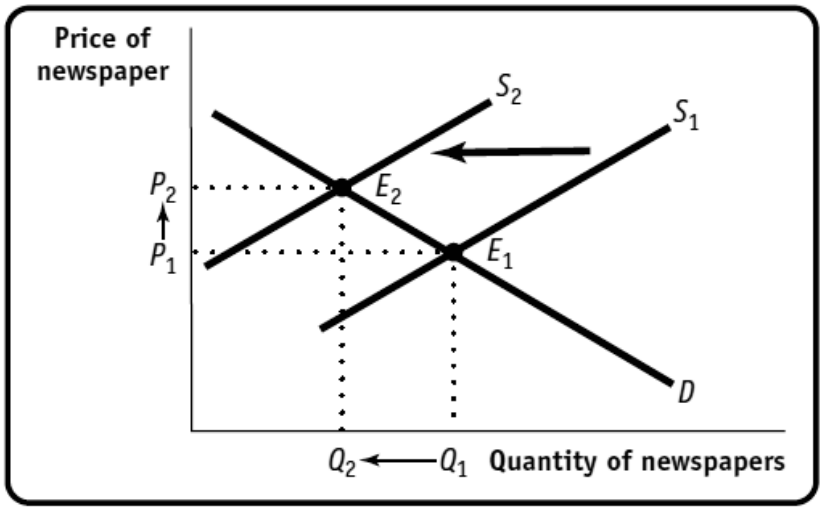


c. There is a leftward shift of the demand curve for tickets to Paris in September, after the end of school vacation, from D_1 to D_2. Other things equal, this leads to a fall in the price of tickets. At the same time, as the cost of operating flights increases, Air France decreases the number of flights, shifting the supply curve leftward from S_1 to S_2. Other

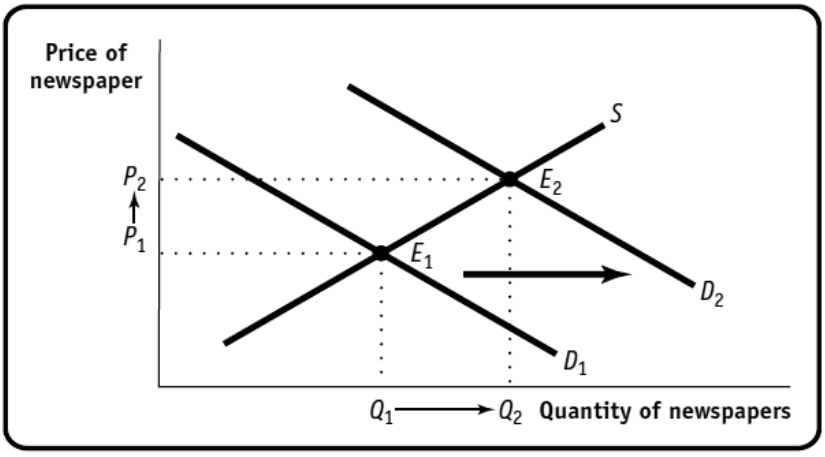
things equal, this leads to a rise in price. Given the simultaneous leftward shifts of both the demand and supply curves, the equilibrium changes from E_1 to E_2. The fall in price indicates that the leftward shift of the demand curve exceeds the leftward shift of the supply curve.



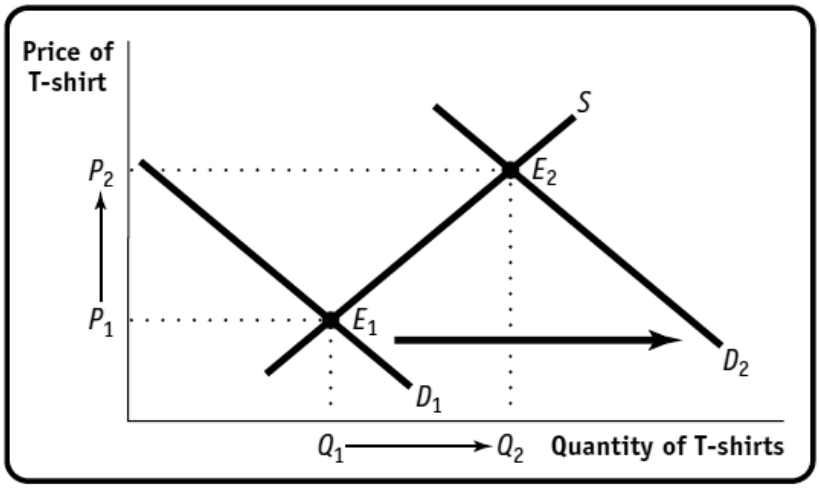
4. a. Case 1: Journalists are an input in the production of newspapers; an increase in their salaries will cause newspaper publishers to reduce the quantity supplied at any given price. This represents a leftward shift of the supply curve from S_1 to S_2 and results in a rise in the equilibrium price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



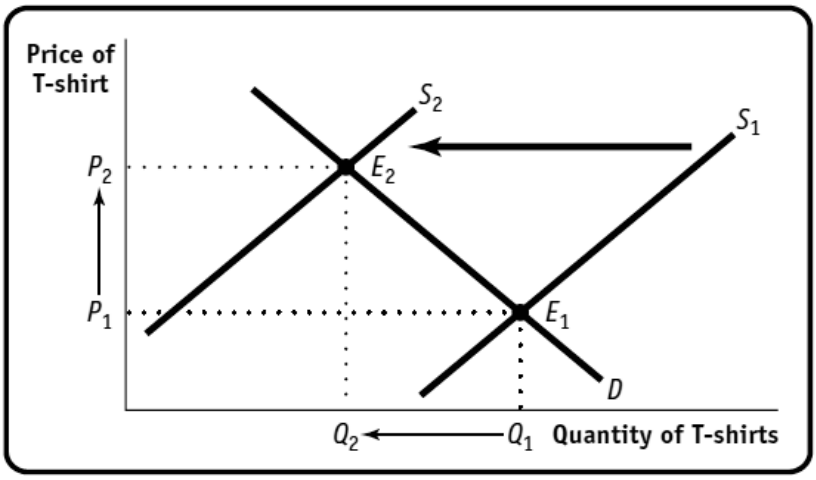
Case 2: Townspeople will wish to purchase more newspapers at any given price. This represents a rightward shift of the demand curve from D_1 to D_2 and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



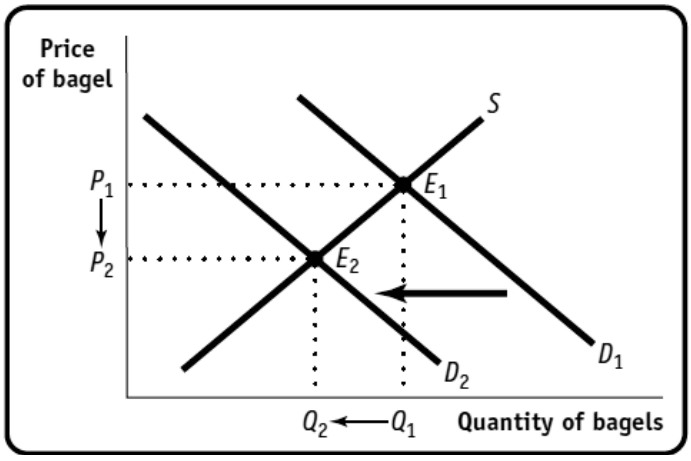
b. Case 1: Fans will demand more St. Louis Rams memorabilia at any given price. This represents a rightward shift of the demand curve from D_1 to D_2 and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



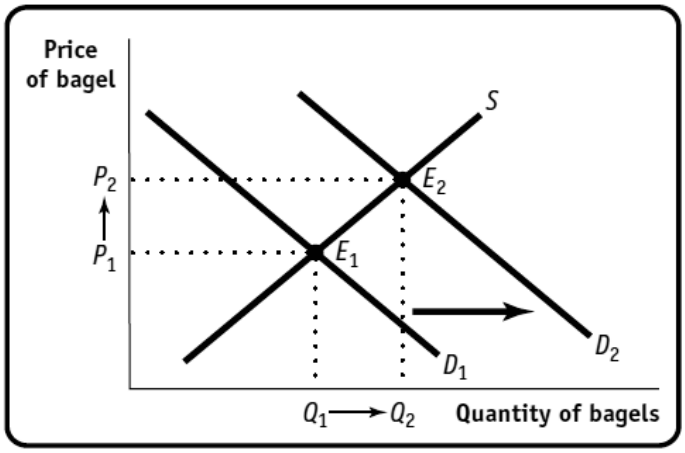
Case 2: Cotton is an input into T-shirts; an increase in its price will cause T-shirt manufacturers to reduce the quantity supplied at any given price, representing a leftward shift of the supply curve from S_1 to S_2. This leads to a rise in the equilibrium price and a fall in the equilibrium quantity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

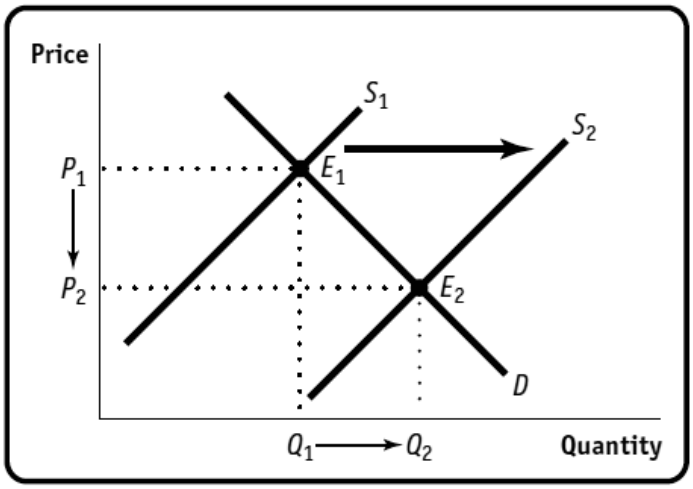


Case 2: Consumers will demand more bagels (a substitute for cooked breakfasts) at any given price. This represents a rightward shift of the demand curve from D_1 to D_2 and leads to a rise in both the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.

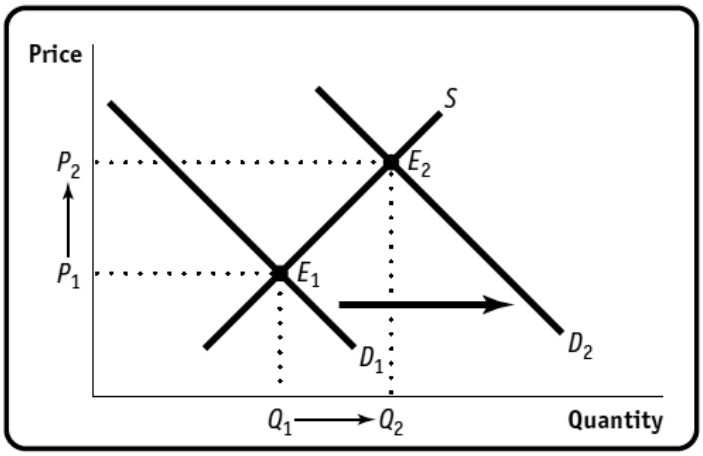


5. a. This statement confuses a shift of a curve with a movement along a curve. A technological innovation lowers the cost of producing the good, leading producers to offer more of the good at any given price. This is represented by a rightward shift of the supply curve from S_1 to S_2. As a result, 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.

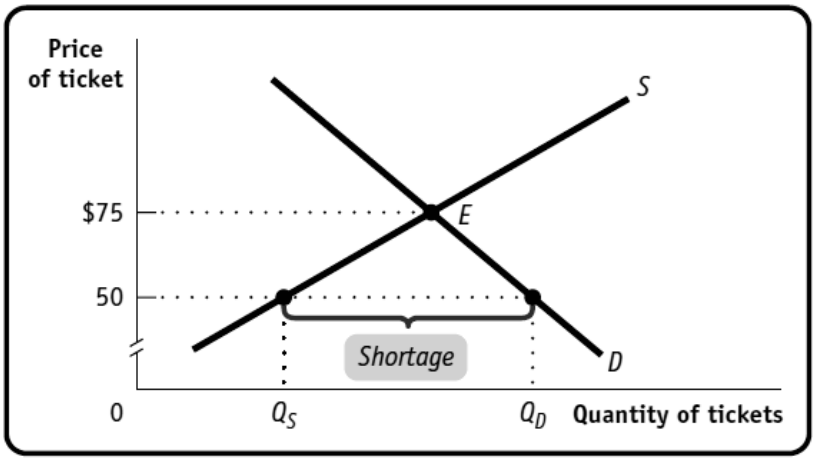


b. This statement also confuses a shift of a curve with a movement along a curve. The health report generates an increase in demand—a rightward shift of the demand curve from D_1 to D_2. This leads to a higher equilibrium price and quantity as we move up along the supply curve, and the equilibrium changes 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.



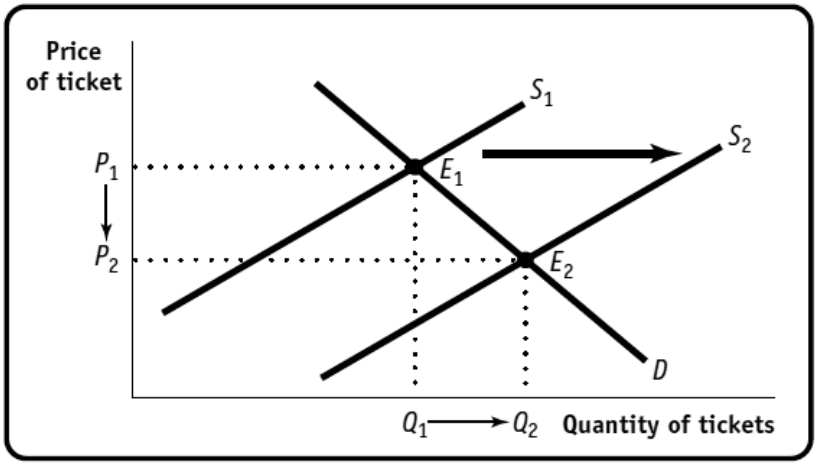
6. a. If markets are competitive, the ticket price is simply the equilibrium price: the price at which quantity supplied is equal to quantity demanded. No one is "made" to pay $75 to go to a concert: a potential concert-goer will pay $75 if going to the concert seems worth that amount and will choose 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.

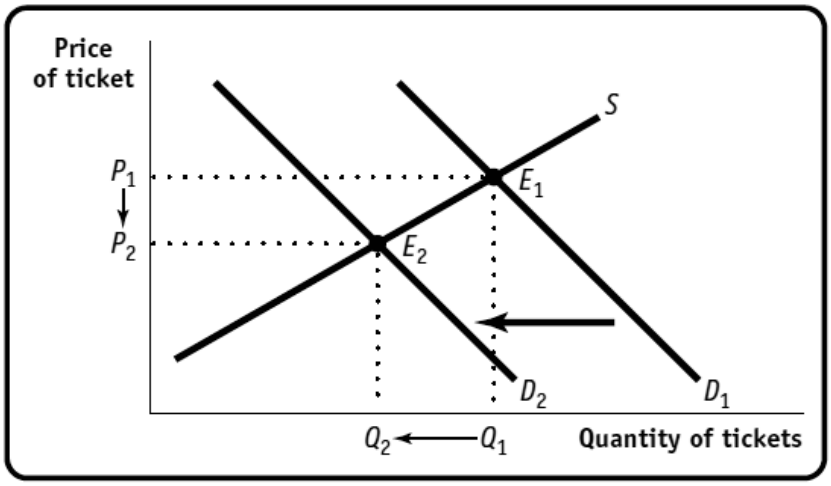


c. The band can lower the average price of a ticket by increasing supply: give more concerts. This is shown as a rightward shift of the supply curve from S_1 to S_2, resulting in

a lower equilibrium price and a higher equilibrium quantity, shown by the change of the equilibrium from E_1 to E_2.

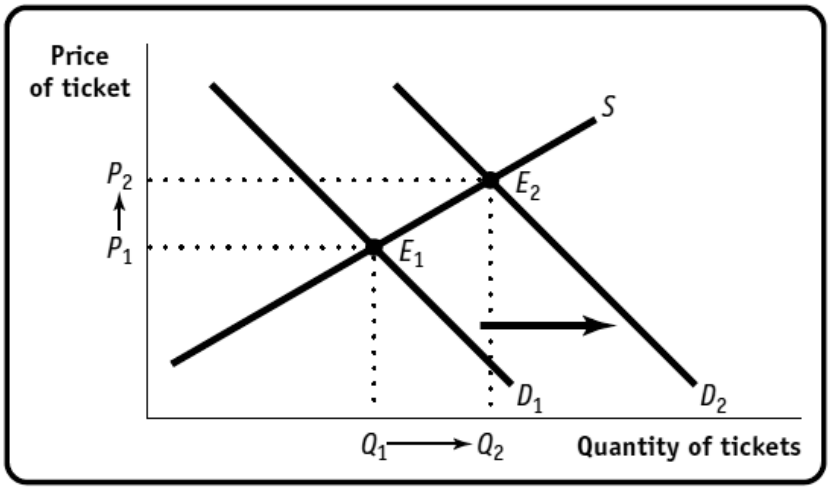


d. If the band's CD is a total dud, the demand for concert tickets is likely to decrease. This represents a leftward shift of the demand curve from D_1 to D_2, resulting in a lower equilibrium price and quantity as the equilibrium changes from E_1 to E_2. This is likely to eliminate the worry that ticket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



7. 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.

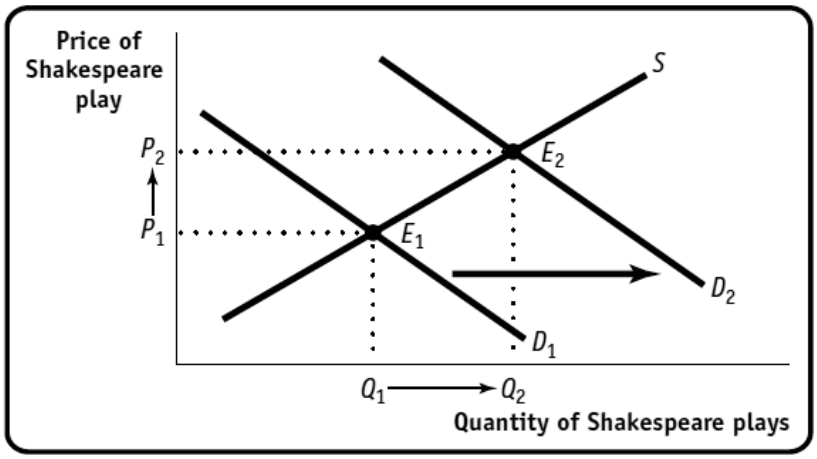
b. This represents a rightward shift of the supply curve, resulting in a fall in the equilibrium price and a rise in the equilibrium quantity.

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.

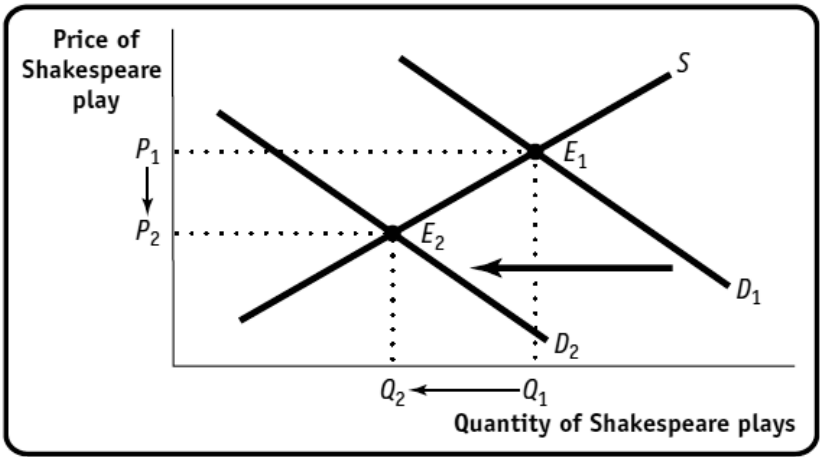
d. If average American income falls sharply, then the demand for handmade acoustic guitars will decrease sharply as well because they are a normal good. This is represented

by a leftward shift of the demand curve, leading to a lower equilibrium price and quantity.

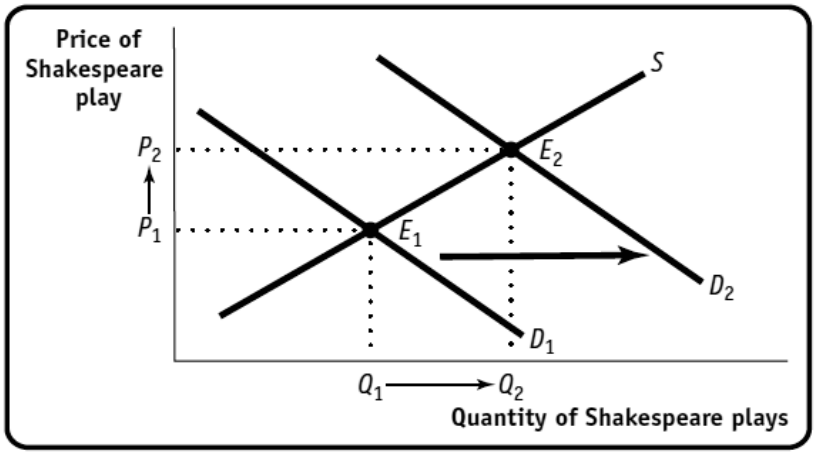
8. a. The death of Marlowe means that the supply of a substitute good (Marlowe's plays) has decreased, and so the price of Marlowe's plays will rise. As a result, the demand for Shakespeare's plays will increase, inducing a rightward shift of the demand curve in the market for Shakespeare's plays from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



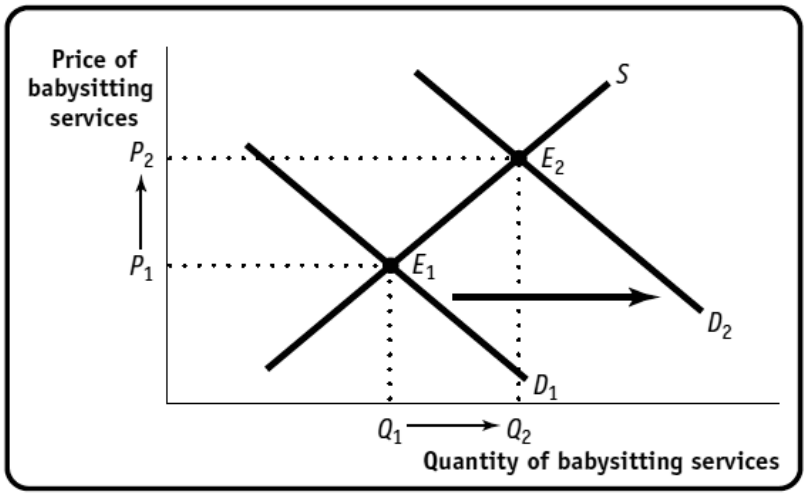
b. After the outbreak of the plague, fewer Londoners will wish to see Shakespeare's plays to avoid contracting the illness, inducing a leftward shift of the demand curve from D_1 to D_2. Equilibrium price and quantity will fall as the equilibrium changes from E_1 to E_2.



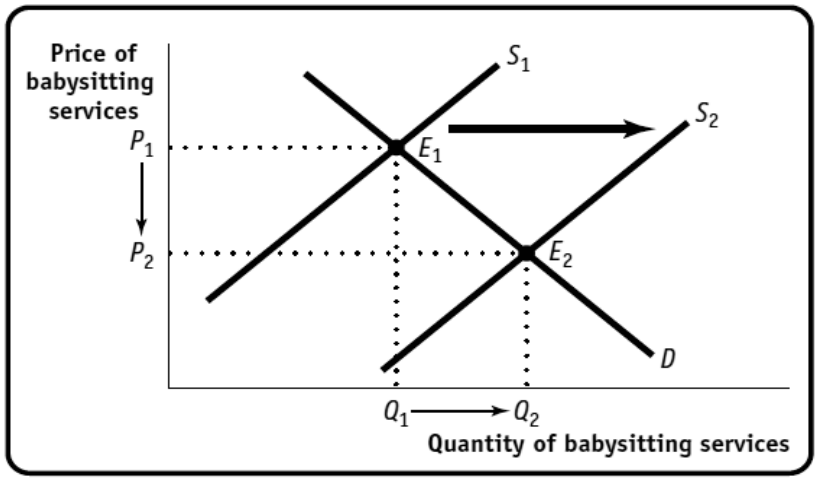
c. Queen Elizabeth's commissions result in a greater quantity of Shakespeare's plays demanded at any given price. This represents a rightward shift of the demand curve from D_1 to D_2, resulting in a higher equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



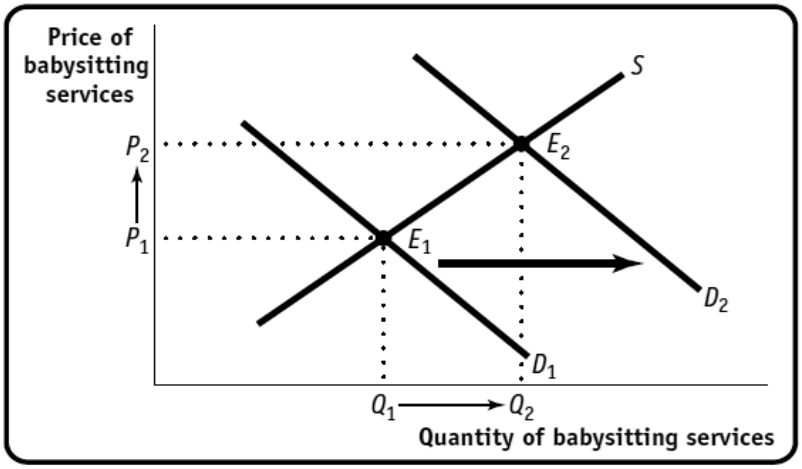
9. a. There are more babies today, so the demand for an hour of babysitting services has increased. This produces a rightward shift of the demand curve for babysitting services from D_1 to D_2, resulting in a rise in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



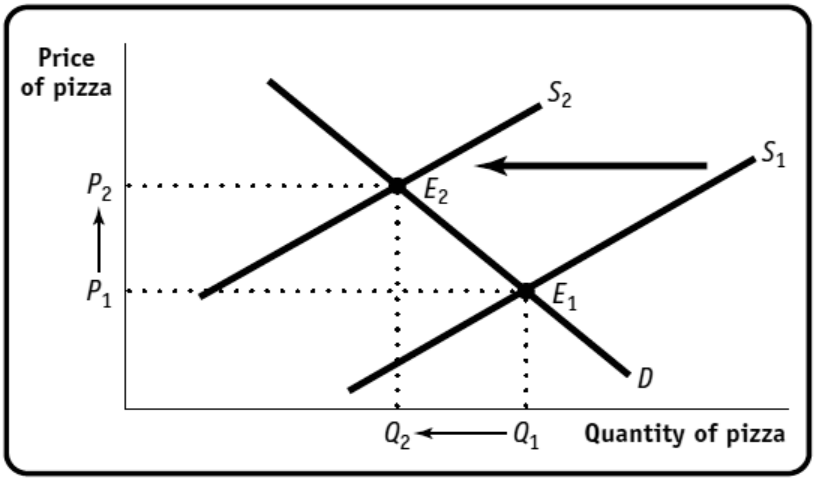
b. The children born today will cause an increase in the supply of babysitters available 14 years from now, when there will be a rightward shift of the supply curve for babysitting services from S_1 to S_2. This will result in a lower equilibrium price and a higher equilibrium quantity as the equilibrium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



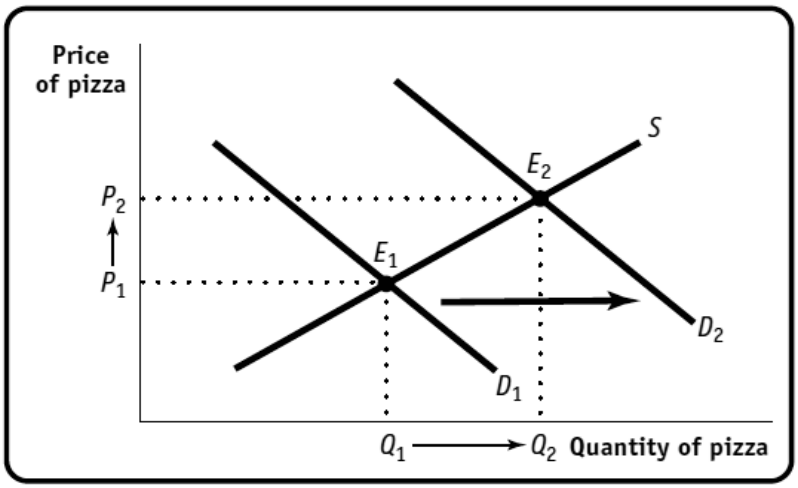
c. It is likely that there will be an increase in the birth rate 30 years from now. Therefore, there will be an increase in the demand for babysitting services, shifting the demand curve rightward from D_1 to D_2. This will result in a higher equilibrium quantity and price as the equilibrium changes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



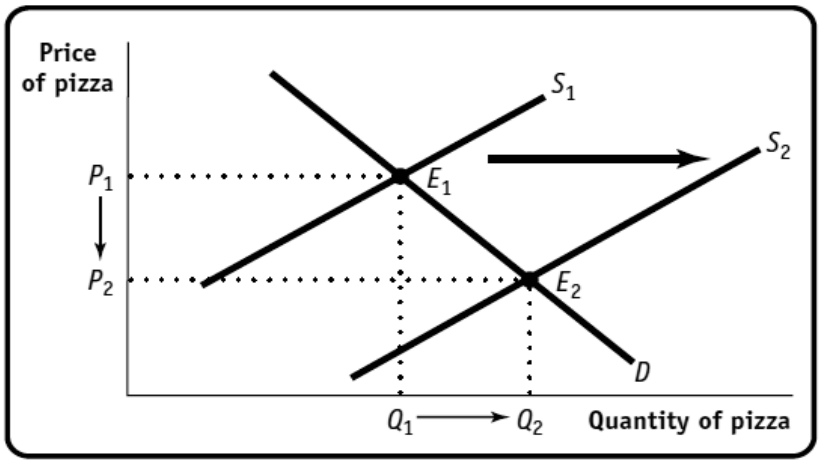
10. a. Mozarella is an input in the production of pizza. Since the cost of an input has risen, pizza producers will reduce the quantity supplied at any given price, a leftward shift of the supply curve from S_1 to S_2. As a result, the equilibrium price of pizza will rise and the equilibrium quantity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



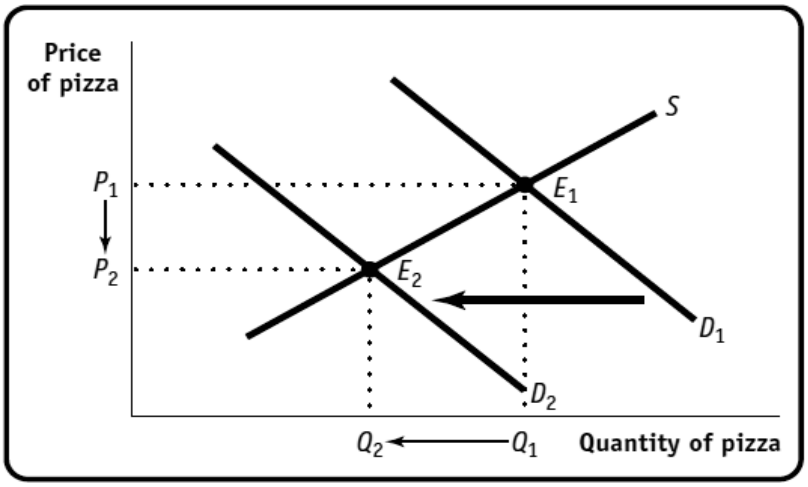
b. Consumers will substitute pizza in place of hamburgers, resulting in an increased demand for pizza at any given price. This generates a rightward shift of the demand curve from D_1 to D_2, leading to a rise in the equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



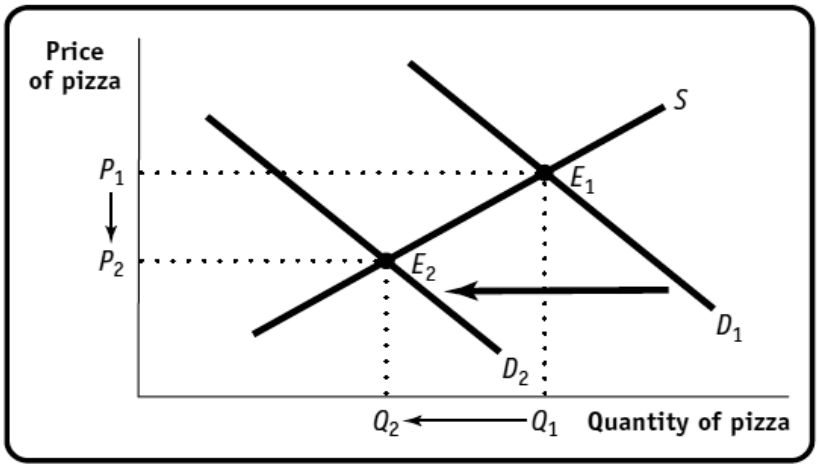
c. Tomato sauce is an input in the production of pizza. Since the cost of an input has fallen, pizza producers will increase the quantity supplied at any given price, a rightward shift of the supply curve from S_1 to S_2. As a result, the equilibrium price of pizza will fall and the equilibrium quantity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



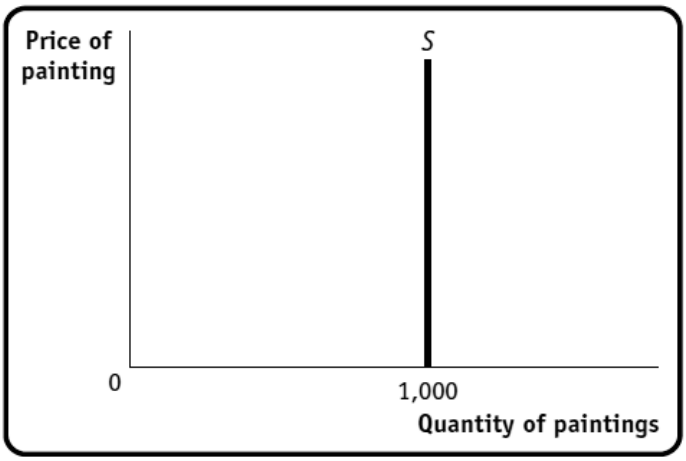
d. The demand for an inferior good decreases when the incomes of consumers rise. So a rise in consumer incomes produces a leftward shift of the demand curve from D_1 to D_2, resulting in a lower equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



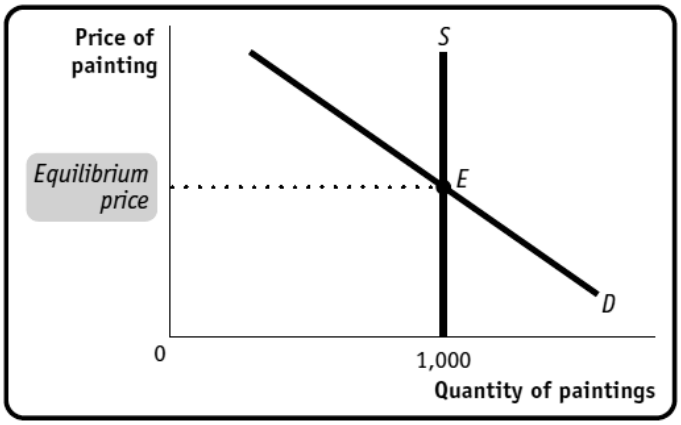
e. Consumers will delay their purchases of pizza today in anticipation of consuming more pizza next week. As a result, the demand curve shifts leftward from D_1 to D_2, resulting in a lower equilibrium price and quantity as the equilibrium changes from E_1 to E_2.



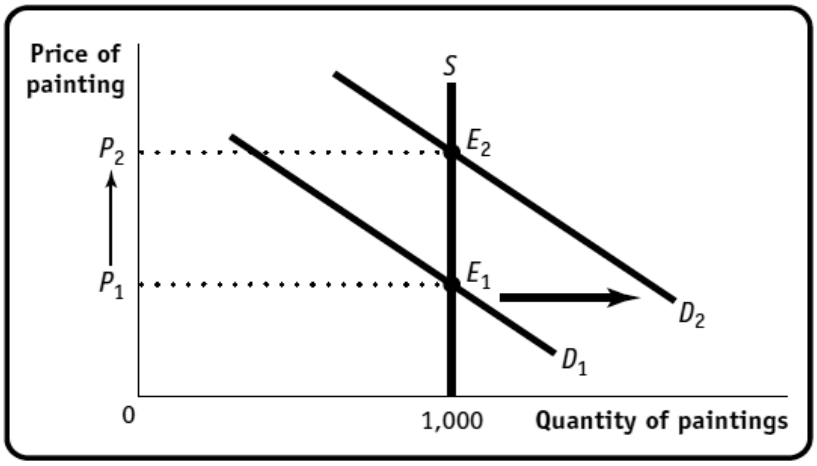
11. a. There are no more Picasso Blue Period works available. Hence the supply curve is a vertical line at the quantity 1,000.



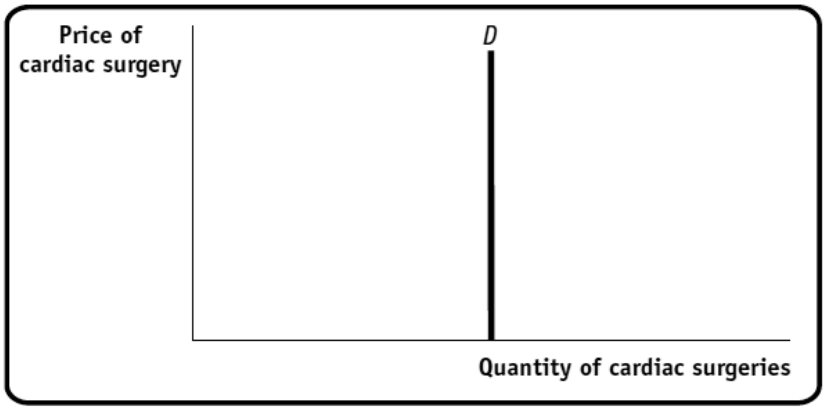
b. Since supply is fixed, the price of a Picasso Blue Period work is entirely determined by demand. Any change in demand is fully reflected in a change in price.



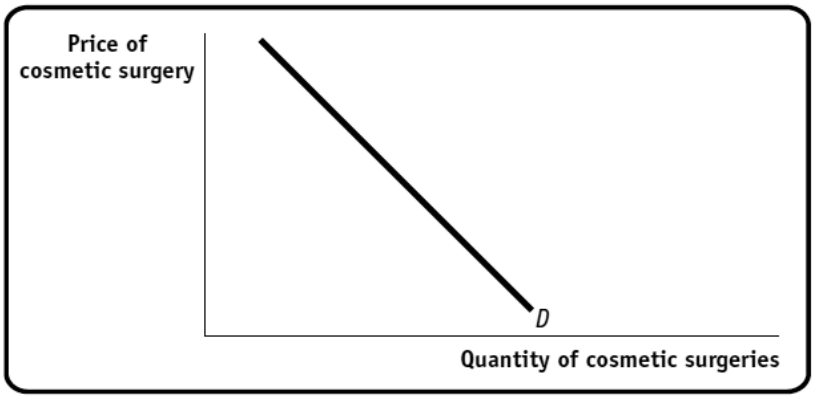
c. This results in a rightward shift of the demand curve for these works from D_1 to D_2, and the equilibrium changes from E_1 to E_2. But since no more works are available, this increase in demand simply results in an increase in the equilibrium price.



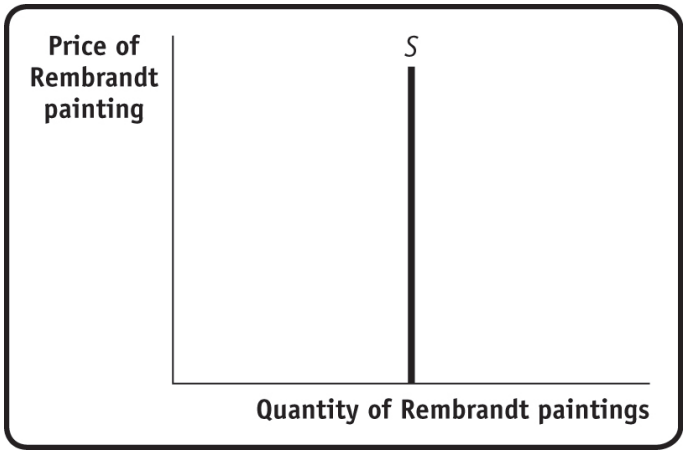
12. a. Since the government pays the full cost of cardiac bypass surgery, the price paid by the patient is always zero. Consequently, the demand for surgery is constant, regardless of the price actually paid by the government. The quantity demanded is constant at the quantity that would be demanded by 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 was zero.



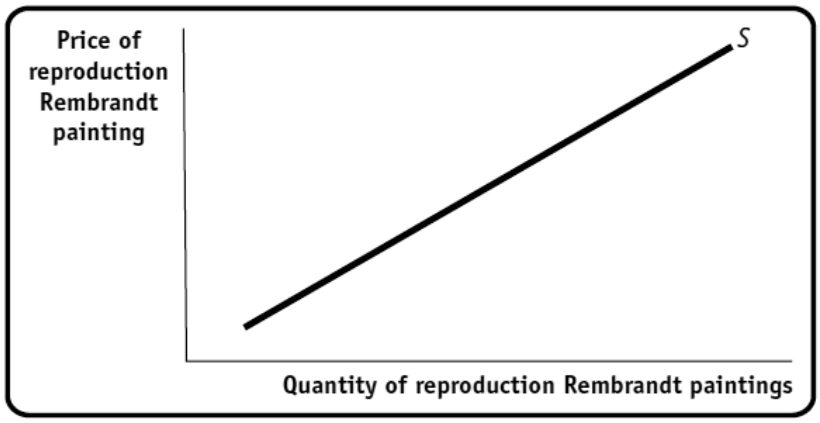
b. In this case the patient must pay the cost of the surgery; so the quantity demanded is affected by price, and the demand curve has its usual downward-sloping shape.



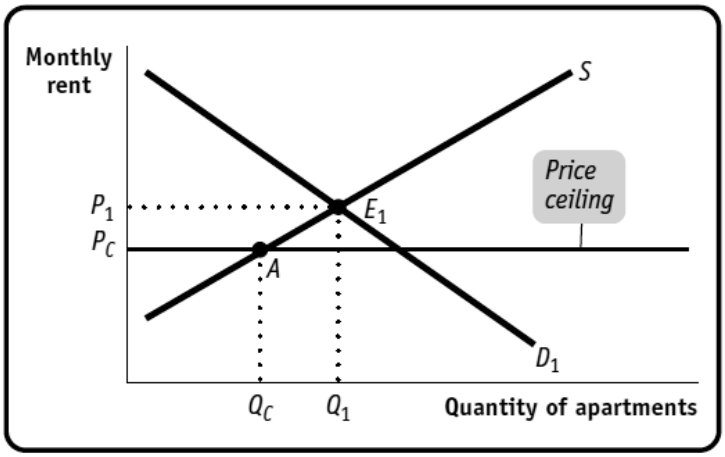
c. The supply of Rembrandt paintings is fixed because no more can be produced. So the supply curve for these paintings is a vertical line at the quantity of Rembrandt paintings that exist.



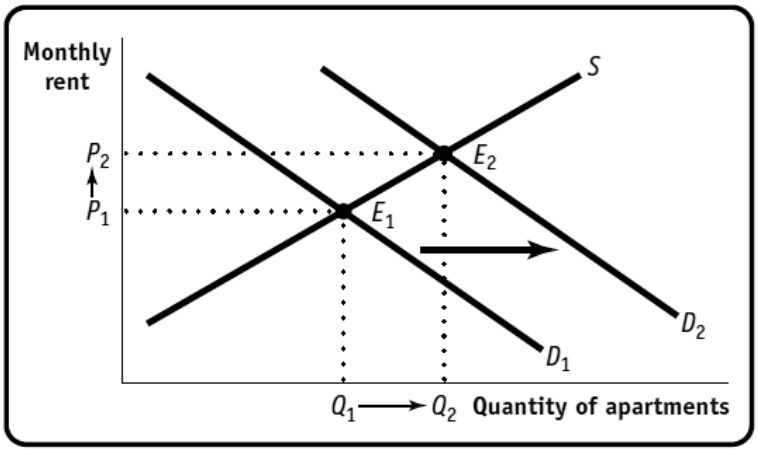
d. The supply of Rembrandt reproductions is not fixed because they can be created by existing artists. So the supply curve of these reproductions has the familiar upward-sloping shape.



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.



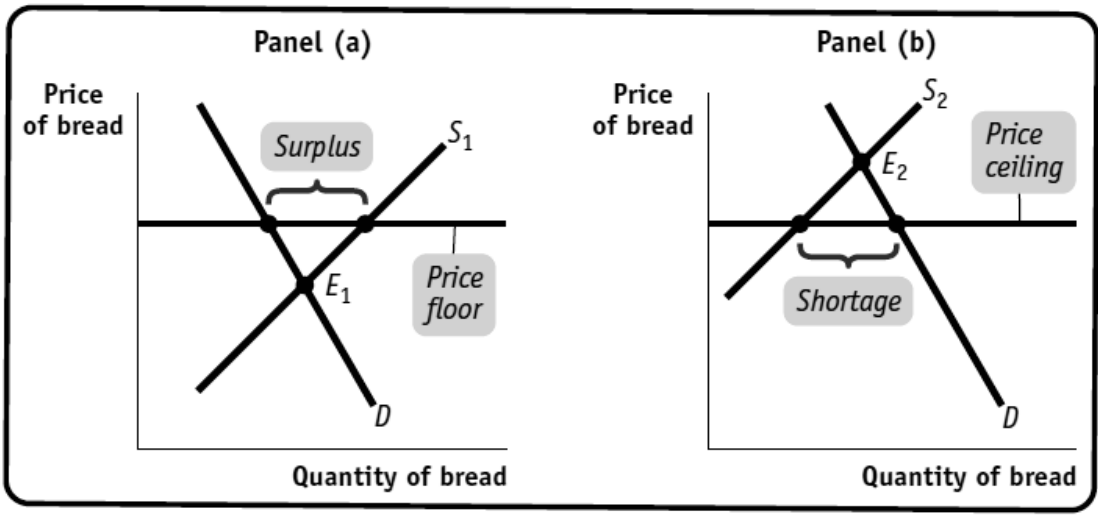
b. The income-supplement policy causes a rightward shift of the demand curve from D_1 to D_2. This results in an increase in the equilibrium rent, from P_1 to P_2, and an increase in the equilibrium quantity, from Q_1 to Q_2, as the equilibrium changes from E_1 to E_2.



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.

14. 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.



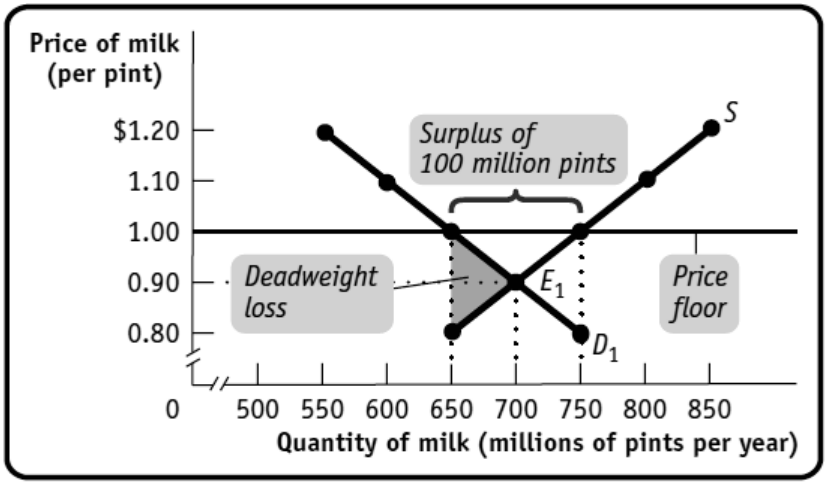
b. As with all price floors above the equilibrium price, there are several associated inefficiencies. First, there is deadweight loss from inefficiently low quantity. Some transactions that would have occurred at the unregulated market price no longer occur. Second, there is inefficient allocation of sales among bakers. Some bakers who have higher cost get to operate, while some who have lower cost do not. 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.

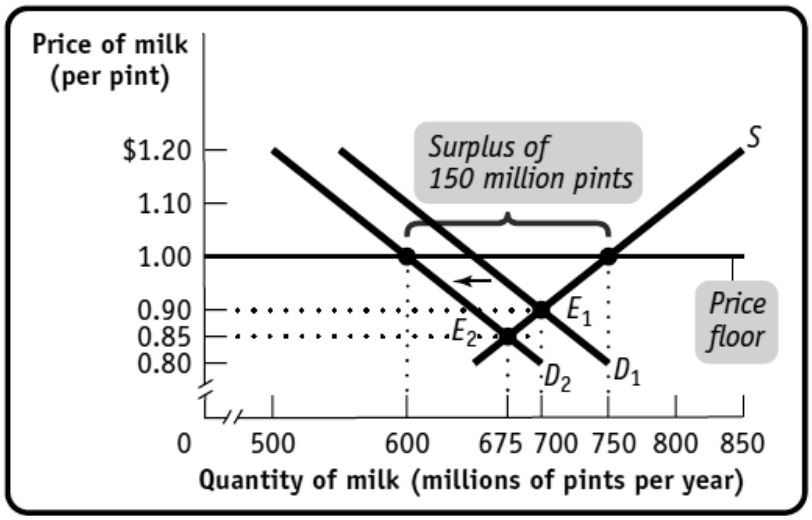
15. a. With demand of D_1 and supply of S, the equilibrium would be at point E_1 in the accompanying diagram. However, with a price floor at \$1, the quantity supplied is 750 million pints and the quantity demanded is 650 million pints. So the policy causes a surplus of milk of 100 million pints per year.



b. 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.

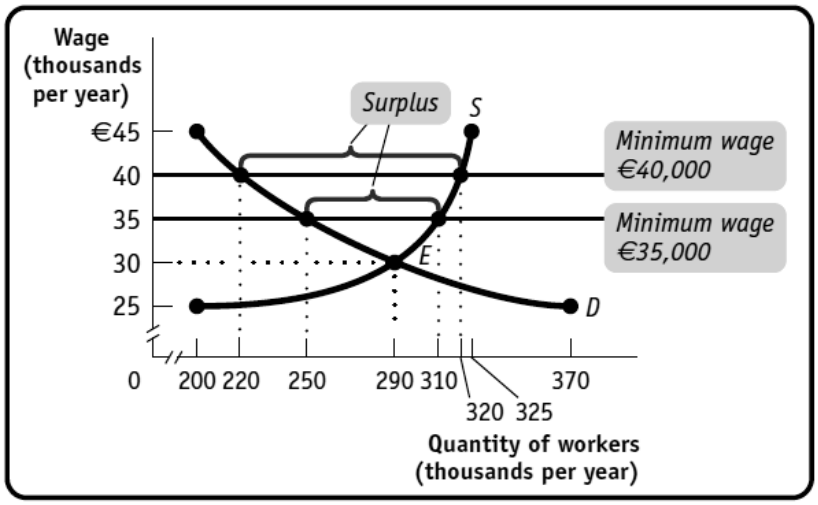
c. As a result of sales of cheap milk to schools, the quantity demanded falls by 50 million pints per year at any price: the demand curve shifts leftward to the new demand curve D_2. Without the price floor, the equilibrium would now be at point

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 × 150 million = \$90 million), so that the policy costs the government \$150 million -\$90 million = \$60 million.



d. One inefficiency arising from wasted resources is the government's cost of purchasing and selling surplus milk. This effort which could be used for other productive purposes represents a missed opportunity. Another inefficiency is the higher cost incurred by farmers of producing more than the market equilibrium quantity of milk using scarce resources. The inability to use these resources for other more productive uses represents a missed opportunity.

16. 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 yearly wage of 35,000 euros, employers would demand 250,000 workers, while 310,000 workers want jobs. This results in a surplus of 60,000 workers, which represents involuntary unemployment. At a minimum yearly wage of 40,000 euros, employers would demand 220,000 workers, while 320,000 workers want jobs. Involuntary unemployment increases to 100,000 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 were 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.

17. The introduction of a quota limit—limiting the workweek to 35 hours, below the current equilibrium quantity—implies that there is quota rent earned by the suppliers of labor. So it should not come as a surprise that workers who expected to keep their jobs under the new policy were in favor of the policy. The demand price (the price paid by the demanders of labor, that is, firms), compared to what the wage had been before the introduction of the policy, had risen. Furthermore, since it is costly to train new workers, firms could not use new hires to completely make up for the shortfall in the hours that their current employees were working. As a result, firms had to produce less output and earn lower revenue than before the policy. Like every quota that is below the equilibrium quantity, this quota introduced inefficiency: even if workers wanted to work longer hours and firms agreed to this arrangement, such trades were no longer legally possible. You should expect some black market activity to occur: workers working longer hours off the books.

18. 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 × □$5 = □$2,000. Corn farmers sell 1,200 bushels (800 to consumers and 400 to the government) and therefore make 1,200 ×□ $5 = $6,000 in revenue.

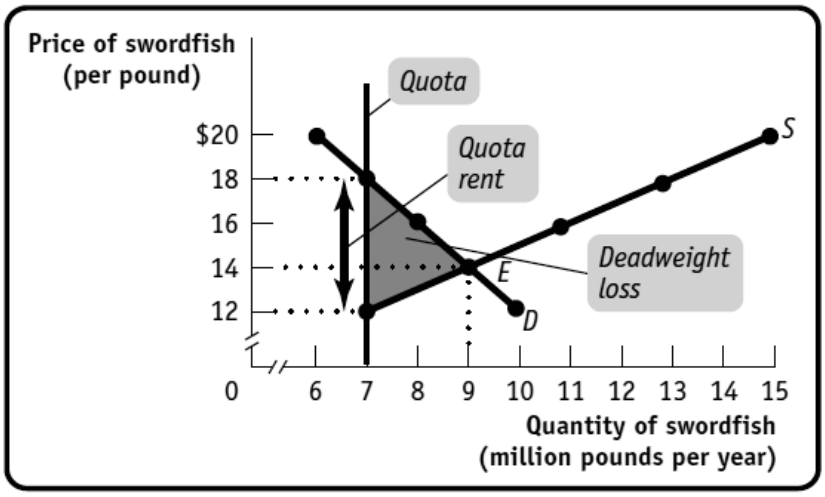
b. If the government sets a target price of $5, the market reaches equilibrium at a price of $3 and a quantity of 1,000 bushels. There is no surplus (or shortage). The government does not buy any corn under this policy. For each bushel sold the government pays

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 × □$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. In part a, the inefficiency arises from the wasted resources of farmers in producing a quantity greater than the market equilibrium, as well as the government resources used to buy the surplus. In part b, the farmers produce an efficient quantity; however, there is still inefficiency caused by the government's use of resources that could be used for more productive activities.

19. 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.)

20. a. If the government adopts a quota that is less than the equilibrium quantity of imported trucks, fewer trucks will be imported. As a result, the price of imported trucks will rise, which will also cause the price of U.S. trucks (a substitute) to rise. A deadweight loss will result.

b. U.S. automakers that compete against the imported trucks will benefit from higher prices and less competition. However, consumers of trucks will lose, as prices for all trucks rise. An inefficiency arises because some consumers who had been willing to pay the equilibrium price can no longer afford the higher price, which creates a missed opportunity.

AP Krugman Section 3 Problem Solutions

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. 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. All figures below are in billions of dollars.

a. Consumer spending is $1,082.8 + $2,833.0 + $5,794.4 = $9,710.2.

b. Private investment spending is $2,134.0 − $3.6 = $2,130.4.

c. Net exports are $1,662.4 − $2,370.2 = −$707.8.

d. Government purchases of goods and services and investment spending are $1,695.5 + $979.3 = $2,674.8.

e. Gross domestic product is $9,710.2 + $2,130.4 + $2,674.8 − $707.8 = $13,807.6.

f. Consumer spending on services as a percentage of total consumer spending is ($5,794.4/$9,710.2) × 100 = 59.7%.

g. Exports as a percentage of imports is ($1,662.4/$2,370.2) × 100 = 70.1%.

h. Government purchases of goods and services on national defense as a percentage of federal purchases of goods and services is ($662.2/$979.3) × 100 = 67.6%.

4. a. To calculate GDP as the value added in production, we need to sum all value added (value of output less input costs) 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 estimate 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. a. To calculate GDP as the value added in production, we need to sum all value added (value of output less input costs) 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 $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. GDP equals $275 because the bread company sells $50 worth as final goods, the cheese company sells $25 worth as final goods, and all $200 worth of pizzas are final goods.

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. a. Real GDP is greater than nominal GDP for all years before 2000 because from 1960 to 2000 prices rose. So to calculate real GDP for the years 1960, 1970, 1980, and 1990, we would multiply output in those years by the higher prices that existed in 2000. To calculate nominal GDP, we would multiply output by the lower prices that existed in those particular years. Since prices rose from 2000 to 2007, valuing the output in 2007 using 2000 prices (real GDP) will result in a lower number than valuing the output in 2007 using 2007 prices. Real GDP equals nominal GDP in 2000 because the year 2000 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, and 1990 to 2000. The percent change in real GDP was the highest during the 1960s.

Year	Real GDP (billions of 2000 dollars)	Percent change in real GDP
1960	$2,501.8	
1970	3,771.9	50.8%
1980	5,161.7	36.8%
1990	7,112.5	37.8%
2000	9,817.0	38.0%

c. We can calculate real GDP per capita by dividing real GDP by population. The accompanying table shows real GDP per capita for each of the years in the table. Remember that real GDP is measured in billions and population is measured in thousands. Real GDP per capita in 1960 was $13,847.27 (equal to $2,501,800,000,000/180,671,000).

Year	Real GDP (billions of 2000 dollars)	Population (thousands)	Real GDP Per capita
1960	$2,501.8	180,671	$13,847.27
1970	3,771.9	205,052	18,394.85
1980	5,161.7	227,726	22,666.27
1990	7,112.5	250,132	28,434.99
2000	9,817.0	282,388	34,764.23
2007	11,566.8	301,140	38,410.04

d. The accompanying table shows the percent change in real GDP per capita from 1960 to 1970, 1970 to 1980, 1980 to 1990, and 1990 to 2000. The percent change in real GDP per capita was the highest during the 1960s.

Year	Real GDP (billions of 2000 dollars)	Population (thousands)	Real GDP Per capita	Percent change in real GDP per capita
1960	$2,501.8	180,671	$13,847.27	
1970	3,771.9	205,052	18,394.85	32.8%
1980	5,161.7	227,726	22,666.27	23.2%
1990	7,112.5	250,132	28,434.99	25.5%
2000	9,817.0	282,388	34,764.23	22.3%

e. In this example, the percent change in real GDP is larger than the percent change in real GDP per capita. As long as the population is growing, the two will always have this relationship.

7. a. The percent change in the price of an English textbook from 2008 to 2010 is 14.0% (equal to (($57 − $50)/$50) × 100).

b. The percent change in the price of a math textbook from 2008 to 2010 is 5.7% (equal to (($74 − $70)/$70) × 100).

c. The percent change in the price of an economics textbook from 2008 to 2010 is 25% (equal to (($100 − $80)/$80) × 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 2008 = 100).

Cost of textbooks in 2008 = (3 × $50) + (2 × $70) + (4 × $80) = $610

Cost of textbooks in 2009 = (3 × $55) + (2 × $72) + (4 × $90) = $669

Cost of textbooks in 2010 = (3 × $57) + (2 × $74) + (4 × $100) = $719

Index value for 2008 = ($610/$610) × 100 = 100

Index value for 2009 = ($669/$610) × 100 = 109.7

Index value for 2010 = ($719/$610) × 100 = 117.9

e. The percent change in the price index for textbooks from 2008 to 2010 is 17.9% (equal to ((117.9 − 100)/100) × 100).

8. 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 286.93 and for the college student is 151.94. Since the CPI for the average consumer was 210.2, the CPI overstates the increase in the cost of living for the college student and understates it for the retired person.

For the retired person:

	Weight	CPI November 2007	CPI Contribution
Housing	0.1	210.7	21.07
Food	0.15	206.3	30.945
Transportation	0.05	190.7	9.535
Medical Care	0.6	357.0	214.2
Education	0	121.4	0
Recreation	0.1	111.8	11.18
Overall CPI			**286.93**

For the college student:

	Weight	CPI November 2007	CPI Contribution
Housing	0.05	210.7	10.535
Food	0.15	206.3	30.945
Transportation	0.2	190.7	38.14
Medical Care	0	357.0	0
Education	0.4	121.4	48.56
Recreation	0.2	118.8	23.76
Overall CPI			**286.93**

9. Answers will vary with the latest data. For January 2010, the CPI was 216.7. The CPI was unchanged from the previous month, and had increased by 2.1% over the last year.

10. 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.

	2002	2003	2004	2005	2006
Real GDP (billions of 2000 dollars)	10,048.80	10,301.00	10,675.80	11,003.40	11,319.40
Nominal GDP (billions of dollars)	10,649.60	10,960.80	11,685.90	12,433.90	13,194.70
GDP deflator	104.19	106.41	109.46	113.00	116.57

b. The inflation rate obtained by using the GDP deflator is calculated using the formula ((current GDP deflator − GDP deflator in the previous year)/(GDP deflator in the previous year)) × 100, yielding the figures in the accompanying table.

	2002	2003	2004	2005	2006
GDP deflator	104.19	106.41	109.46	113.00	116.57
Inflation		2.13%	2.87%	3.23%	3.16%

11. a. The cost of living for an average college student in 2006 is as follows:

Two-year public college: commuter: $12,294

Four-year public college: resident: $16,087

Four-year public college: commuter: $16,967

Four-year public college: out-of-state: $26,304

Four-year private college: resident: $33,301

Four –year private college: commuter: $33,085

The cost of living for an average college student in 2007 is as follows:

Two-year public college: commuter: $13,126

Four-year public college: resident: $17,336

Four-year public college: commuter: $18,014

Four-year public college: out-of-state: $27,791

Four-year private college: resident: $35,374

Four –year private college: commuter: $35,001

b. The inflation rate would be calculated as the ((Cost of living in 2007 – Cost of living in 2006)/(Cost of living in 2006)) x 100 as follows:

Two-year public college: commuter: 6.77%

Four-year public college: resident: 7.76%

Four-year public college: commuter: 6.17%

Four-year public college: out-of-state: 5.65%

Four-year private college: resident: 6.23%

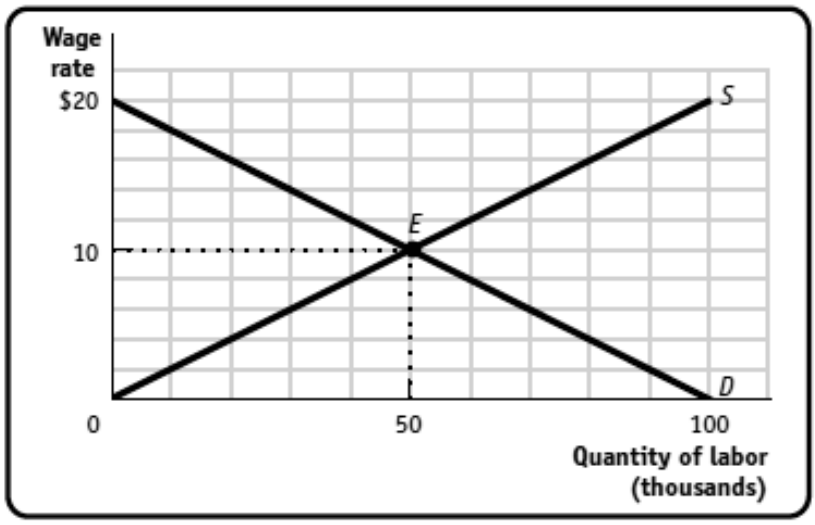
Four –year private college: commuter: 5.79%

12. Answers will vary with the latest data. For February 2010, the unemployment rate was 9.7%, which was unchanged from January 2010. Since February 2009, the unemployment rate has increased by 1.5%.

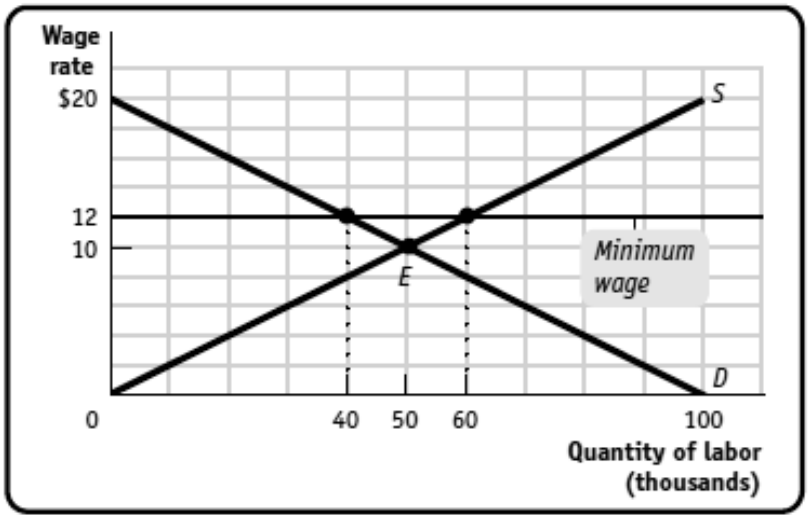
13. In general, the change in the unemployment rate varies inversely with the rate of growth in real GDP: when the economy is growing, we expect the unemployment rate to be falling rapidly. However, after several quarters of a severe recession, unemployed workers may become discouraged and stop looking for work. Since the definition of unemployed persons requires that they be looking for work, 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 to attract new workers, leave existing jobs to search for new ones and discouraged workers begin to search for jobs again.

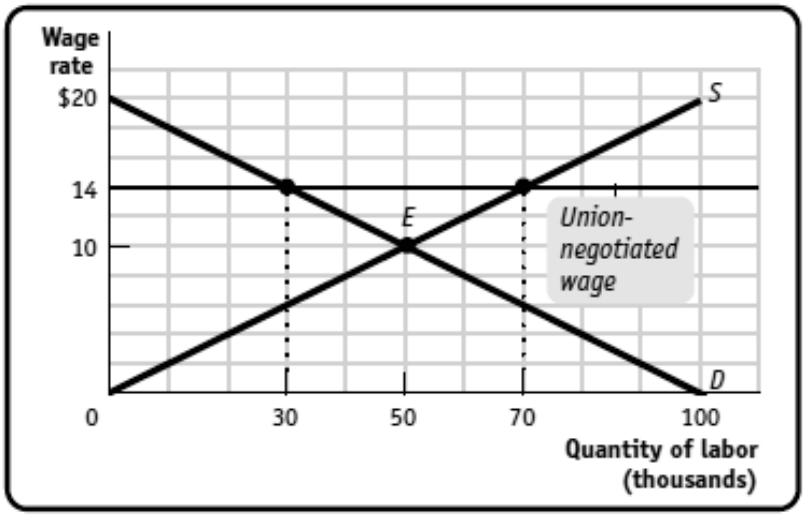
14. a. The equilibrium wage rate is $10. At this wage rate, there will be 50,000 employed workers, no unemployed workers, a labor force of 50,000, and an unemployment rate of 0%.



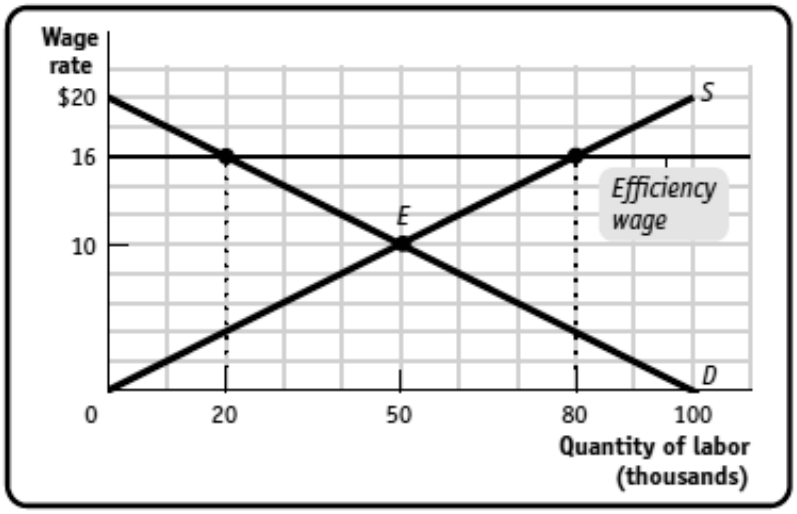
b. If the government of Profunctia sets a minimum wage equal to $12, 60,000 workers (the size of the labor force) will be looking for work but only 40,000 will find jobs. There will be 20,000 unemployed workers, and the unemployment rate will be 33.3% ((20,000/60,000) × 100).



c. If unions bargain with the firms in Profunctia and set a wage rate equal to $14, 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) × 100).



d. If the concern for retaining workers and encouraging high-quality work leads firms to set a wage rate of $16, 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) × 100).



15. 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.

	Employed (thousands)		
Region	**March 2007**	**March 2008**	**Change**
Northeast	26,665.7	26,685.3	19.6
South	51,902.9	52,300.1	397.2
Midwest	33,106.1	33,177.8	71.7
West	33,643.8	33,988.9	345.1

b. The accompanying table shows the change in the size of the labor force during the period March 2007 to March 2008.

Region	**Growth in the labor force (thousands)**
Northeast	172.1
South	670.1
Midwest	224.3
West	671.5

c. The unemployment rate is calculated as (Number of unemployed workers/ labor force) × 100, as shown in the accompanying table.

	Unemployment rate	
Region	**March 2007**	**March 2008**
Northeast	4.3%	4.8%
South	4.2	4.7
Midwest	4.9	5.3
West	4.5	5.3

d. Across the different regions of the United States, more people were employed in March 2008 than in March 2007. However, the unemployment rates increased because an even larger number of people were in the labor force, seeking jobs.

16. a. 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.

b. 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.

c. 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).

17. a. 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.

b. 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.

c. Greater access to the Internet would facilitate job searches, reducing frictional unemployment and lowering the natural rate of unemployment.

d. 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.

18. **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.

19. Home mortgages in Albernia would have been especially attractive from about 1993 to 1998. During this time, inflation was higher than mortgage interest rates, making real interest rates negative. Whenever nominal interest rates are lower than inflation, borrowers are better off and lenders are worse off.

20. a. The countries with the highest average inflation rates should have the highest menu costs. Order: Zimbabwe, Turkey, Indonesia, Brazil, United States, France, China, Japan.
b. The countries with an average inflation rate higher than the inflation rate in 2000 should favor borrowers with seven-year loans payable in 2007. The higher the difference between the average inflation rate and the inflation rate in 2000, the lower the real value of the loan. Order: Zimbabwe, Indonesia, China, Japan, Brazil, France, United States, Turkey.
c. During this period, borrowers would have gained at the expense of lenders in Japan since −0.3% is greater than −0.7%. Average inflation in Japan was greater between 2000 and 2007 than it was in 2000.

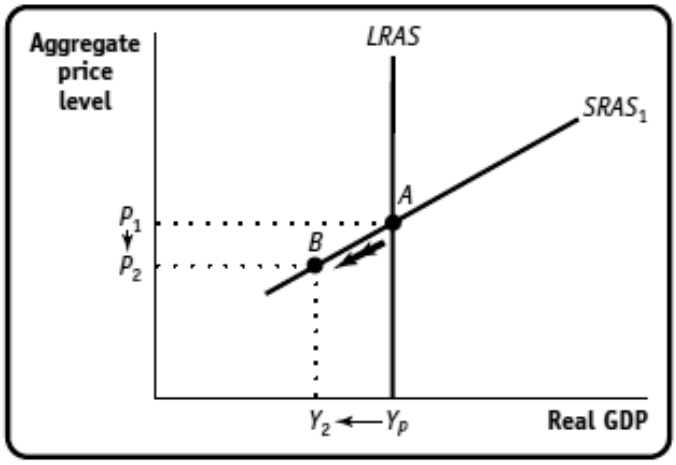
AP Krugman Section 4 Problem Solutions

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.

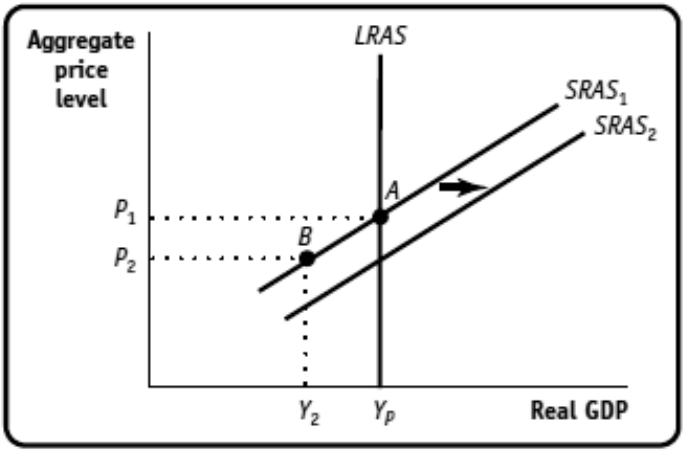
2. The short-run aggregate supply curve slopes upward because nominal wages are sticky in the short run. Nominal wages are fixed by either formal contracts or informal agreements in the short run. So, as the aggregate price level falls and nominal wages remain the same, production costs will not fall 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. 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. a. The discovery of iron ore reduces the price of steel, which will decrease production costs and increase profit per unit 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.

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. 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. a. 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.

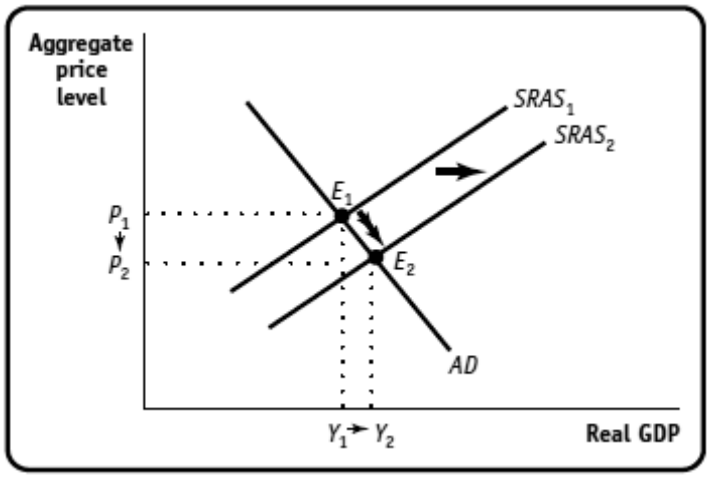
b. If the government increases TANF, consumer spending will increase because disposable income increases (disposable income equals income plus government transfers, such as TANF

payments, less taxes). Aggregate demand will increase, and the aggregate demand curve will shift to the right.

c. 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.

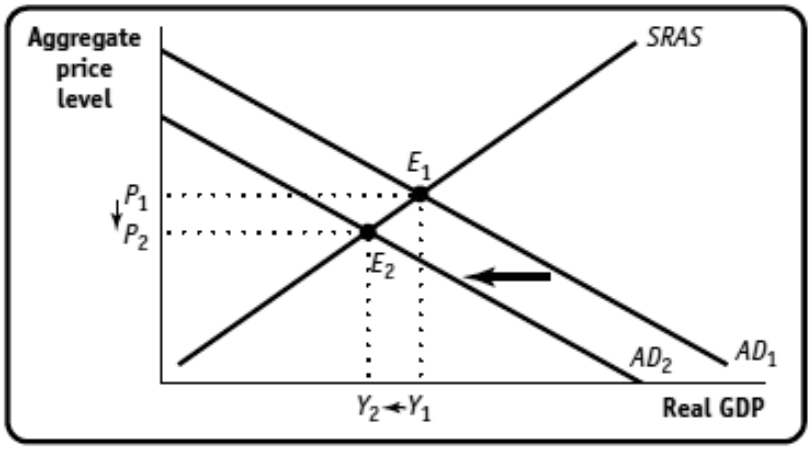
d. If the government reduces military spending, this will decrease aggregate demand. The amount of aggregate output demanded at any given aggregate price level will fall, and the aggregate demand curve will shift to the left.

8. 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.



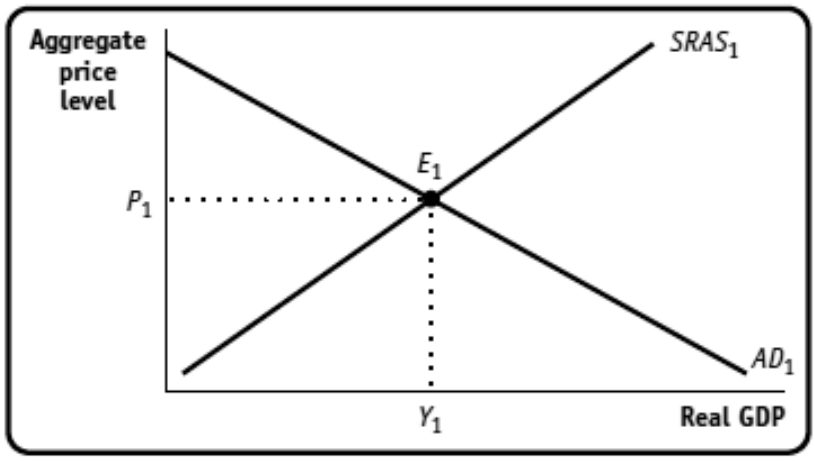
9. **a.** No. Consumers base their spending on how confident they are about the income they will have in the future. Likewise, firms base their investment spending on what they expect conditions to be like in the future. If consumers become more optimistic, spending will rise, but if consumers become more pessimistic, spending will fall. A fall in the CCI indicated that consumers were more pessimistic in April of 2008 than they were in March of 2008.

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.

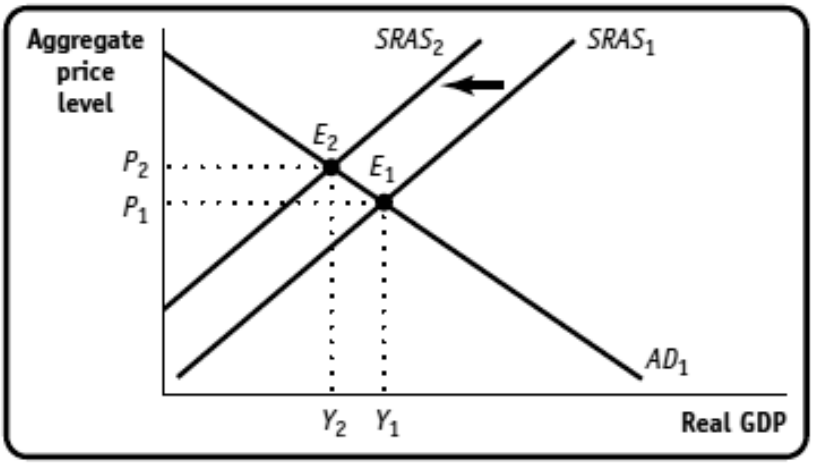


c. The government could use expansionary monetary policy or fiscal policy to help remedy the situation. A tax break, an increase in government spending, or an increase in the money supply would help to improve economic performance.

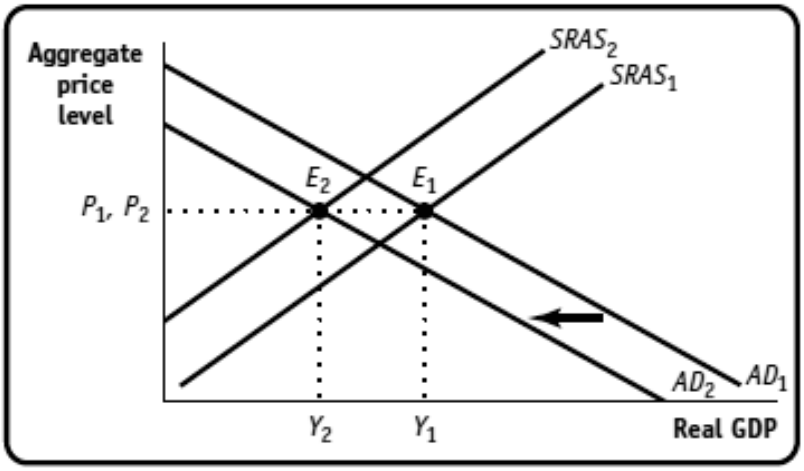
10. a.



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.

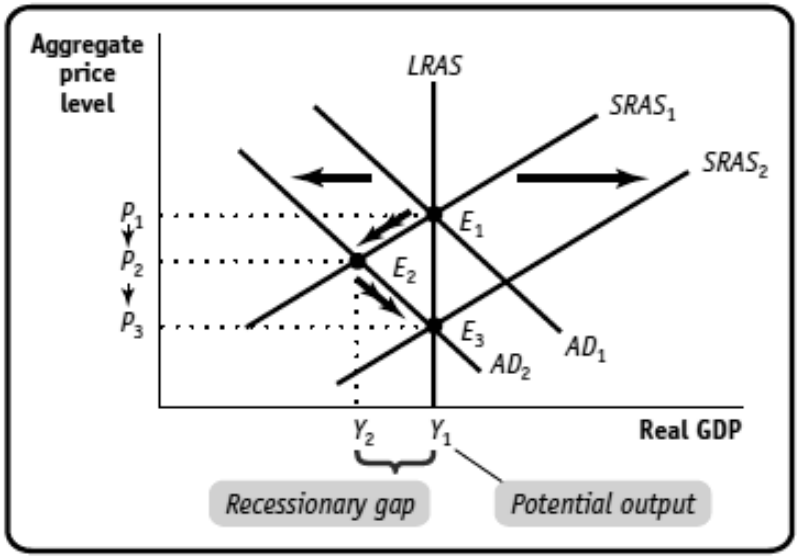


c. The fall in home prices would cause a demand shock because of the wealth effect. The aggregate demand (*AD*) curve shifts leftward, from AD_1 to AD_2. The new aggregate price level, P_2, could either be equal to, above, or below $P1$. The new level of real GDP, Y_2, is below the original level, Y_1.

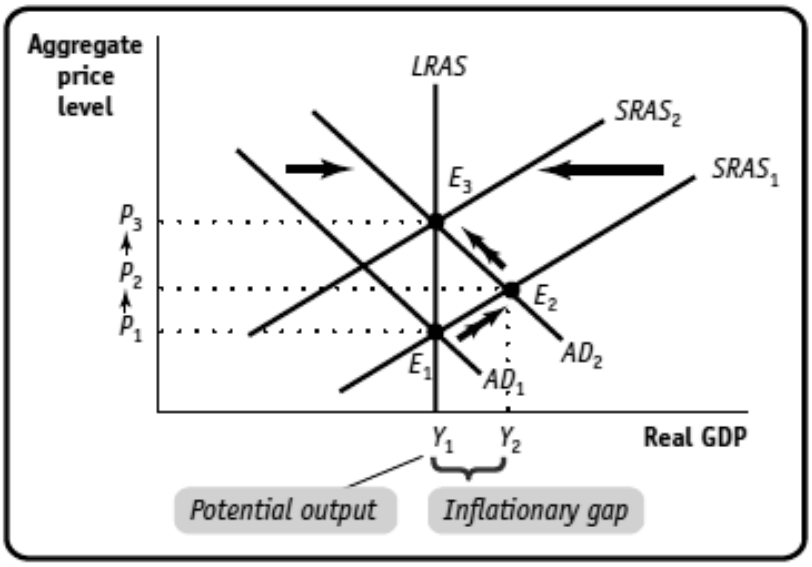


d. The effect on the aggregate price level is indeterminate. As drawn in the diagram for part c, P_1 and P_2 coincide because the negative supply and demand shocks have exactly offsetting price effects. However, prices could either rise or fall when both a negative demand shock and a negative supply shock occur. The fall in real GDP is unambiguous because the two shocks reinforce their negative effects on GDP.

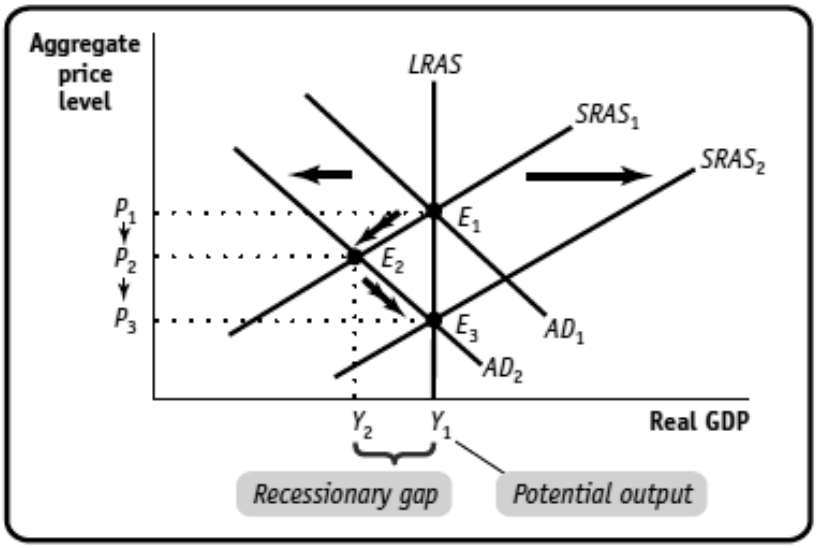
11. a. A decrease in households' wealth will reduce consumer spending. Beginning at long-run macroeconomic equilibrium, E_1 in the accompanying diagram, the aggregate demand curve will shift from AD_1 to AD_2. In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic 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.



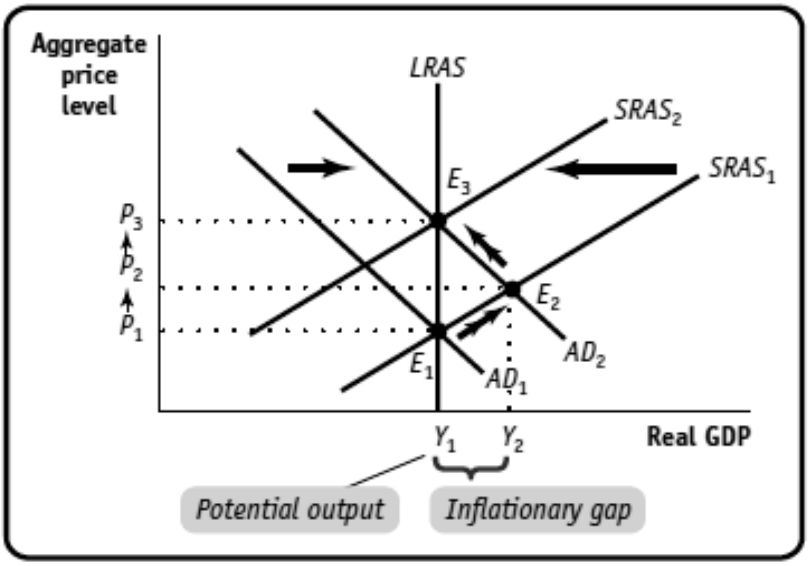
b. An increase in disposable income will increase consumer spending; at any given aggregate price level, the aggregate demand curve will shift to the right. Beginning at long-run macroeconomic equilibrium, E_1 in the accompanying diagram, the aggregate demand curve will shift from AD_1 to AD_2. In the 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.



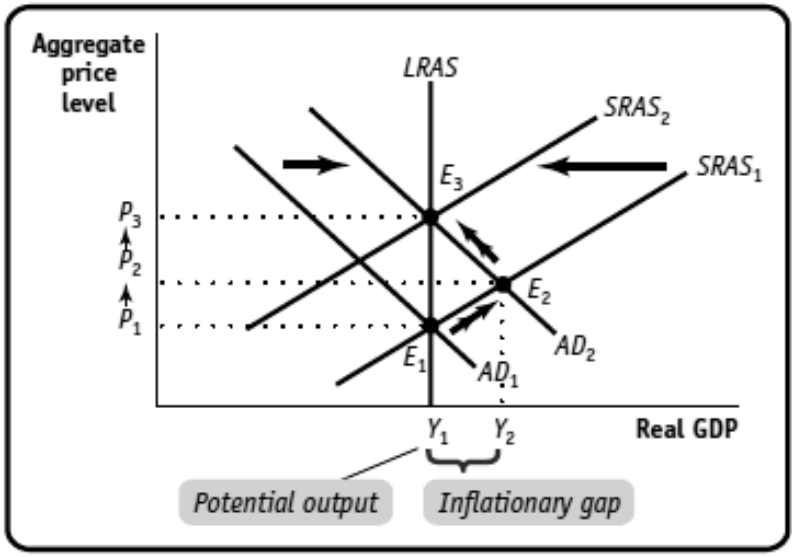
12. a. An increase in taxes will decrease consumer spending by households. Beginning at *E*1 in the accompanying diagram, the aggregate demand curve will shift leftward from AD_1 to AD_2. In the short run, nominal wages are sticky, and the economy will be in short-run macroeconomic equilibrium at point 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.

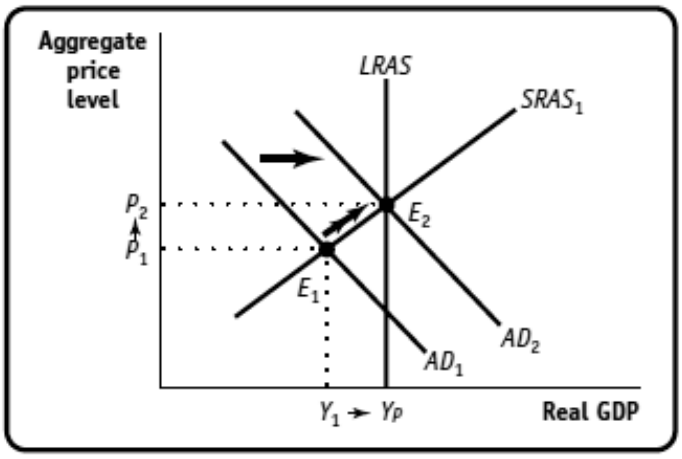


c. An increase in government spending will increase aggregate demand; at any given aggregate price level, the quantity of aggregate output demanded will be higher. Beginning at long-run macroeconomic equilibrium, E_1 in the accompanying diagram, the aggregate demand curve will shift from AD_1 to AD_2. 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.

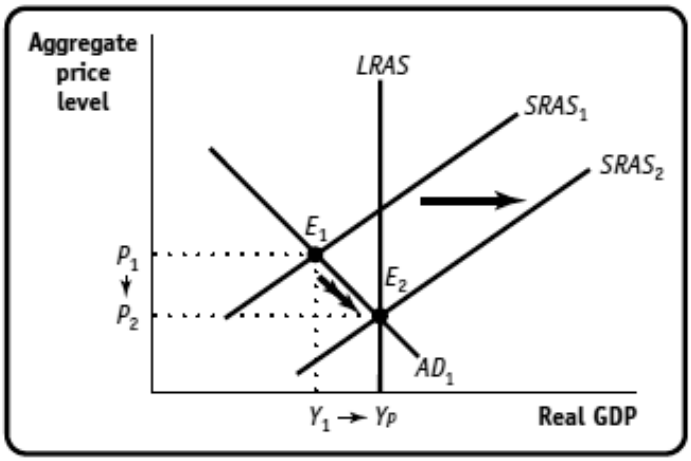


13. a. The economy is facing a recessionary gap because Y_1 is less than the potential output of the economy, Y_P.

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.

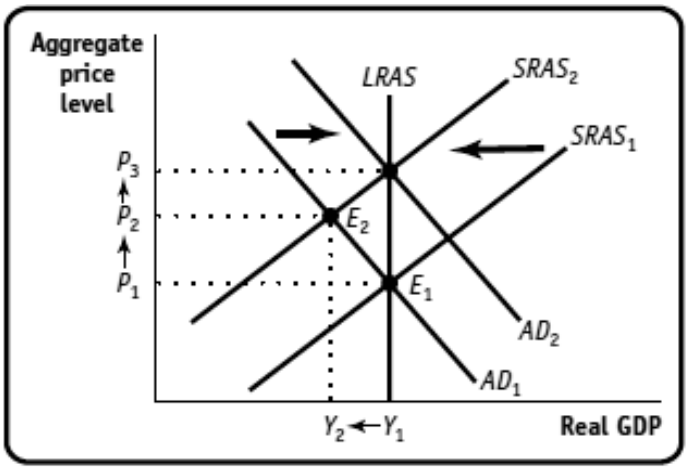


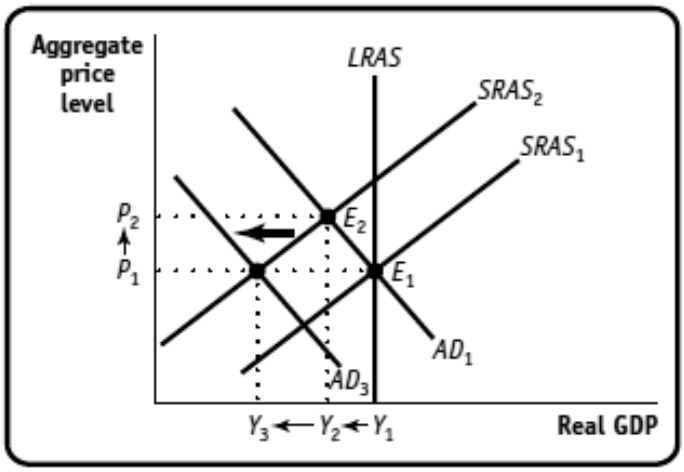
d. If the government implements fiscal or monetary policies to move the economy back to long-run macroeconomic equilibrium, the recessionary gap might be eliminated faster than if the economy were left to adjust on its own. However, because policy makers aren't perfectly informed and policy effects can 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. 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.

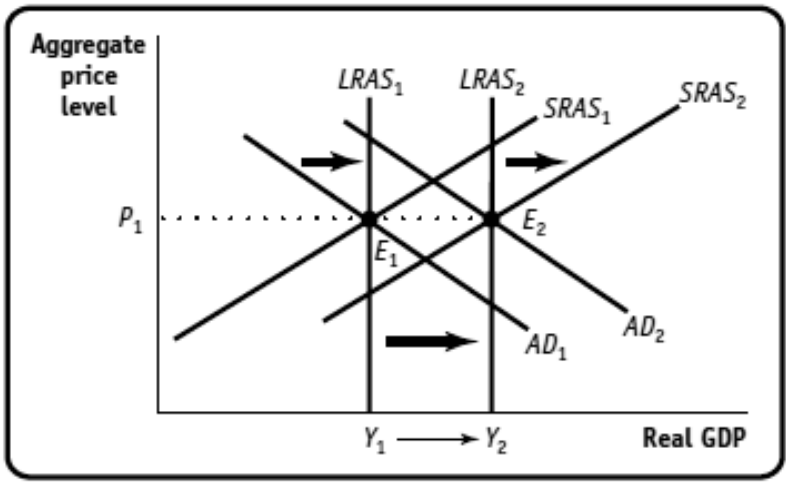
b. The government can use fiscal and monetary policies to either increase real GDP or lower the aggregate price level, but not both. If the government increases government spending, decreases taxes, or increases the quantity of money in circulation, it can raise real GDP but it will also raise the aggregate price level. This is illustrated in the first diagram below 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 second diagram below 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. 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.



16. 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.

17. 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

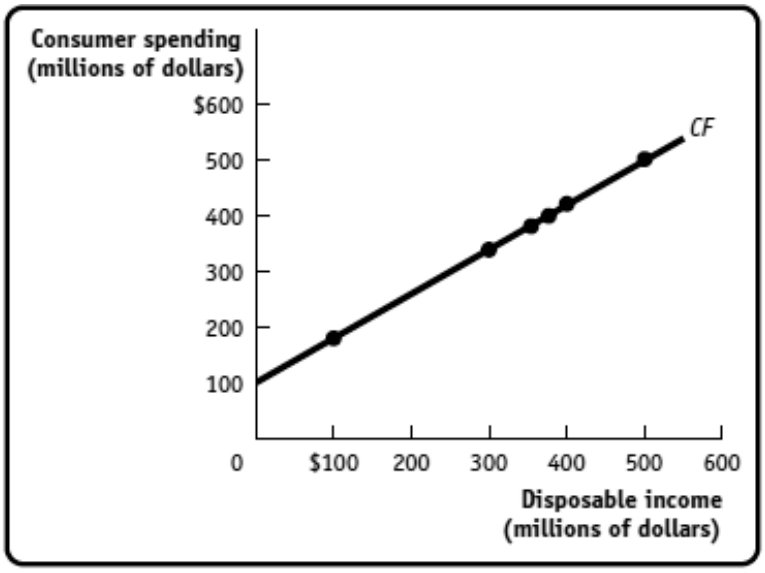
it, the smaller multiplier means that the change in government purchases of goods and services, government transfers, or taxes necessary to close the gap is larger.

18. 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.

19. 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 $C = A + MPC \times Y_D$. We know $MPC = 0.8$, so we must now solve for A. Rearranging, we have $A = C - MPC \times Y_D$. Plugging in the data from the first row of the table, we have A = \$180 million − 0.8 × \$100 million = \$100 million. Hence, the aggregate consumption function is C = \$100 million + 0.8 × Y_D.

20. As the S&P rose almost 150% from the end of 1995 to March 2000, stockholders experienced a large increase in the value of their wealth held in stocks. This increased consumer spending in the economy dramatically and added to the strong economic growth of the late 1990s. However, as the stock index fell 28.5% from its peak in
March 2000 to the day before the terrorist attacks, other things equal, consumer spending should have fallen as stockholders' wealth decreased. There was great concern that the terrorist attacks would reduce consumer spending further and worsen the recession that had begun earlier in 2001.

21. 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.

22. 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.

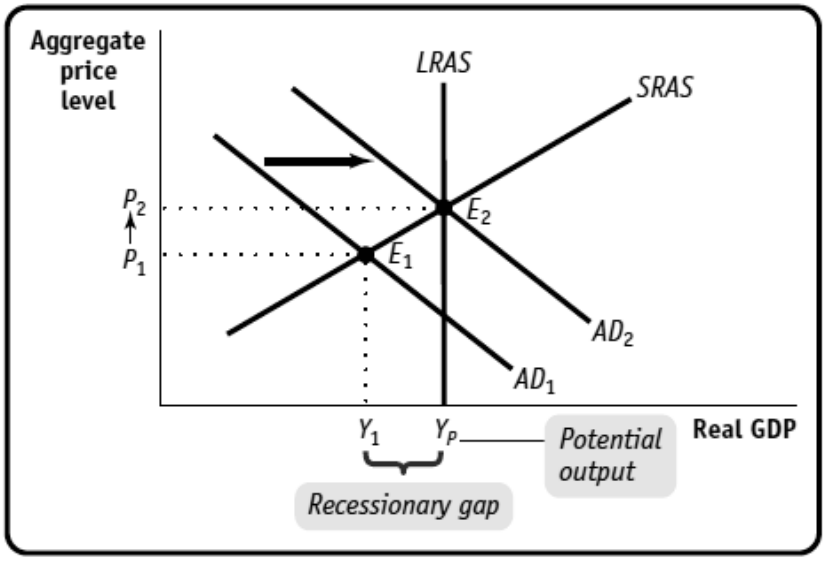
b. A rise in the expected growth rate of real GDP will lead firms to increase their planned investment spending. Planned aggregate spending will now exceed GDP. Sales will exceed firms' expectations, firms will draw down inventories unexpectedly, and unplanned inventory investment will be negative.

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.

23. a. Albernia is facing a recessionary gap; Y_1 is less than Y_P.

b. Albernia could use expansionary fiscal policies to move the economy to potential output. Such policies include increasing government purchases of goods and services, raising government transfers, and lowering taxes.

c.



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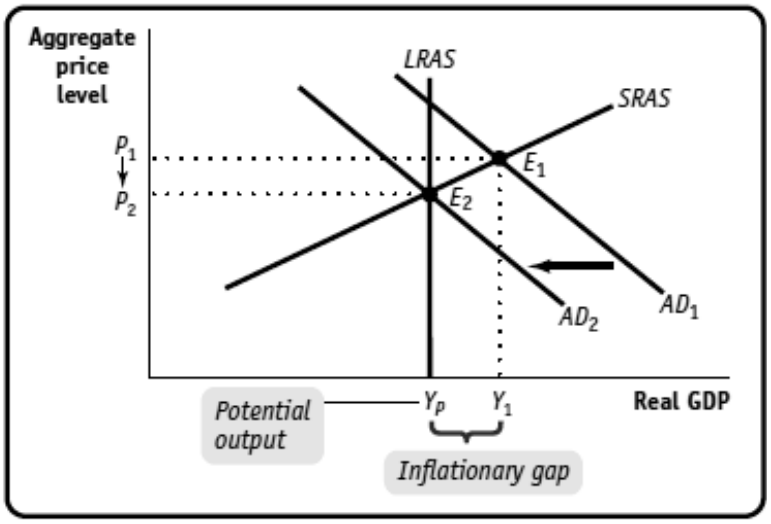
24. a. Brittania is facing an inflationary gap; Y_1 is greater than Y_P.

b. 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.

c.



25. 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 nondefense 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.

AP Krugman Section 5 Problem Solutions

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 = GDP − C − G

I = $1,000 million − $850 million − $100 million = $50 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:

Private savings = GDP − T − C = $1,000 million − $50 million − $850 million = $100 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:

Budget balance = T − G = $50 million − $100 million = −$50 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. a. 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.

b. 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 pre-existing.

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.

3. 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.

4. 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.

5. 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 the savings account is 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.

6. 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.

7. 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 account is not part of either M1 or M2 because it does not represent an asset.

8. The NPV of $1 million now is $1 million. The NPV of $1.2 million paid out over time is as follows: $\$300{,}000 + \$300{,}000/1.20 + \$300{,}000/(1.20)^2 + \$300{,}000/(1.20)^3 = \$300{,}000 + \$250{,}000 + \$208{,}333.33 + \$173{,}611.11 = \$931{,}944.44$. It is better to receive your prize as a $1 million payment now, since the high interest rate makes the net present value of $1.2 million paid out over time less than $1 million.

9. a. The NPV of Pfizer's project is: $-\$10 \text{ million} + \$4 \text{ million}/1.12 + \$4 \text{ million}/(1.12)^2 + \$4 \text{ million}/(1.12)^3 = -\$10{,}000{,}000 + \$3{,}571{,}428.57 + \$3{,}188{,}775.51 + \$2{,}847{,}120.99 = -\$392{,}674.93$. This project has a negative NPV, so Pfizer should not invest in the development of this new drug.

b. The NPV of Pfizer's project is: $-\$10 \text{ million} + \$4 \text{ million}/1.08 + \$4 \text{ million}/(1.08)^2 + \$4 \text{ million}/(1.08)^3 = -\$10{,}000{,}000 + \$3{,}703{,}703.70 + \$3{,}429{,}355.28 + \$3{,}175{,}328.96 =$

$308,387.94. This project has a positive NPV, so Pfizer should invest in the development of this new drug.

10. 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.

11. 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 $3,600 ($360/0.1) 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 $3,600 (−$400/0.1 + $400). 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 $1,600 (−$400/0.2 + $400). Checkable deposits fall by $2,000, but only $1,600 represents a decrease in the money supply.

12. 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 $2,000 ($500/0.2 − $500); 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

13. 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.

14. 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.

15. Answers will vary depending on where you live and when you look up your answer. If you live in Reedley, California, in September 2008, you were in the San Francisco district of the Federal Reserve system. Janet Yellen was the president of the Federal Reserve Bank of San Francisco and an alternate (nonvoting) member of the FOMC at that time.

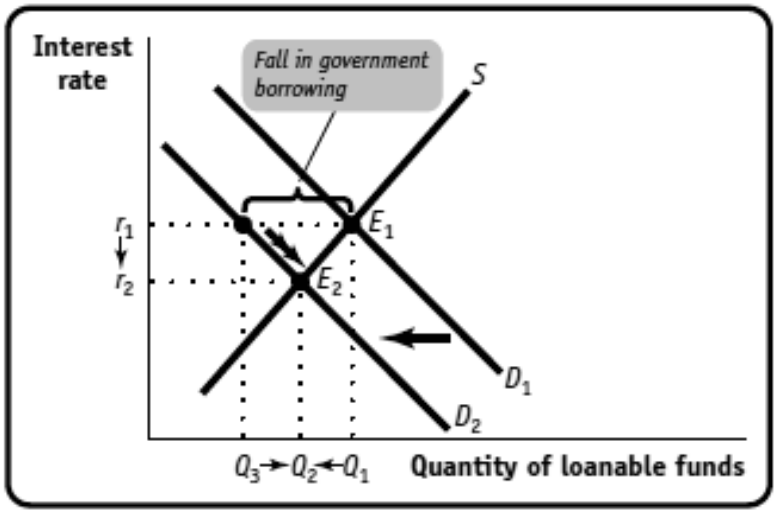
16. a. When North Korea circulates fake currency, the Federal Reserve does not hold any assets, and the U.S. government does not get the interest from the Treasury bills it would have gotten if it had printed the notes. The cost of counterfeiting is the interest forgone on U.S. Treasury bills that the U.S. government would receive from legally printed $100 notes. U.S. taxpayers lose because the government does not get this interest.
b. The amount of interest forgone per year is 2.2% × $45 million = $990,000.

17. a. 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.

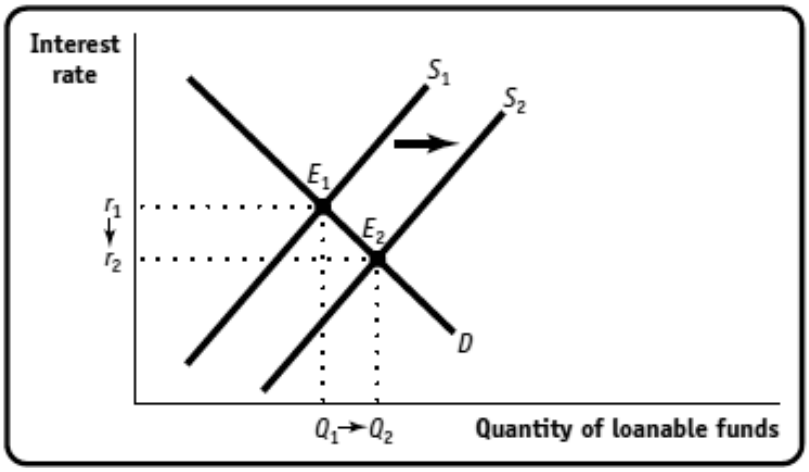
b. The drop in new housing starts in 2006–2008 was caused by the unavailability of easy mortgage financing that precipitated the 2008 financial crisis. When many homeowners who had financed their homes at subprime lending rates defaulted on their mortgages, those financial institutions that had invested in securitized subprime loans got into financial trouble and restricted—or stopped—lending.

c. 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.

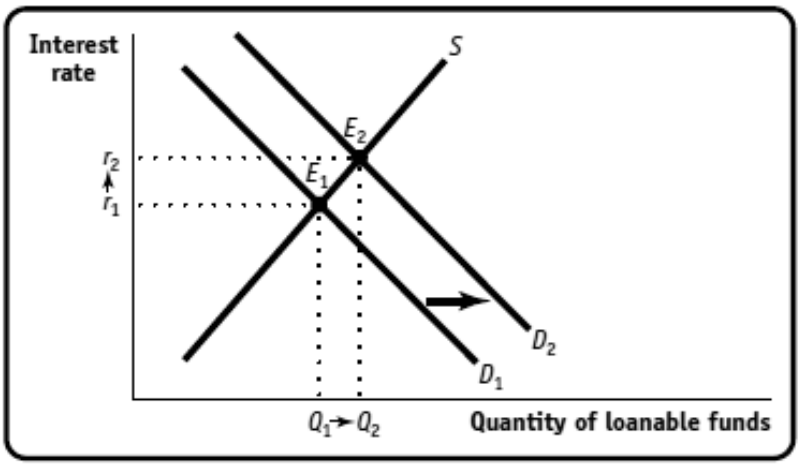
18. a. If the government reduces its deficit to zero, there will be a decrease in the demand for loanable funds, from D_1 to D_2, equal to the reduction in the size of the deficit. In the accompanying figure, the amount $Q_1 - Q_3$ represents the amount by which the government decreases its deficit. 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.



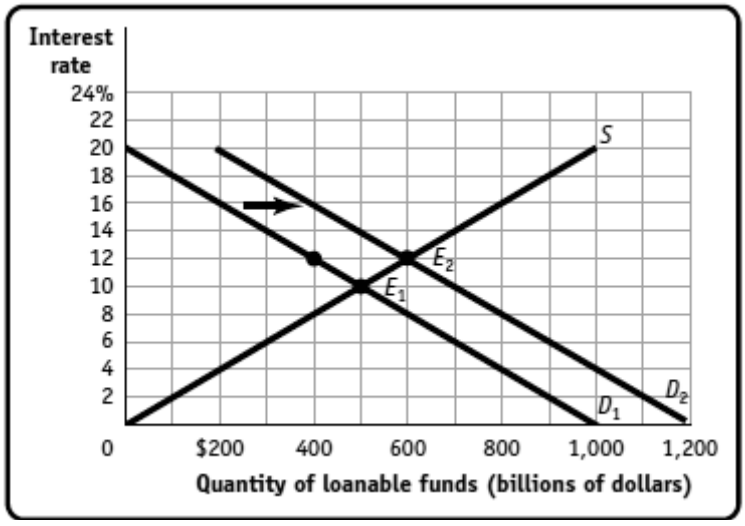
b. If consumers decide to save more, there will be an increase in the supply of loanable funds. In the accompanying figure, this is represented by the rightward shift of the supply curve from S_1 to S_2. The increase in the supply of loanable funds reduces the equilibrium interest rate from r_1 to r_2. In response to the lower interest rate, private investment spending will rise from Q_1 to Q_2.



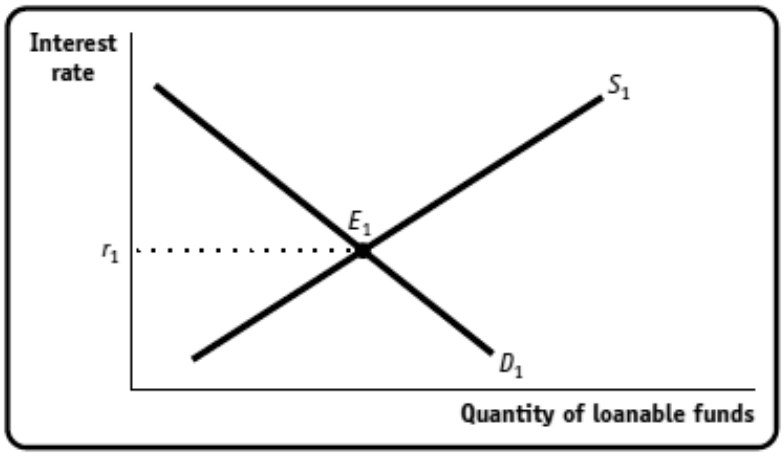
c. Higher investment spending at any given interest rate leads to an increase in the demand for loanable funds. In the accompanying figure, the increase in the demand for loanable funds shifts the demand curve from D_1 to D_2 and raises the equilibrium interest rate from r_1 to r_2. In response to the higher interest rate, private savings will rise from Q_1 to Q_2.



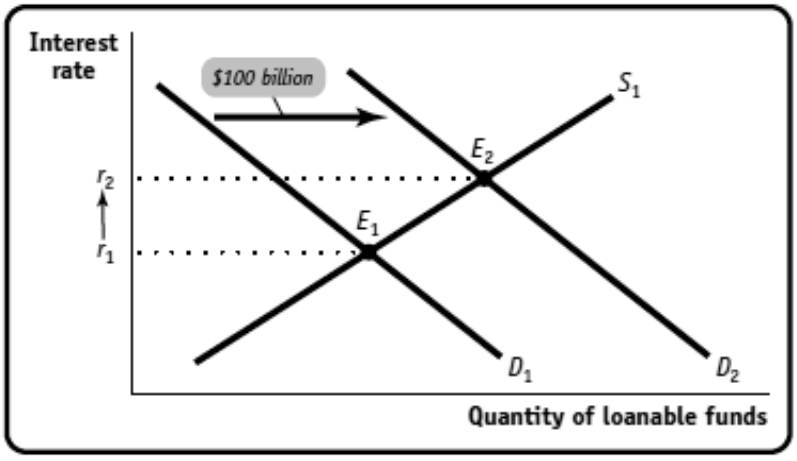
19. The $200 billion in government borrowing will increase the demand for loanable funds from D_1 to D_2 as shown in the accompanying diagram. The equilibrium interest rate rises from 10% to 12%, and the equilibrium quantity of loanable funds increases from $500 billion to $600 billion. The rise in the interest rate will lead to an increase in private savings of $100 billion, and private investment spending will fall by $100 billion. Through the rise in the interest rate, the increase in government borrowing crowded out $100 billion in private investment spending.



20. a. The demand for loanable funds without government borrowing to finance the Iraq War is shown in the accompanying diagram.



b.



c. Government borrowing to finance the Iraq War raises the interest rate in equilibrium because the supply of loanable funds remains constant but the demand rises.

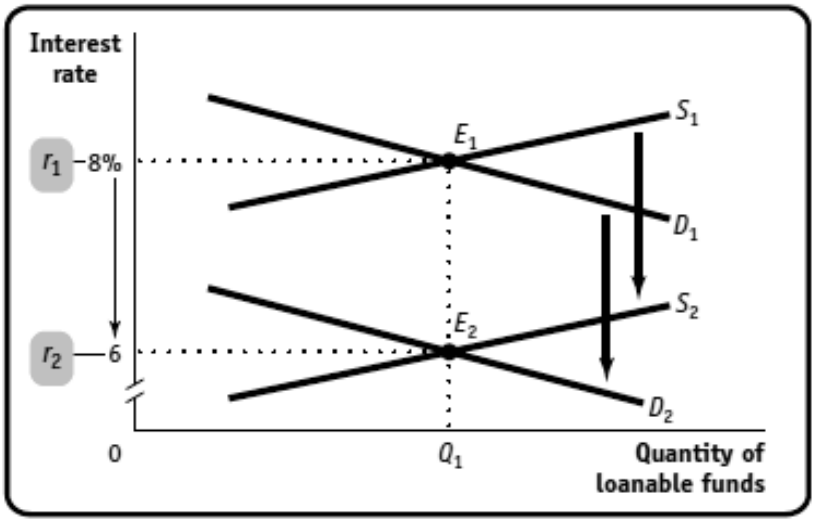
21. You might first acknowledge that when the government runs a budget deficit, there is an increase in the demand for loanable funds. The increase in demand raises interest rates and decreases private investment spending. This means that businesses will add less physical capital each year and productivity 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.

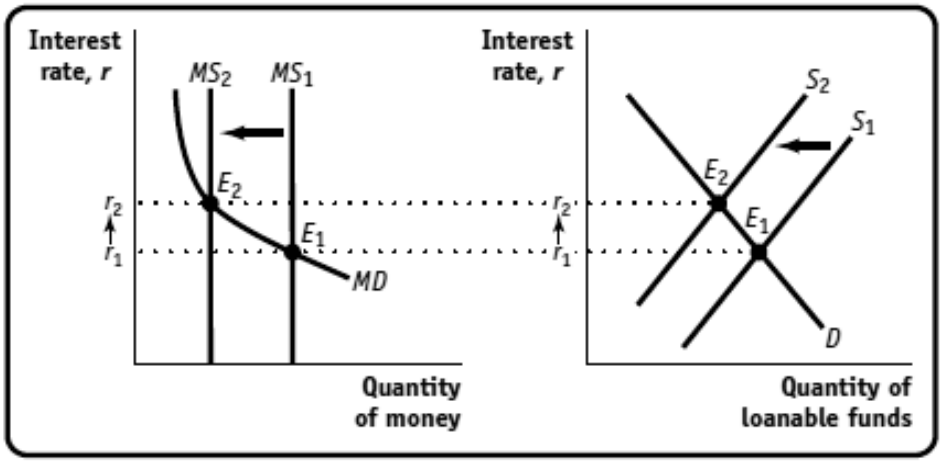
22. a. If the actual inflation rate is 4%, Lynn is better off and Boris is worse off. Boris had expected to pay, and Lynn had expected to receive, a real interest rate of 3%. However, with an actual inflation rate of 4%, an 8% nominal interest rate yields a real interest rate of 4% (8% − 4% = 4%). So, 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.

23. 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.



24. In the accompanying diagram, both the money market and the loanable funds market are initially in equilibrium at the same rate of interest, r_1. A decrease in the money supply shifts the money supply curve leftward, to MS_2, and the equilibrium interest rate rises to r_2. The increase in the interest rate leads to a decrease in real GDP, which generates a decrease in savings through the multiplier process. This decrease in savings shifts the supply curve for loanable funds leftward, to S_2. Consequently, the equilibrium interest rate in the loanable funds market rises. The new equilibrium interest rate in the loanable funds market equals the rate in the money market because savings fall by exactly enough to match the fall in investment spending.



25. In the short run, the interest rate is determined in the money market: the short-run equilibrium interest rate is determined where money demand equals money supply. Beginning with an economy in long-run macroeconomic equilibrium, an increase in the money supply will lead to a fall in the interest rate in the money market. The fall in the interest rate will lead to an increase in real GDP, followed by an increase in savings through the multiplier process. The increase in savings will increase the supply of loanable funds, leading to a fall in the interest rate in the loanable funds market as well. So in the short run an expansionary monetary policy will increase real GDP; similarly, a contractionary monetary policy will reduce real GDP in the short run.

In the long run, real GDP cannot differ from potential output. So in the long run, the interest rate is determined in the loanable funds market: the long-run equilibrium interest rate equalizes the supply of loanable funds and the demand for loanable funds that arise when aggregate output is equal to potential output. In the long run an increase in the money supply will ultimately result in an increase in nominal wages. The short-run aggregate supply curve will shift leftward and real GDP will fall. As real GDP falls, savings will fall as well, leading to a reduction in the supply of loanable funds and a rise

in the interest rate. This process will continue until aggregate output is equal to potential output. The interest rate in the money market will also rise, as a higher aggregate price level in the long run leads to an increase in the nominal demand for money. So in the long run the Fed cannot influence the interest rate and monetary policy will have no effect on real GDP.

AP Krugman Section 6 Problem Solutions

1. It's impossible to determine which policy maker is correct given the information available. Everything else being 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.

2. 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.

3. 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.

4. a. The annual interest on the debt is 5% of $9 trillion, or $450 billion.

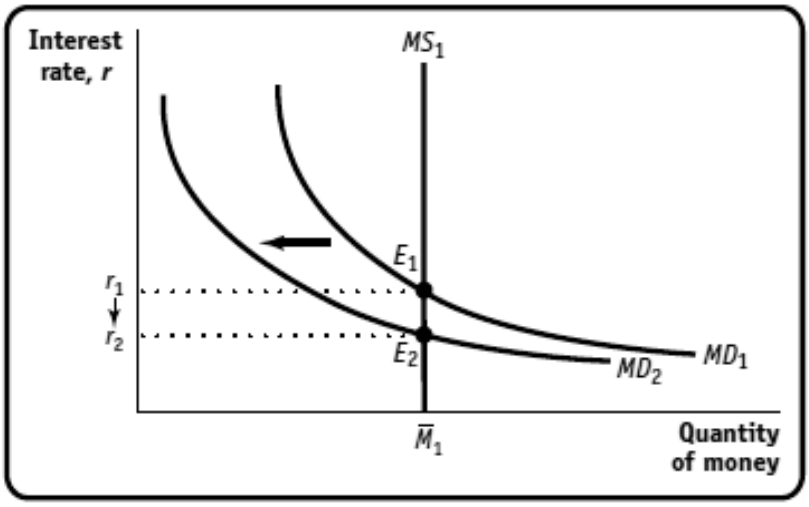
b. U.S. GDP must grow at 5% so that the debt–GDP ratio remains unchanged. This is because the total debt and GDP would grow at the same rate.

c. The total debt increases by $650 billion, the $200 billion budget deficit plus the $450 billion interest payment.

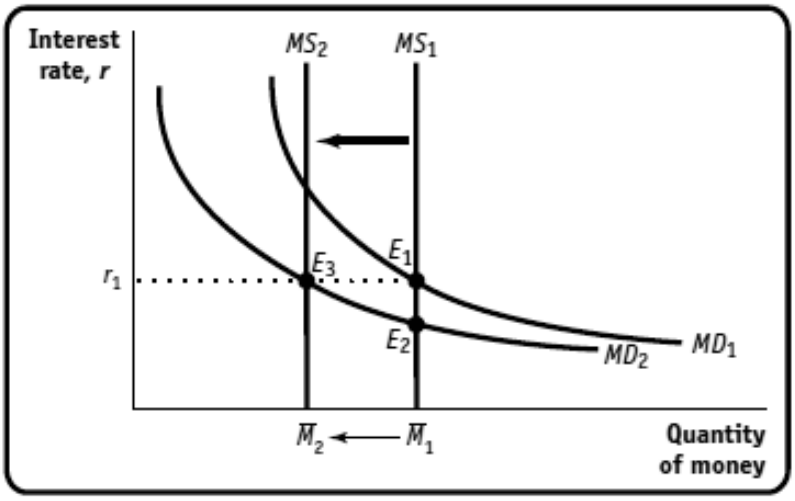
d. $650 billion is 7.22% of the government's total debt. So, in order for the debt–GDP ratio to remain constant, GDP must also grow by 7.22%.

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.

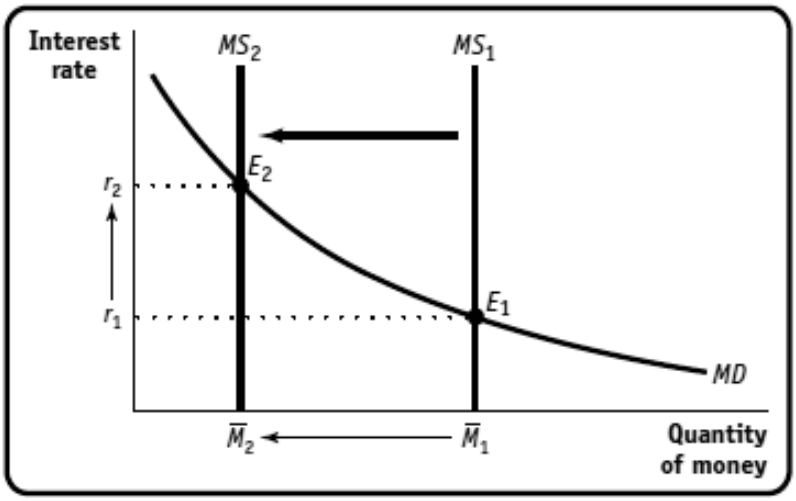
5. a. Beginning at equilibrium point E_1 in the accompanying money market diagram, when the economy of Eastlandia goes into recession, aggregate spending will fall and the money demand curve will shift to the left, from MD_1 to MD_2, moving the money market from its initial equilibrium, E_1, to a new 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. The decrease in the interest rate would encourage investment spending and would help close the recessionary gap.



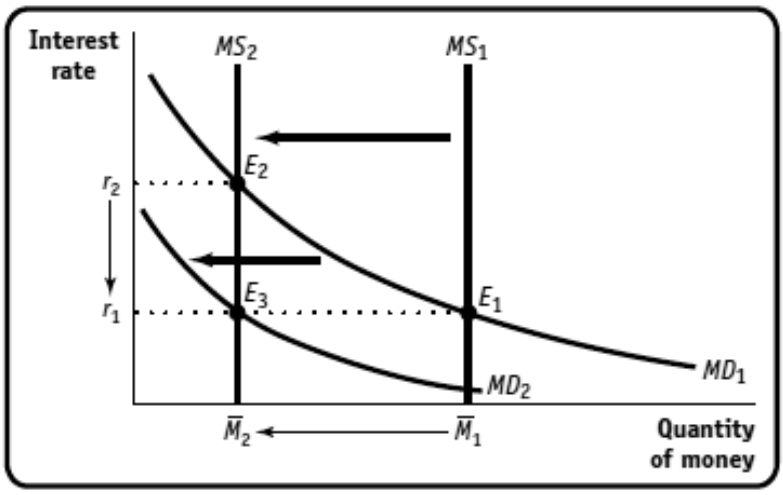
b. If the central bank is committed to maintaining an interest rate target of r_1, then the central bank will reduce the money supply as the economy goes into recession, from MS_1 to MS_2 in the accompanying diagram, eliminating the potential for interest rates to fall. The new equilibrium in the money market is at E_3, with the interest rate at its target rate, r_1.



6. 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.

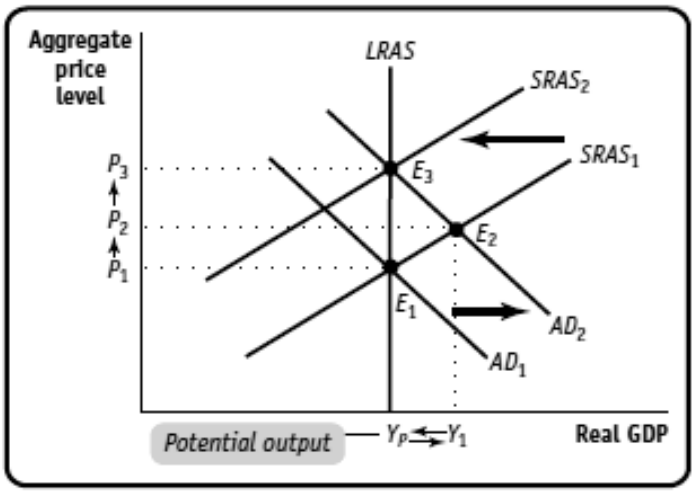


b. Over time, the aggregate price level will fall. This will reduce money demand, shifting the money demand curve left from MD_1 to MD_2, which causes the equilibrium interest rate to fall back to r_1.



7. 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 $SRAS_2$). So to keep the unemployment rate at 3% in the short run, the central bank would have to engage in continuous increases in the money supply, shifting the aggregate demand curve to the right as the short-run aggregate supply curve shifts to the left, and the aggregate price level will go higher and higher. 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%.



8. 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.

9. a. The real inflation tax paid is \$100 (\$1,000 × 0.10).

b. The price level at the end of the first year will be 1 × 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 × 0.10).

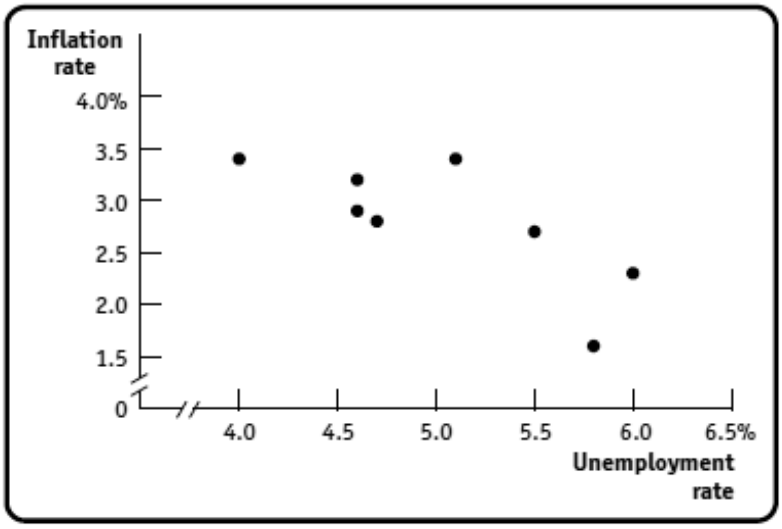
c. The price level at the end of the second year will be 1.10 × 1.10 = 1.21. The real value of \$1,000 at the beginning of the third year is \$1,000/1.21 = \$826.45. So the real inflation tax paid for the third year is \$82.65 (\$826.45 × 0.10).

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 \$250.00 (\$1,000 × 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 × 0.25); and for the third year, it is \$160 ([\$1,000/$(1.25)^2$] × 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.

10. 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 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.

11. 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 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 in the short run.



12. 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.

13. 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 539/101 = 5.3. The velocity of money for each of the countries is in the accompanying table.

Country	Velocity of money
Egypt	5.3
South Korea	10.4
Thailand	8.2
United States	9.1
Kenya	6.1
India	4.9

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 that wealthy countries have more sophisticated financial systems.

14. 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 rapidly between 1969 and 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%.

15. 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.

Modern 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.

16. 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 modern consensus believe that discretionary monetary policy can be useful in addressing short-run problems and would not recommend a monetary policy rule.

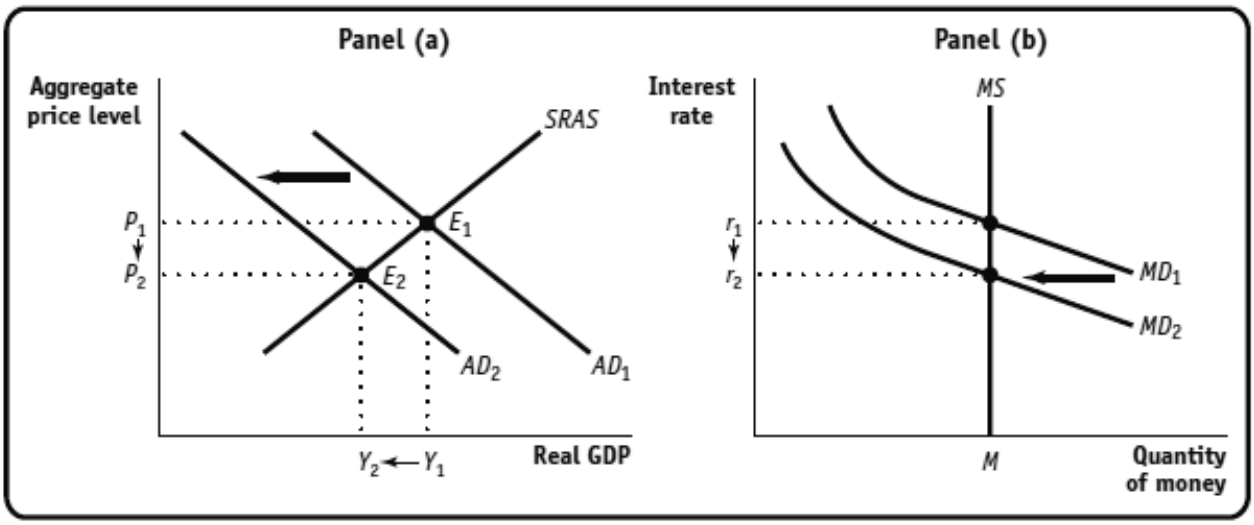
b. Classical economists would see the inflationary pressure as a short-run problem and would not advocate any policy; their view would be that the inflationary pressure will not exist in the long run. Monetarists would also be reluctant to endorse fiscal policy in the short run; they believe discretionary 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 modern 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 modern consensus if the economy is not suffering from a liquidity trap.

d. Keynesians and followers of the modern 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.

17. 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.



AP Krugman Section 7 Problem Solutions

1. a. The accompanying table shows each nation's real GDP per capita in terms of its 1960 and 2000 levels.

	Argentina			Ghana		
Year	**Real GDP per capita (2000 dollars)**	**Percentage of 1960 real GDP per capita**	**Percentage of 2000 real GDP per capita**	**Real GDP per capita (2000 dollars)**	**Percentage of 1960 real GDP per capita**	**Percentage of 2000 real GDP per capita**
1960	$7,838	100%	69%	$412	100%	30%
1970	9,821	125	87	1,052	255	76
1980	10,921	139	96	1,142	277	82
1990	8,195	105	72	1,153	280	83
2000	11,332	145	100	1,392	338	100

	South Korea			United States		
Year	**Real GDP per capita (2000 dollars)**	**Percentage of 1960 real GDP per capita**	**Percentage of 2000 real GDP per capita**	**Real GDP per capita (2000 dollars)**	**Percentage of 1960 real GDP per capita**	**Percentage of 2000 real GDP per capita**
1960	$1,458	100%	9%	$12,892	100%	38%
1970	2,552	175	16	17,321	134	50
1980	4,497	308	29	21,606	168	63
1990	9,593	658	61	27,097	210	79
2000	15,702	1,077	100	34,365	267	100

b. South Korea experienced the greatest increase in living standards from 1960 to 2000; in 2000 it produced 1,077% ($15,702/$1,458 × 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 2000 produced 267% ($34,365/$12,892 × 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 had started from a much lower level than Argentina but has made some progress. Real GDP per capita in Ghana was only 5% of that in Argentina in 1960 but was 12% in 2000. Living standards in Africa suffered because of major political instabilities, poor education and infrastructure, and disease.

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 for real GDP per capita to double according to the Rule of 70		
Years	**Argentina**	**Ghana**	**South Korea**
1960-1970	27.7	4.5	9.3
1970-1980	62.5	82.4	9.2
1980-1990	--	700.0	6.2
1990-2000	18.3	33.7	11.0

b. If each nation continues to grow as it did from 1990 to 2000, real GDP per capita will have doubled in Argentina by 2018, in Ghana by 2033, and in South Korea by 2011.

3. a. i. The ratio of per capita GDP in 2005 of middle-income to high-income countries is 7.7%.

ii. The ratio of per capita GDP in 2005 of low-income to high-income countries is 1.7%.

iii. The ratio of per capita GDP in 2005 of low-income to middle-income countries is 22.5%.

b. Middle-income countries are projected to take 70/5.7 = 12.3 years to double their per capita GDP, and low-income countries are projected to take 19.4 years.

c. High-income countries are projected to double their GDP in 37 years to $57,224. During the same period, middle-income countries are projected to double their per capita GDP 37/12.3 = 3 times. So the projected per capita GDP for middle-income countries is $2,196 × 2 × 2 × 2 = $17,568. In 2042, low-income countries are expected to increase their per capita GDP by 37/19.4 = 1.9 times. Hence, starting from $494, per capita GDP doubles to $988, then increases by 90% to $1,877. This implies that low-income countries will have a per capita GDP of approximately $1,877 in 2042.

d. Using the projected per capita GDP figures in 2042, the percentages are as follows:

i. Middle-income to high-income countries: 30.7%

ii. Low-income to high-income countries: 3.2%

iii. Low-income to middle-income countries: 10.5%

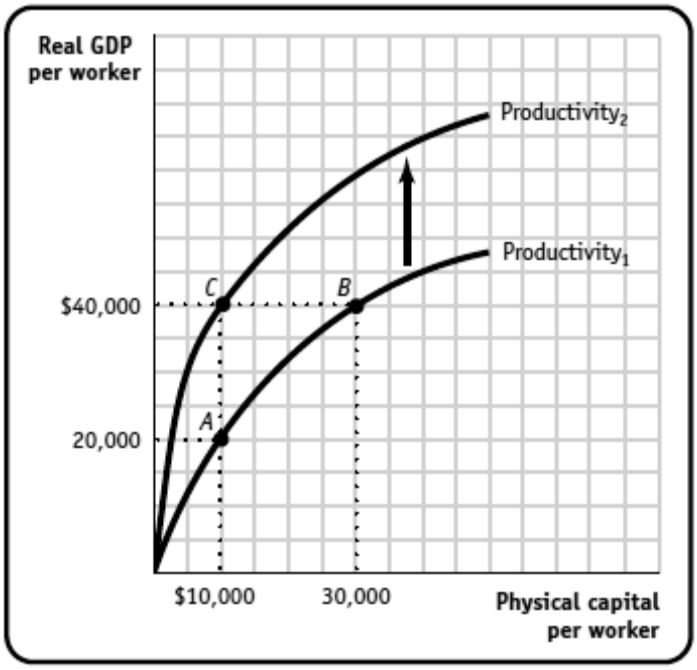
e. Both the low-income countries and the middle-income countries (as defined in 2005) have improved their per capita GDP relative to high-income countries due to their higher growth rates. This suggests that economic inequality is projected to be lower. However, at the same time, middle-income countries grew faster than low-income countries and the inequality between the two regions widened.

4. 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 Brittania experience diminishing returns to physical capital since in both countries equal

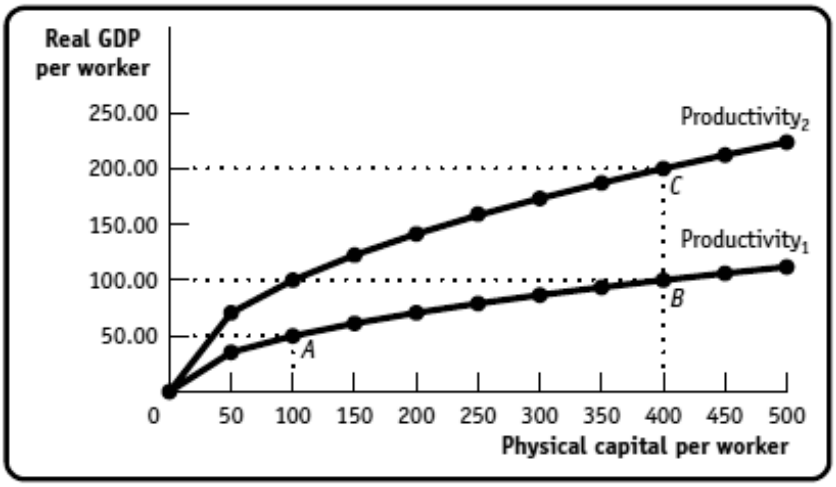
successive increases in physical capital per worker—holding human capital per worker and technology constant—will result in smaller and smaller increases in real GDP per worker.

b. Albernia should increase its physical capital per worker to $30,000.

c. If it were possible to increase the amount of human capital per worker, or improve the technology, or both, then $Productivity_1$ could shift to $Productivity_2$ and Albernia could double 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*.



5. a. In the accompanying diagram, the line labeled *Productivity*$_1$ shows the production function using Method 1, and the line labeled *Productivity*$_2$ 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 by 2% per year. (Taking 70/2 = 35 years to double, and then another 35 years to double again).

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.

6. Answers will vary with the latest data. For the last quarter of 2009, business and nonfarm business productivity grew by 7.2% and 6.9%, respectively. These were lower than the productivity growth figures for the third quarter of 2009, which were 8.0% and 7.8%, respectively.

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. 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 × $(1 + 0.02)^{100}$]. At an average annual rate of growth of 1.5%, real GDP per capita in Sloland in 100 years will be \$88,641 [\$20,000 × $(1 + 0.015)^{100}$]. Although both nations start with the same real GDP per capita today, the differential growth rates will result in living standards in Sloland that are 61.2% (\$88,641/\$144,893 × 100) of those in Groland.

9. The accompanying table shows real GDP per capita (2000 U.S. dollars) in France, Japan, and the United Kingdom as a percentage of real GDP per capita in the United States.

	1950		**2004**	
	Real GDP per capita (2000 dollars)	**Percentage of U.S. real GDP per capita**	**Real GDP per capita (2000 dollars)**	**Percentage of U.S. real GDP per capita**
France	\$5,921	52.7%	\$26,168	72.5%
Japan	2,188	19.5	24,661	68.3
United Kingdom	8,082	71.9	26,672	74.1
United States	11,233	100.0	36,098	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 2004. Japan's real GDP per capita

grew from only 19.5% of that in the United States to 68.3%, and France's rose from 52.7% to 72.5%. Living standards in the United Kingdom relative to those in the United States rose relatively little; real GDP per capita grew from 71.9% of that in the United States to 74.1%. These countries have converged.

10. The accompanying table shows real GDP per capita (2000 U.S. dollars) in Argentina, Ghana, and South Korea as a percentage of real GDP per capita in the United States.

	1960		2003	
	Real GDP per capita (2000 dollars)	**Percentage of U.S. real GDP per capita**	**Real GDP per capita (2000 dollars)**	**Percentage of U.S. real GDP per capita**
Argentina	$7,838	60.8%	$10,170	29.2%
Ghana	412	3.2	1,440	4.1
South Korea	1,458	11.3	17,597	50.5
United States	12,892	100.0	34,875	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 60.8% of that of the United States to 29.2%. There is some evidence of convergence for Ghana; Ghana's real GDP rose from 3.2% of that of the United States to 4.1%. South Korea's real GDP per capita showed strong signs of convergence; real GDP per capita rose from 11.3% of that of the United States to 50.5%.

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. a. In one year, approximately $48.2 \times 365 = 17.6$ billion barrels of oil are produced. At this rate, 1,137 billion barrels of oil will last for approximately 65 years. The numbers, if correct, 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.

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. a. As shown in the accompanying table, the five countries with the highest percentage increase in CO_2 emissions are Finland, Cyprus, Slovenia, Germany, and Greece. The five countries with the lowest percentage increase in CO_2 emissions are France, Belgium, Austria, Ireland, and Portugal.

Country	Percent change in Real GDP per capita 2005-2007	Percent change in CO_2 emissions 2005-2007
Finland	9.23%	28.50%
Cyprus	5.56	6.20
Slovenia	11.79	3.80
Germany	5.79	2.50
Greece	8.09	2.00
Spain	4.28	1.60
Italy	2.28	0.20
Netherlands	4.61	-0.60
Luxembourg	8.55	-1.40
France	2.76	-3.50
Belgium	4.19	-4.60
Austria	6.30	-4.90
Ireland	6.56	-5.30
Portugal	2.67	-14.40

b. As shown in the accompanying table, the five countries with the highest percentage increase in real GDP per person are Slovenia, Finland, Luxembourg, Greece, and Ireland. The five countries with the lowest percentage increase in real GDP per person are Spain, Belgium, France, Portugal, and Italy.

Country	Percent change in real GDP per capita 2005-2007	Percent change in CO_2 emissions 2005-2007
Slovenia	11.79%	3.80%
Finland	9.23	28.50
Luxembourg	8.55	-1.40
Greece	8.09	2.00
Ireland	6.56	-5.30
Austria	6.30	-4.90
Germany	5.79	2.50
Cyprus	5.56	6.20
Netherlands	4.61	-0.60

Spain	4.28	1.60
Belgium	4.19	-4.60
France	2.76	-3.50
Portugal	2.67	-14.40
Italy	2.28	0.20

c. Yes. Three of the five countries with the highest percentage increase in CO_2 emissions also have the highest percentage increases in GDP per person: Finland, Slovenia, and Greece. Three of the five countries with the lowest percentage increase in CO_2 emissions also have the lowest percentage increases in GDP per person: France, Belgium, and Portugal.

d. Although growth rates and CO_2 emissions are linked, the experience of Luxembourg and Ireland show that it is possible to have a high growth rate of GDP and reduce 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 GDP reductions would put only a minor dent in long-run GDP per capita growth.

AP Krugman Section 8 Problem Solutions

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. a. No, the diagram does not indicate that the United States has experienced net capital outflows. Over the same period, rest-of-the-world assets have also flowed into the United States, increasing them as a percentage of U.S. GDP. In fact, between 1996 and 2008, 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.

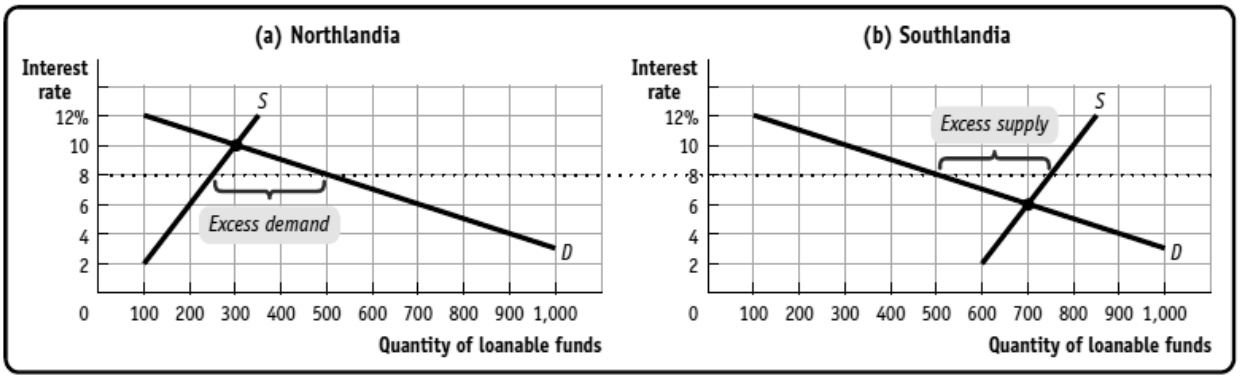
b. Yes, the diagram indicates that world economies were more tightly linked in 2008 than they were in 1980. Because the United States has more assets abroad and other countries own more assets in the United States, "financial contagion" has become a possibility—a financial crisis in one country is more likely to lead to a financial crisis in another country.

3. In 2008, 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 2008, 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. 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 demand for loanable funds falls 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. For each of the exchange rates shown except for the U.S. dollar–Japanese Yen exchange rate, the U.S. dollar depreciated. When the U.S. dollar depreciates, it is less attractive for Americans to buy foreign goods and more attractive for foreigners to buy American goods, other things equal.

7. Answers will vary. On May 3, 2010, the exchange rate was 1.31 U.S. dollars per euro, 1.52 U.S. dollars per British pound sterling, 0.99 U.S. dollars per Canadian dollar, 94.71 Japanese yen per U.S. dollar, and 1.09 Swiss francs per U.S. dollar. Since January 4, 2010, the U.S. dollar had appreciated against the euro, the British pound, the Japanese yen, and the Swiss franc. It depreciated against the Canadian dollar.

8. 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.

9. 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.

10. 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.

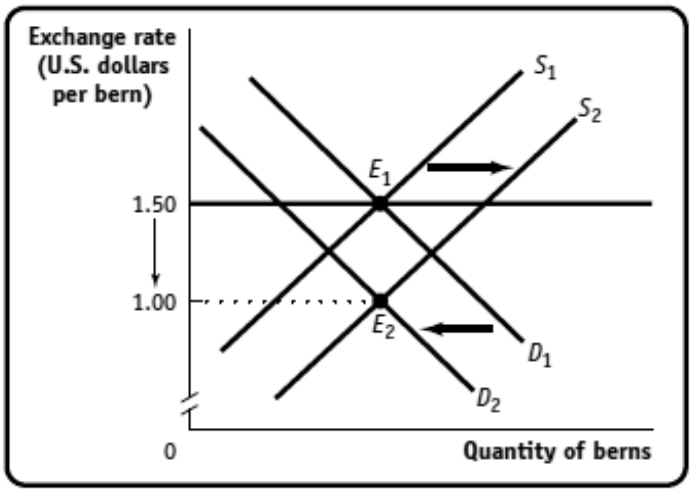
c. If inflation is 5% in the United States and 3% in the eurozone, and the price of the euro falls from $1.30 to $1.20, both the lower inflation in the eurozone and the appreciation of the dollar (depreciation of the euro) make eurozone goods more attractive.

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.

11. 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 could 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.

12. 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.



13. 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.

AP Krugman Economics Section 9 Problem Solutions

AP Krugman Microeconomics Section 3 Problem Solutions

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

b. 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.

c. 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.

2. a. The price elasticity of demand for Ford SUVs will increase because more substitutes are available.

b. The price elasticity of demand for Ford SUVs will decrease because fewer substitutes are available.

c. The price elasticity of demand for Ford SUVs will decrease because other cars are viewed as less of a substitute.

d. The price elasticity of demand for Ford SUVs will increase over time because more substitutes (such as four-wheel-drive cargo vans) become available.

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

$\frac{\$1,100-\$900}{(\$900+\$1,100)/2}\times 100=\frac{\$200}{\$1,000}\times 100=10\%$. 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. 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%. Therefore, a 5% increase in the price of Pepsi would increase the quantity of Coke demanded by five times as much, that is, by 5 × 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%. Therefore, a 10% fall in the price of gasoline would increase the quantity of SUVs demanded by 10 times as much, that is, by 10 × 0.28% = 2.8%.

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

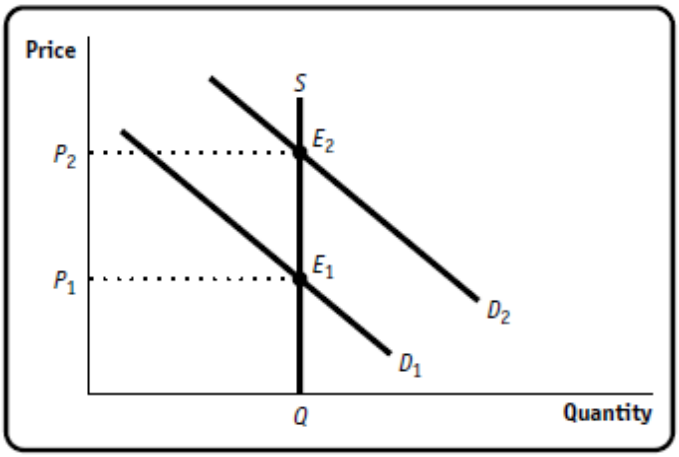
Now suppose the price is \$7. The percent change in the quantity demanded is

$\frac{1,800-800}{(800+1,800)/2}\times 100=\frac{1,000}{1,300}\times 100=76.9\%$ and the percent change in income is, as before,

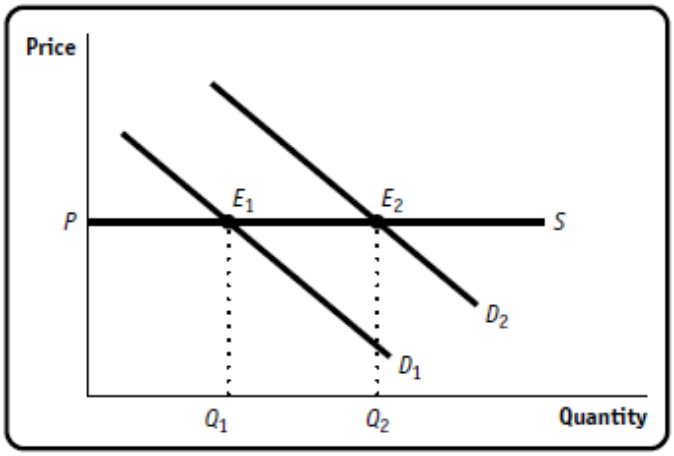
$\frac{\$30,000-\$20,000}{(\$20,000+\$30,000)/2}\times 100=\frac{\$10,000}{\$25,000}\times 100=40\%$. The income elasticity of demand is therefore

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

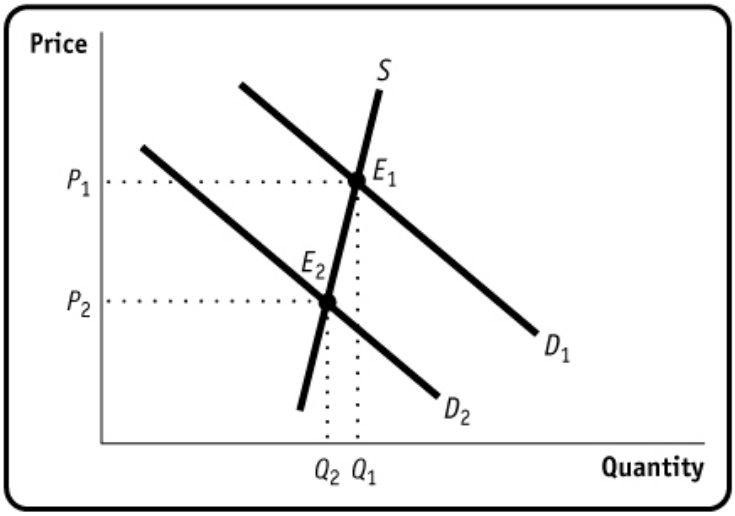
6. a. Supply is perfectly inelastic: the quantity of cabins on the Queen Mary 2 is fixed. As demand increases (a rightward shift in the demand curve), the price of a cabin on the Queen Mary 2 increases, without an increase in the quantity supplied. See the accompanying diagram.



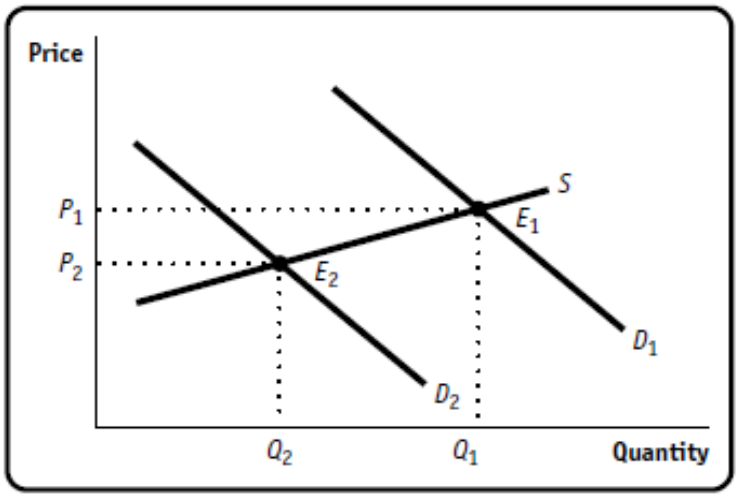
b. Supply is perfectly elastic. As demand changes (for instance, as demand increases in times of high electricity demand), price does not change but the quantity supplied does change. See the accompanying diagram.



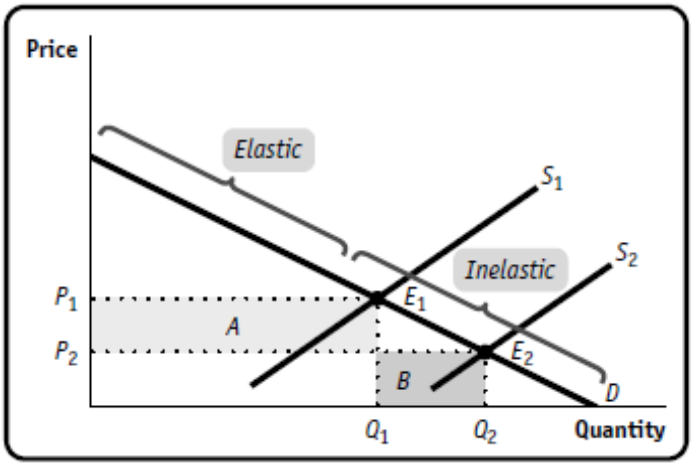
c. Supply is inelastic. As price falls by 20%, the quantity supplied falls by 10%. This implies a price elasticity of supply of $\frac{10\%}{20\%} = 0.5$, which is inelastic. See the accompanying diagram.



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.



7. 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,* so total revenue falls.



8. 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 $10 and the price of the CD is $10, 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.

9. 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.

10. 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 $1/2 \times (\$10 - \$5) \times 10 = \$25$.

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 $1/2 \times \$10 \times 20 = \$100$. This is the maximum admission fee that Fun World can charge with a price per ride of zero.

11. a. At a price of $4, the taxi driver supplies 40 rides. His producer surplus is therefore $1/2 \times \$4 \times 40 = \$80$.

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 1⁄2 × $8 × 80 = $320. So $320 is the most the city can charge as a licensing fee when the price per ride is $8.

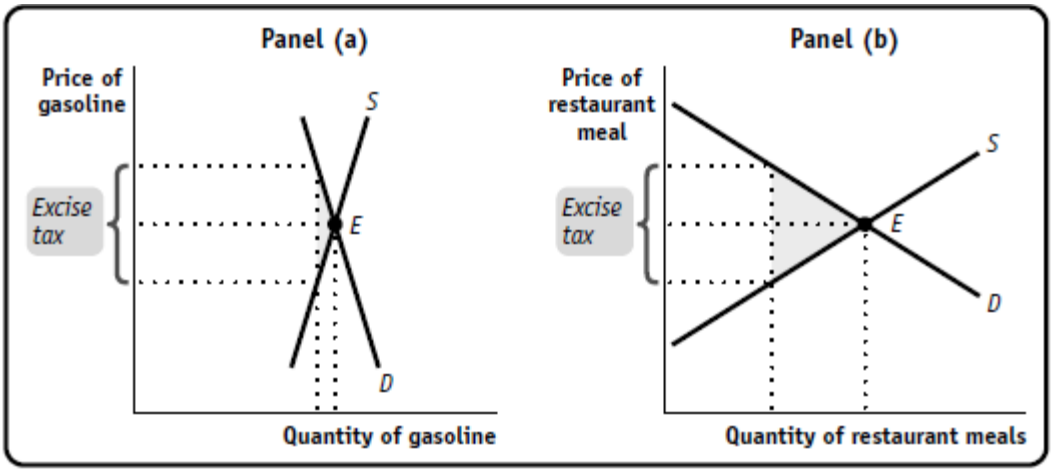
12. a. The tax drives a wedge between the price paid by consumers and the price received by producers. Consumers now pay $9, and producers receive $5. So after the imposition of the tax, the quantity bought and sold will be one pizza.

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 been reduced 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 the situation before, it has decreased 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.

13. 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).



14. a. Al has increasing marginal utility of economics classes. Each additional class adds more to his total utility than the previous class.

b. Al has constant marginal utility of volume of music. His total utility increases by 5 utils for each additional notch of volume, so his marginal utility is constant at 5 utils.

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.

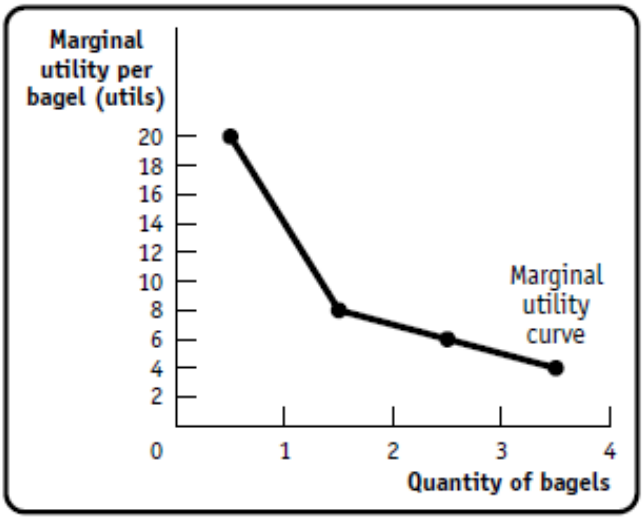
15. After you have taken the first newspaper, the marginal utility of the second newspaper is zero: you don't learn any more news by having two copies of the same paper instead of just one. So once you have paid for the vending machine to open, you will take only one paper. For soda, on the other hand, marginal utility is positive: after you have drunk the first soda, the second will still give you more utility. It will give you less 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.

16. 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			
Quantity of bagels	Quantity of coffee (cups)	Total utility (utils)	Marginal utility per bagel (utils)
0	2	28	
			20
1	2	48	
			8
2	2	56	
			6
3	2	62	
			4
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.



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

0 notebooks, 5 CDs

2 notebooks, 4 CDs

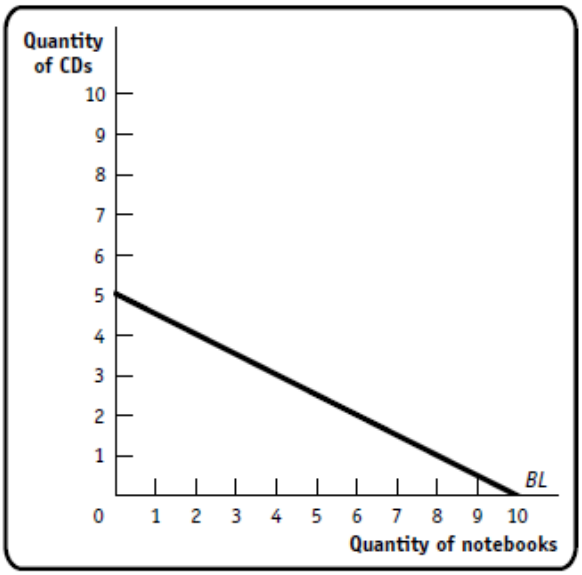
4 notebooks, 3 CDs

6 notebooks, 2 CDs

8 notebooks, 1 CD

10 notebooks, 0 CDs

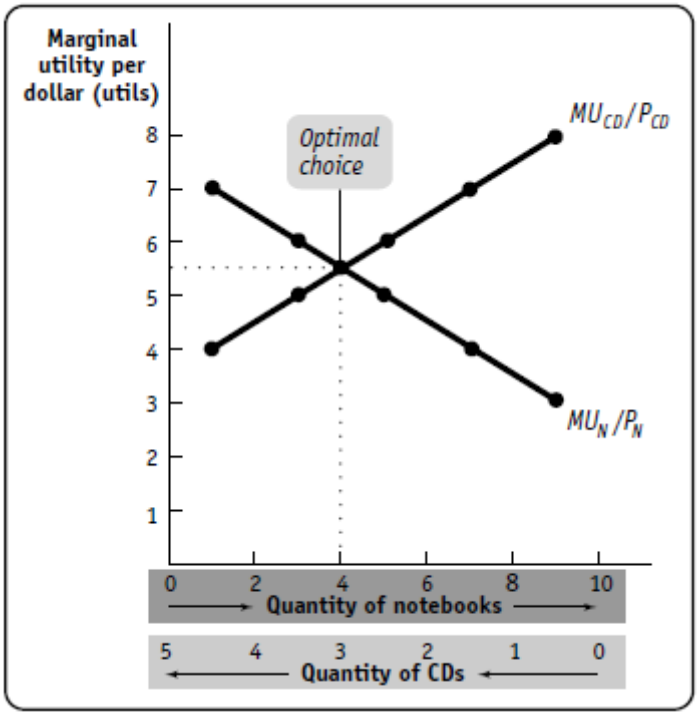
The accompanying diagram shows Bernie's budget line.



b. The accompanying table shows the marginal utility for each notebook and for each CD, the marginal utility per dollar spent on notebooks, and the marginal utility per dollar spent on CDs. 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 CDs	Utility from CDs (utils)	Marginal utility per CD (utils)	Marginal utility per dollar (utils)
0	0			0	0		
		35	7			80	8
2	70			1	80		
		30	6			70	7
4	130			2	150		
		25	5			60	6
6	180			3	210		
		20	4			50	5
8	220			4	260		
		15	3			40	4
10	250			5	300		

c. The optimal consumption rule 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 CDs. When Bernie consumes 4 notebooks and 3 CDs, the marginal utility per dollar spent on notebooks is the same as the marginal utility per dollar spent on CDs, so this is the optimal consumption bundle. It is also the *only* bundle—from all the bundles he can consume (that is, from all the bundles on his budget line)—for which the marginal utility per dollar is equal for the two goods.



18. 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.

AP Krugman Economics Section 10 Problem Solutions

AP Krugman Microeconomics Section 4 Problem Solutions

1. a.

Hiro's accounting profit is:

$100,000	(total revenue)
-$55,000	(travel and other expenses)
-$2,000	(depreciation)
$43,000	(accounting profit)

b.

Hiro's accounting profit is:

$43,000	(accounting profit)
-$100	(interest forgone)
-$50,000	(salary as economics professor)
-$7,100	(accounting 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.

2. a. Jackie's accounting profit is: Total revenue - $5,000. (The only cost that her accountant would add into the accounting profit calculation is depreciation.) 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. (Depreciation, 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.

3.

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.

4. 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.

5. 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)
$10	$15

Since the baseball game would have given you the greater total net gain, 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:

Go to the soccer game	**Go to the baseball game**
$20 (benefit)	$35 (benefit)
	-$20 (cost of ticket)
$20	$15

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 customer.

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. 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.

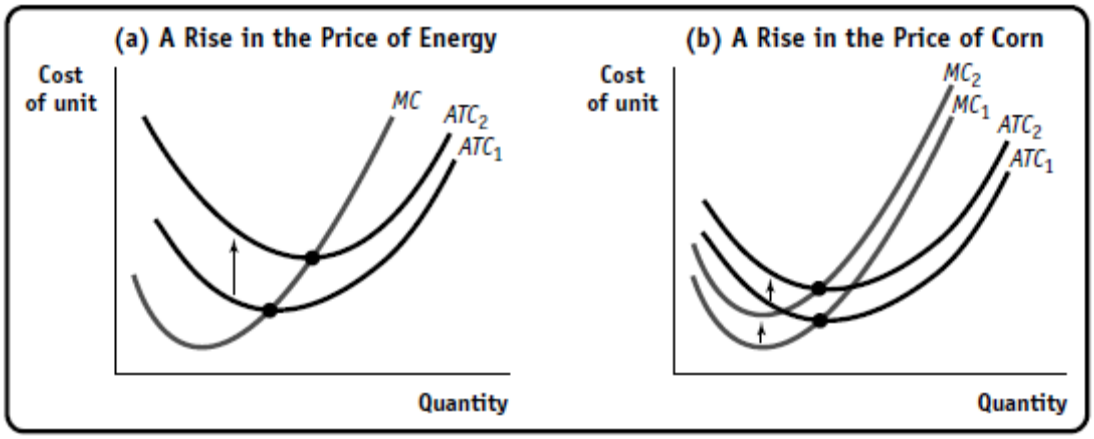
b. Georgia would be better off adding a second class per week. For the second class, the marginal benefit to Georgia ($22) exceeds the marginal cost ($20), so she wants to take the second class. For the third class, the marginal cost ($20) would exceed the marginal benefit ($15), so Georgia does not want to take the third class. For Georgia, the optimal number of classes per week is two.

8. 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*.

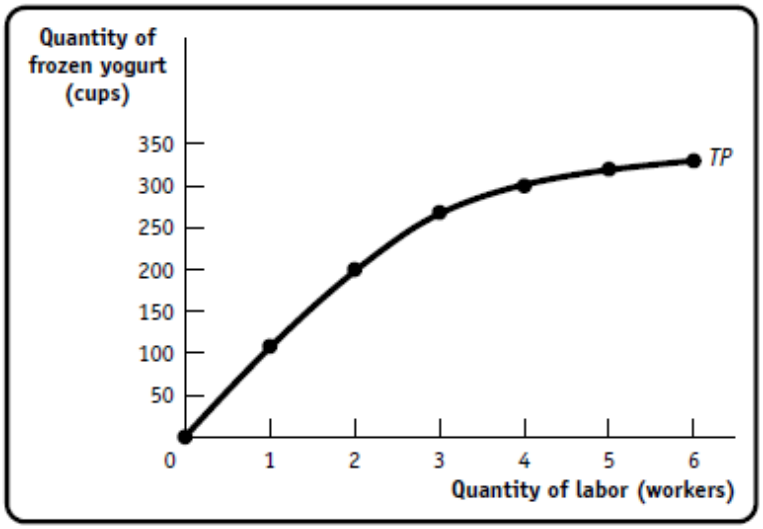
c. Corn is a direct input in the production of ethanol. The more ethanol produced, the more corn is used. If no ethanol is produced, then no corn is needed. Hence, corn is a variable cost, rather than a fixed cost, for an ethanol producer.

d. When the price of corn, a variable cost, increases, both average total cost and marginal cost will rise. The corresponding ATC_1 and MC_1 curves will shift upwards to ATC_2 and MC_2, respectively, as shown in panel (b) of the diagram.



9. 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.

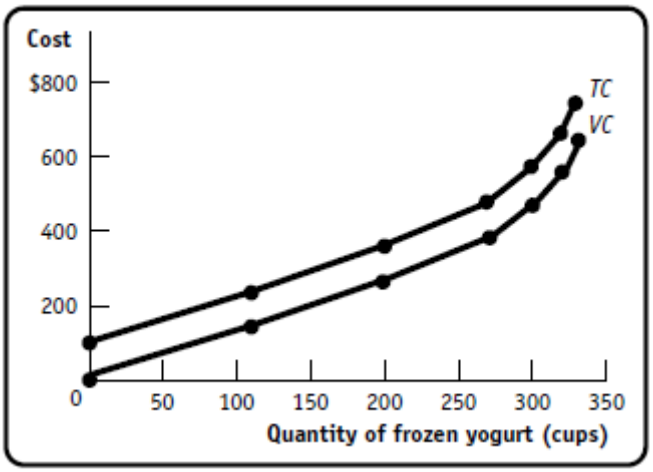


c. The marginal product, *MPL*, of the first worker is 110 cups. The *MPL* of the second worker is 90 cups. The *MPL* of the third worker is 70 cups. The *MPL* declines as more and more workers are added due to the principle of diminishing returns to labor. Since the number of frozen-yogurt machines 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.

10. 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)	*VC*	*TC*	*MC* of cup
0	0	$0	$100	
				$1.23
110	1	1 × 80 + 110 × 0.5 = 135	235	
				1.39
200	2	2 × 80 + 200 × 0.5 = 260	360	
				1.64
270	3	3 × 80 + 270 × 0.5 = 375	475	
				3.17
300	4	4 × 80 + 300 × 0.5 = 470	570	
				4.50
320	5	5 × 80 + 320 × 0.5 = 560	660	
				8.50
330	6	6 × 80 + 330 × 0.5 = 645	745	

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

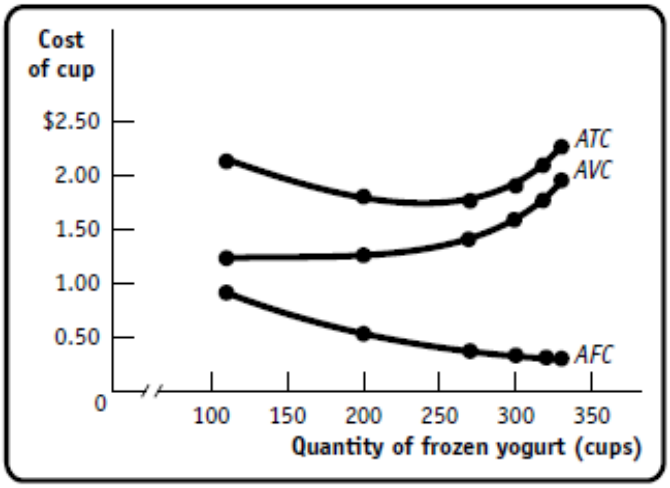


c. Marginal cost, *MC*, per cup of frozen yogurt is shown in the table in part a; it is the change in total cost divided by the change in quantity of output.

11. 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)	*VC*	*TC*	*AFC* of cup	*AVC* of cup	*ATC* 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.



c. *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.

d. 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.

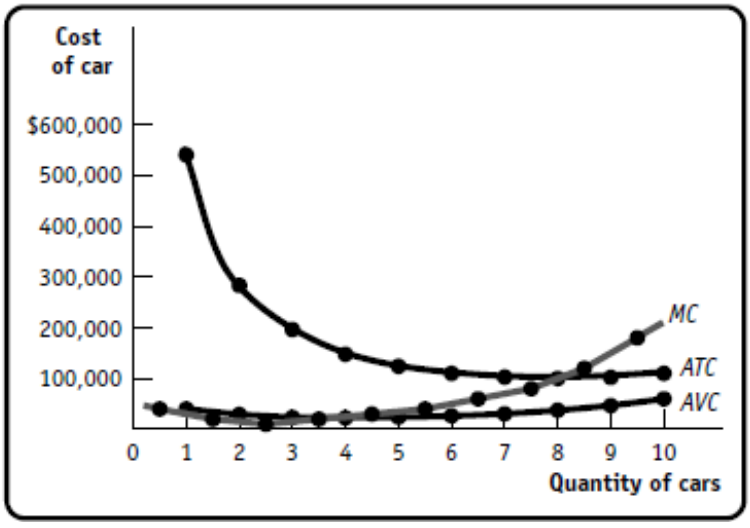
12. a. The manufacturer's fixed cost is $500,000. Even when no output is produced, the manufacturer has a cost of $500,000.

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	—	—	—
		$40,000				
1	540,000		40,000	$40,000	$540,000	$500,000
		20,000				
2	560,000		60,000	30,000	280,000	250,000
		10,000				
3	570,000		70,000	23,333	190,000	166,667
		20,000				
4	590,000		90,000	22,500	147,500	125,000
		30,000				
5	620,000		120,000	24,000	124,000	100,000
		40,000				
6	660,000		160,000	26,667	110,000	83,333
		60,000				
7	720,000		220,000	31,429	102,857	71,429
		80,000				
8	800,000		300,000	37,500	**100,000**	62,500
		120,000				
9	920,000		420,000	46,667	102,222	55,556
		180,000				
10	1,100,000		600,000	60,000	110,000	50,000

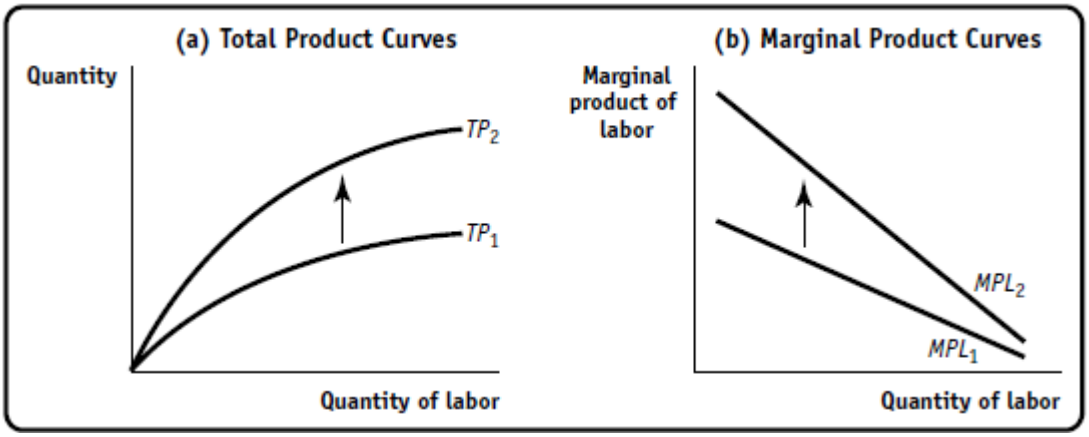
c. The table also shows *MC*, the additional cost per additional car produced. Notice that *MC* is below *ATC* for levels of output less than the minimum-cost output and above *ATC* for levels of output greater than the minimum-cost output.

d. The *AVC*, *ATC*, and *MC* curves are shown in the accompanying diagram.

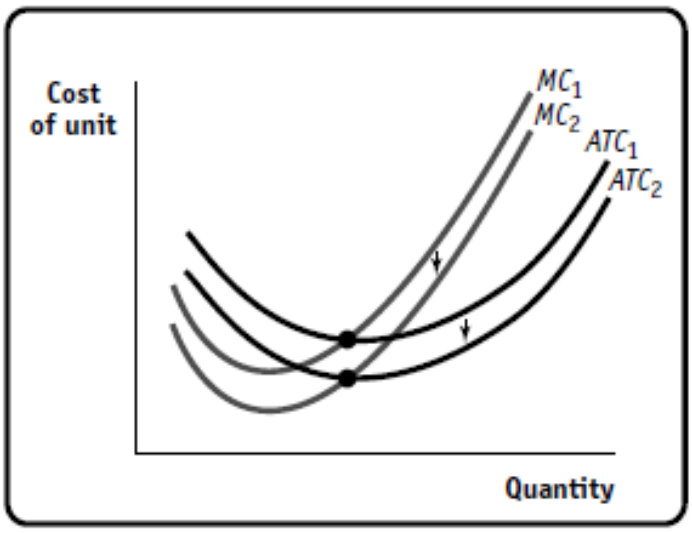


13. a. When labor costs are a variable cost but not a fixed cost, an increase in labor costs leads to an increase in both average total cost and marginal cost. When labor costs are a variable cost and a fixed cost, the result is the same: both the average total cost and the marginal cost increase.

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.

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

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.

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

16. 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.

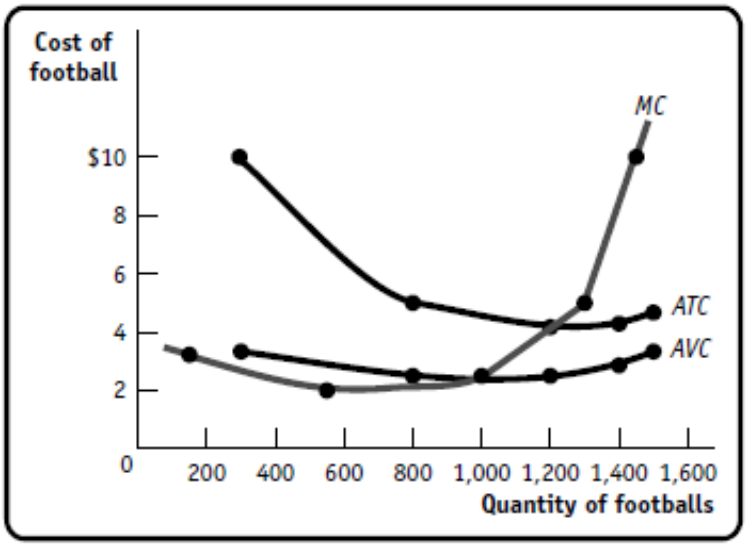
c. False. An increase in fixed cost does not change marginal cost. Marginal cost is the additional cost of producing an additional unit of output. Fixed cost does not change as output is increased, and so the additional cost of producing an additional unit of output is independent of the fixed cost.

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.

17. 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	
						$3.33
1	300	$3.33	$6.67	$10.00	3,000.00	
						2.00
2	800	2.50	2.50	5.00	4,000.00	
						2.50
3	1,200	2.50	1.67	4.17	5,000.00	
						5.00
4	1,400	2.86	1.43	4.29	6,000.00	
						10.00
5	1,500	3.33	1.33	4.67	7,000.00	

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.

18. 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.

AP Krugman Economics Section 11 Problem Solutions

AP Krugman Microeconomics Section 5 Problem Solutions

1. 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.

2. 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	*VC*	*TC*	*MC* of meal	*AVC* of meal	*ATC* of meal
0	$0.00	$100.00		—	—
			$20.00		
10	200.00	300.00		$20.00	$30.00
			10.00		
20	300.00	400.00		15.00	20.00
			18.00		
30	480.00	580.00		16.00	19.33
			22.00		
40	700.00	800.00		17.50	20.00
			30.00		
50	1,000.00	1,100.00		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 will incur a loss: the price is below her break-even price. Also, since the price is below her shut-down price, Kate should shut down immediately to limit her losses to her fixed cost.

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

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

b. When the price is $25, Bob will sell 8,000 DVDs per month and make a profit of $78,000. If there is free entry into the industry, this profit will attract new firms.

As firms enter, the price of DVDs 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 DVDs per month. So the long-run price of DVDs will be $13.83.

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

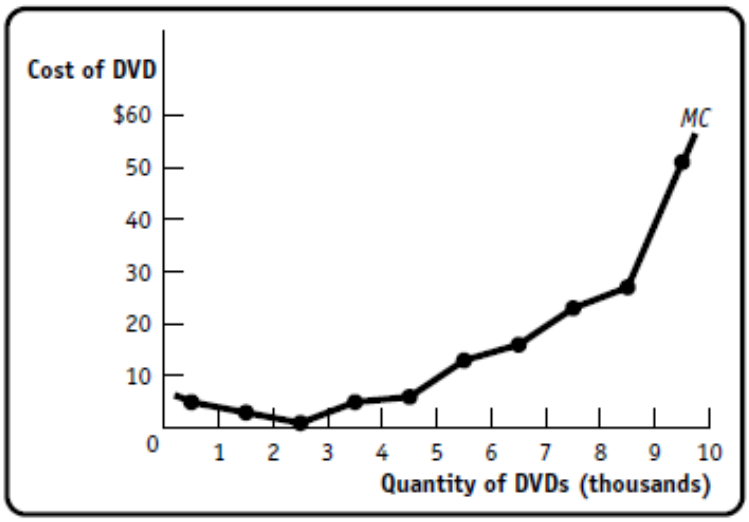
not even cover his variable costs.

b. If the price of DVDs is $2, the price is below Bob's shut-down price of $3. So Bob should shut down in the short run.

c. If DVDs sell for $7, Bob should produce 5,000 DVDs 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. 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 DVD is below his break-even price of $13.83.

d. If DVDs sell instead for $20, Bob should produce 7,000 DVDs because at this quantity his marginal cost approximately equals his marginal revenue (the market price). His total profit will be $41,000. 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).

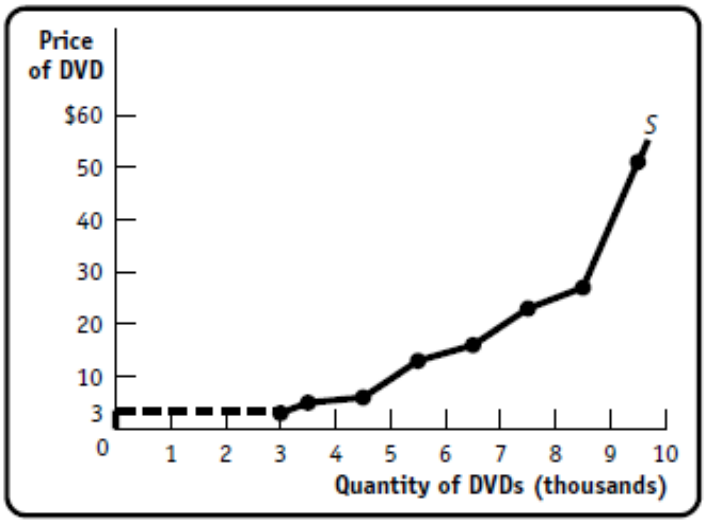
5. a. Bob's marginal cost curve is shown in the accompanying diagram.



b. Bob will produce no DVDs 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.



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. 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. In the long run, the firm should exit the industry because it is incurring a loss.

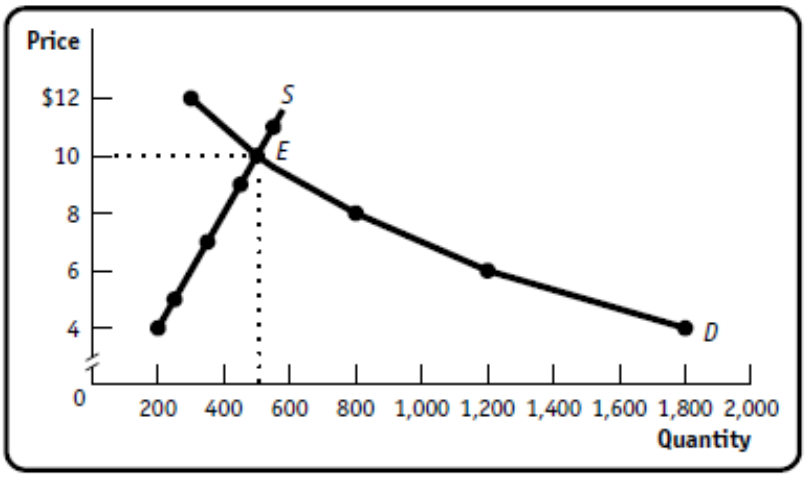
7. a. The short-run profit of the sushi restaurant will rise, inducing others to open sushi restaurants. The number of sushi restaurants in town will increase. Over time, as the supply of sushi restaurants increases, the equilibrium price of sushi will decrease, lowering the short-run profit of the original 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. 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	TC	MC	AVC	ATC
0	$5.00		—	—
		$5.00		
1	10.00		$5.00	$10.00
		3.00		
2	13.00		4.00	6.50
		5.00		
3	18.00		4.33	6.00
		7.00		
4	25.00		5.00	6.25
		9.00		
5	34.00		5.80	6.80
		11.00		
6	45.00		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 ×5 =$50. Its total cost is $34. So it makes a profit of $16.

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			0
			10	0	
10	45	0			10 − 0 = 10
			9	1	
20	36	1			19 − 1 = 18
			8	2	
30	28	3			27 − 3 = 24
			7	3	
40	21	6			34 − 6 = 28
			6	4	
50	15	10			40 − 10 = 30
			5	5	
60	10	15			45 − 15 = 30
			4	5	
70	6	20			49 − 20 = 29
			3	5	
80	3	25			52 − 25 = 27
			2	5	
90	1	30			54 − 30 = 24
			1	5	
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. a. Since the yield is 50 bushels per acre, we know that producing 50 bushels of wheat is associated with an average variable cost of $107. So the production of 1 bushel of wheat is associated with an average variable cost of $107/50 bushels = $2.14 per bushel.

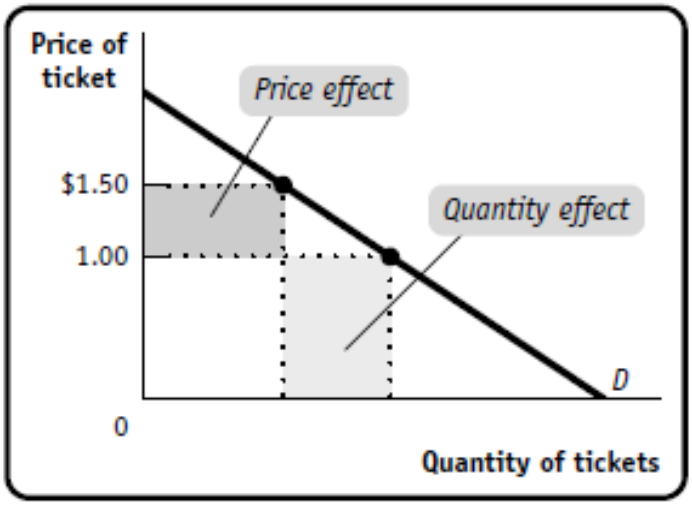
b. We would not expect the average farm to have exited the industry in the short run because the price it received for wheat, $2.65 per bushel, was greater than the average variable cost of production, $2.14 per

bushel.

c. The average farm would have exited the industry in the long run because the price it received per bushel was less than the average total cost of production. The farm was incurring an economic loss by operating. So a decline in the harvested acreage of wheat should have been expected after 1998.

d. Because unprofitable farms were operating in 1998, when prices were $2.65 per bushel, we would expect that prior to 1998, prices were higher—assuming that production costs were approximately the same. So prior to 1998, farms were at least breaking even. Indeed, the average price of wheat was $4.25 per bushel in 1996 and $3.85 per bushel in 1995.

11. 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.

12. 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*.

13. 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	*TR*	*MR*
$10	0	$0	
			$8
8	1	8	
			5
6	3	18	
			2
4	6	24	
			−1
2	10	20	
			−4
0	15	0	

b. Bob would charge $0. At that price, there would be 15 downloads, the largest quantity they can sell.

c. Bill would charge $4. At that price, total revenue is greatest ($24). At that price, there would be 6 downloads.

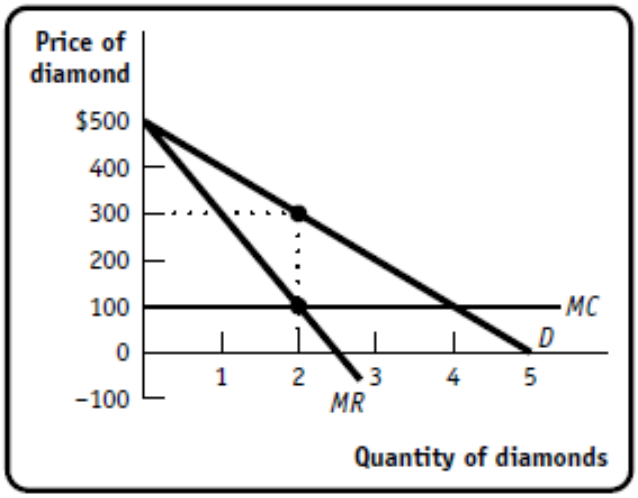
d. Ben would charge $6. At that price, there would be 3 downloads. For any more downloads, marginal revenue would be below marginal cost, and so further downloads would lose the Baxters' money.

e. Brad would charge $4. A price equal to marginal cost is efficient. At that price, there would be 6 downloads.

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

Price of diamond	Quantity of diamonds demanded	*TR*	*MR*
$500	0	$0	
			$400
400	1	400	
			200
300	2	600	
			0
200	3	600	
			−200
100	4	400	
			−400
0	5	0	

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 ×$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.

15. 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 ×$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.

16. 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.

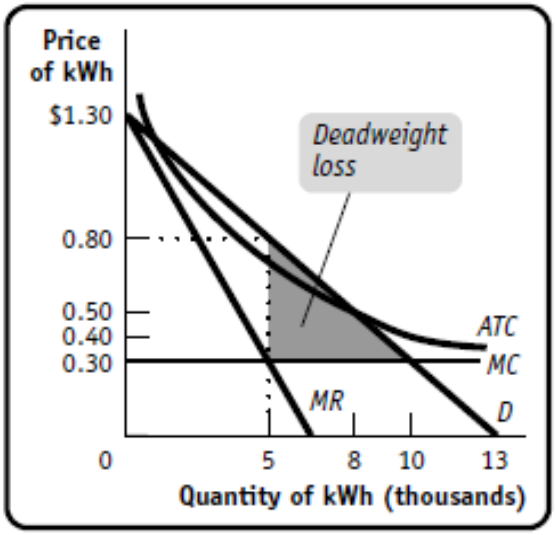
17. a. Total revenue (*TR*) and marginal revenue per album (*MR*) is shown in the accompanying table.

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

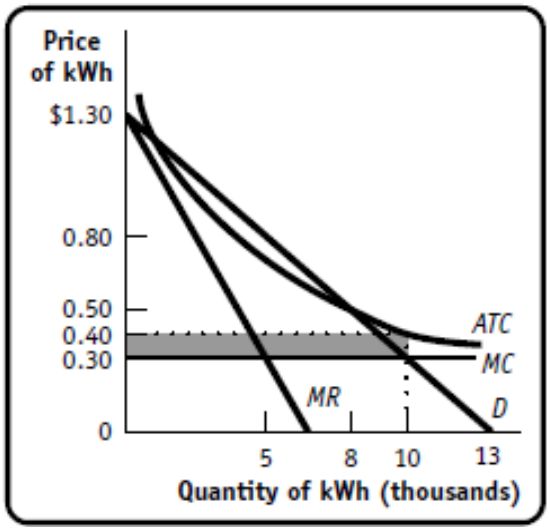
b. If the marginal cost of each album is $6, Download Records will maximize profit by producing 4,000 albums, since for each album up to 4,000, marginal revenue is greater than marginal cost. For any further albums, marginal cost would exceed marginal revenue. Producing 4,000 albums, Download Records 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.

18. 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.

19. a. 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 ×$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 ×$5 =$500.

b. 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 ×$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.

c. 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 ×$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 ×\$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.

20. The quantity effect is \$1 (the increase in total revenue from selling the 9th unit at \$1). The price effect is 8 × (−\$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 it increases the total cost (since marginal cost is positive). So it will definitely lower profit. Instead, the monopolist should produce less output.

AP Krugman Economics Section 12 Problems Solutions

AP Krugman Microeconomics Section 6 Problem Solutions

1. a. The HHI is $30^2 + 26^2 + 14^2 + 13^2 + 11^2 + 6^2 = 900 + 676 + 196 + 169 + 121 + 36 =$ 2,098.

b. Since the HHI exceeds 1,800, the industry is an oligopoly.

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 × (−$1) = −$40. Since BASF produces an additional 10 tons and sells them at $3, the quantity effect is 10 × $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 × (−$1) = −$20. Since BASF produces an additional 10 tons and sells them at $3, the quantity effect is 10 × $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. 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 profits 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 × $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 × $70 = $105,000 and cost of 1,500 × $40 = $60,000. So their profit is $105,000 − $60,000 = $45,000. The Contraltos have revenue of 1,000 × $70 = $70,000 and cost of 1,000 × $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 × $60 = $90,000 and cost of 1,500 × $40 = $60,000. So each family's profit is $30,000.

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 million − (3 million × €2) = €8 million. Evian's profit, however, falls to (2 million × €5) − €1 million − (2 million × €2) = €5 million.

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. 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

b. 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.

c. 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 × $15 = $16,500, and the U.S. fleet's revenue will fall to 1,000 × $15 = $15,000.

d. 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 × $14 = $15,400.

6. 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 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.

7. 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:

i. 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.

ii. 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.

iii. 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.

iv. 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.

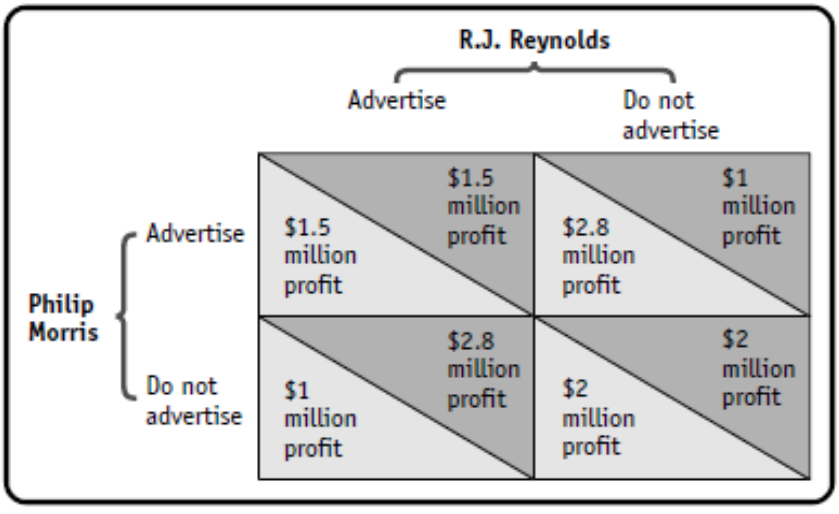
8. a. **i.** Pepsi sells 4 million cans at \$0.20 for total revenue of \$0.20 × 4 million = \$800,000. Its only cost is the fixed cost of \$100,000, so its profit is \$800,000 − \$100,000 = \$700,000.

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 × 3 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.

9. a. See the accompanying payoff matrix.



b. Each firm should not advertise, since this would maximize joint profits. Each firm then earns a profit of \$2 million.

c. 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.

10. 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.

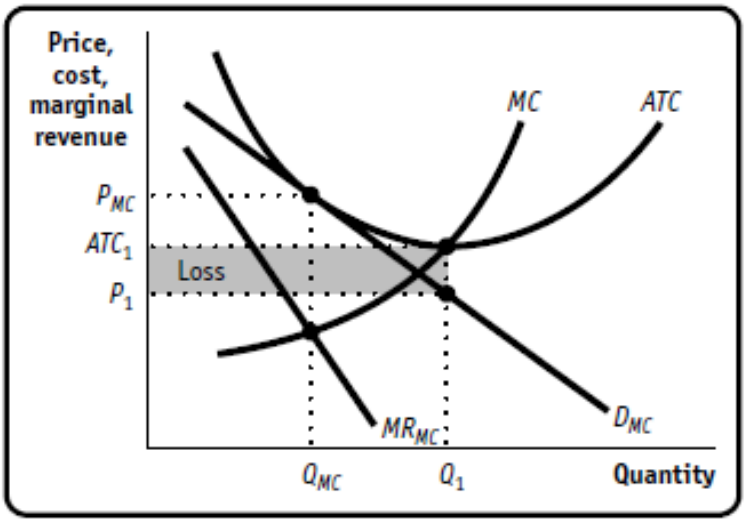
b. The industry for individual-serving juice boxes is dominated by a few very large firms (for example, Minute Maid, Welch's, and Kool Aid), and there are significant barriers to entry, in part because of the large costs (for example, advertising) involved in gaining any market share of the national 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.

11. 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.

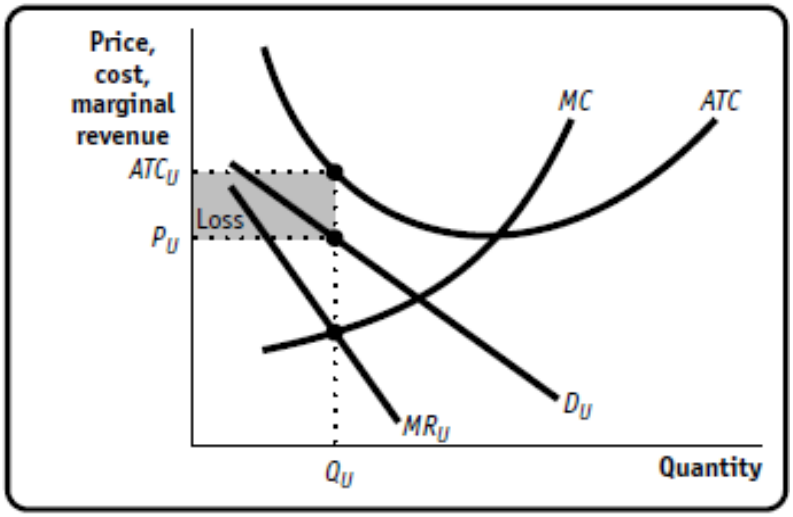
12. She should not lower her price. Since the industry is in long-run equilibrium, each restaurant makes zero profit. That is, the restaurant's demand, marginal revenue, marginal cost, and average total cost curves are as shown in the accompanying diagram.



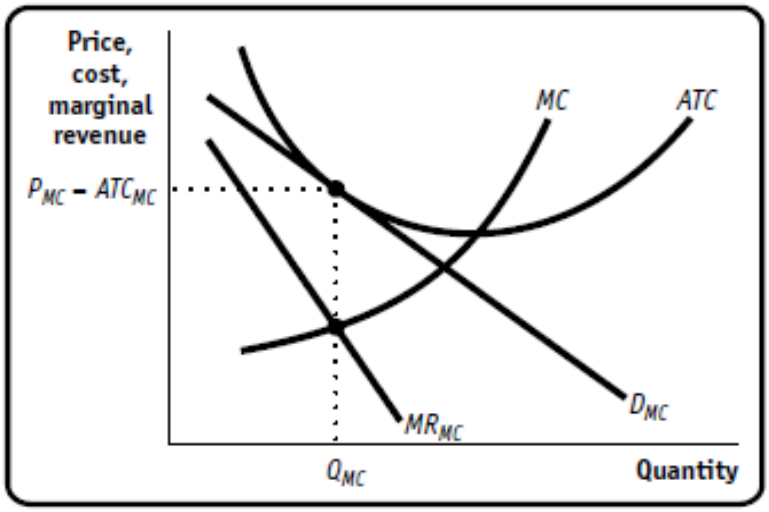
The restaurant owner produces output (the number of tables served) Q_{MC} at a price of P_{MC}. The price is equal to average total cost, so she makes zero profit. If she were to lower the price to P_1, she would attract more customers and sell the minimum cost output Q_1. That is, there is excess capacity: 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 make a loss. So she should not change the prices on her menu.

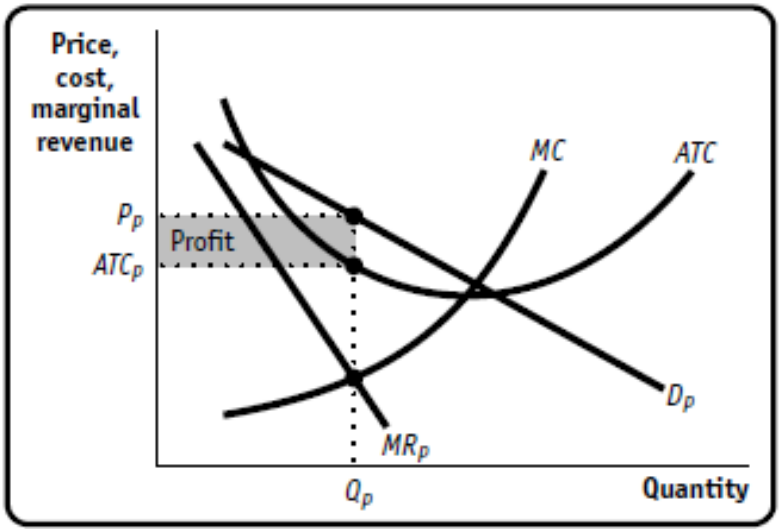
13. Each gas station will produce the output, and so charge the price, that maximizes its profit or minimizes its loss. That is, it will produce quantity Q_U, where marginal cost equals marginal revenue, and so charge price P_U. Since the price P_U is lower than average total cost at the quantity Q_U, ATC_U, each gas station incurs a loss. That is, the situation for the typical gas station looks like the accompanying diagram.



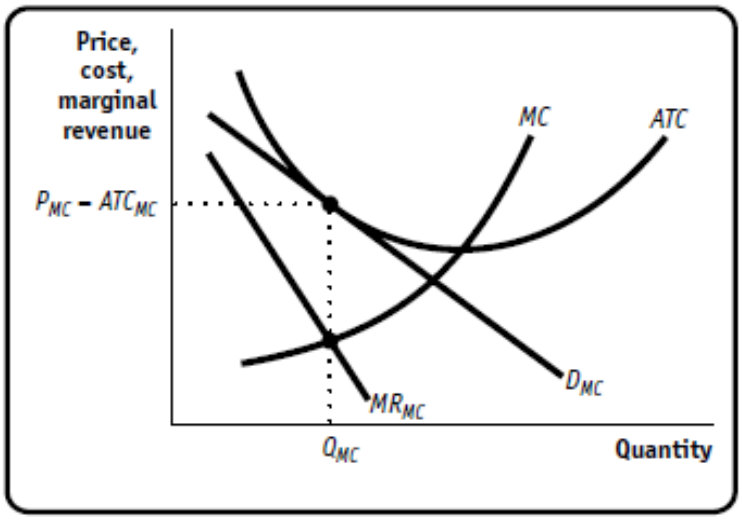
Since gas stations are incurring losses, in the long run some will exit the industry. This shifts the demand and marginal revenue curves for each of the remaining gas stations rightward. Exit continues until each remaining gas station makes zero profit. This is the long-run equilibrium. The situation 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}.



14. Your hairdresser currently makes a profit. His demand, marginal revenue, marginal cost, and average total cost curves are shown in the accompanying diagram.

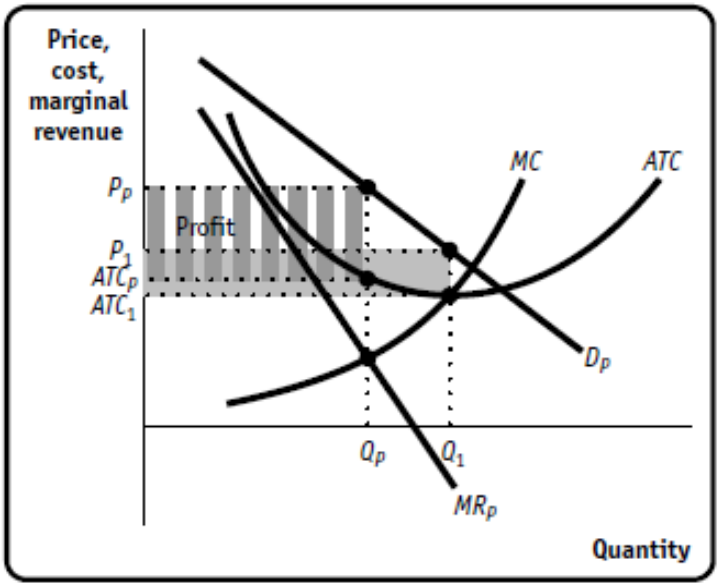


Since this hairdresser (and all other hairdressers) makes a profit equal to the shaded rectangle by producing quantity Q_P at a price P_P , there will be entry into this industry. As more hairdressers open shops in town, demand for the typical existing hairdresser will fall—the demand curve and marginal 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.



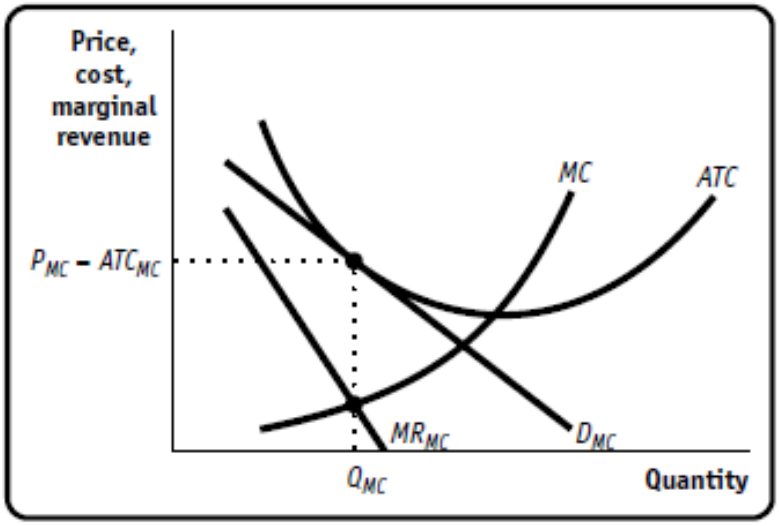
The best the typical hairdresser can do is to produce quantity Q_{MC} at a price of P_{MC}. Since price equals average total cost at this quantity, each hairdresser will make exactly zero profit.

15. 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 and 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.



16. In the short run, a monopolist can make positive profits. 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 can make positive profits. 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.

17. 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.

18. 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, Tiger Woods commands a very high fee for advertising. What the commercial therefore signals is something like "we can afford to pay Tiger Woods'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.

19. 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.

20. a. 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.

AP Krugman Economics Section 13 Problems Solutions

AP Krugman Microeconomics Section 7 Problems Solutions

1. a. Since 137 million workers were employed at an average yearly wage of $57,526, the total amount of compensation of employees was 137 million × $57,526 = $7,881.1 billion.

b. Of a total of $11,186.9 billion, the amount received by workers was $7,881.1 billion. In percentage terms, this is $7,881.1 billion/$11,186.9 billion × 100 = 70.4%.

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 workers in the labor force would increase or decrease the share of income going to compensation of employees.

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		
		110	$220
1	110		
		90	180
2	200		
		70	140
3	270		
		30	60
4	300		
		20	40
5	320		
		10	20
6	330		

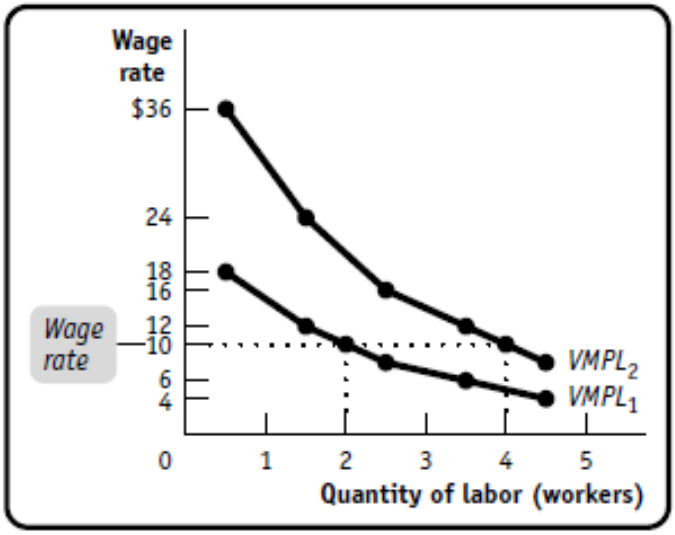
b. Marty should employ 3 workers. The value of the marginal product of the third worker ($140) is above the wage rate of $80: Marty should hire the third worker. But the fourth worker's value of the marginal

product is only $60. This is less than Marty would have to pay this worker, so Marty should not hire a fourth worker.

3. a. The accompanying table shows the marginal product of labor (*MPL*) and the value of the marginal product of labor ($VMPL_1$).

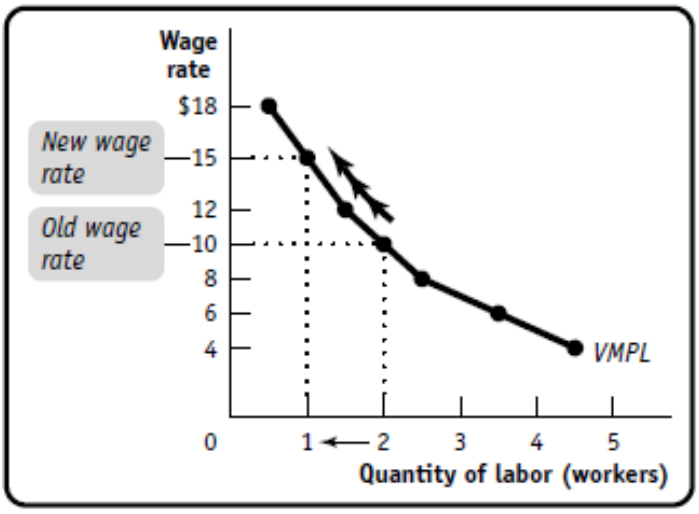
Number of workers	Quantity of pizza	*MPL* (pizzas per worker)	$VMPL_1$ (per worker) (price of pizza = $2)	$VMPL_2$ (per worker) (price of pizza = $4)
0	0			
		9	$18	$36
1	9			
		6	12	24
2	15			
		4	8	16
3	19			
		3	6	12
4	22			
		2	4	8
5	24			

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.

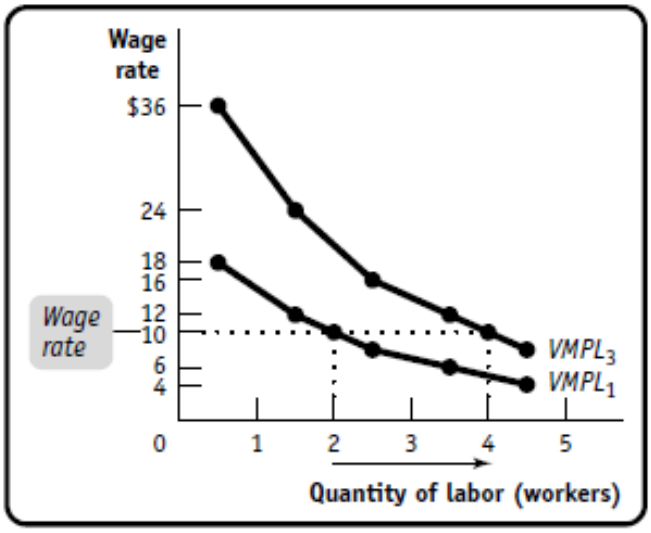
4. The accompanying diagram shows the value of the marginal product of labor curve and the wage rates of $10 and $15. As the wage rate increases from $10 to $15, Patty's demand for workers decreases from 2 workers to 1 worker. So, as the wage rate increases, Patty should hire fewer workers.



5. a. 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		
		18	$36
1	18		
		12	24
2	30		
		8	16
3	38		
		6	12
4	44		
		4	8
5	48		

b. The accompanying diagram shows the original value of the marginal product of labor curve from Problem 3 ($VMPL_1$) 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.



6. 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)	*MPL* (hours per driving instructor)	*VMPL* (per driving instructor)
0	0		
		8	$280
1	8		
		7	245
2	15		
		6	210
3	21		
		5	175
4	26		
		4	140
5	30		
		3	105
6	33		

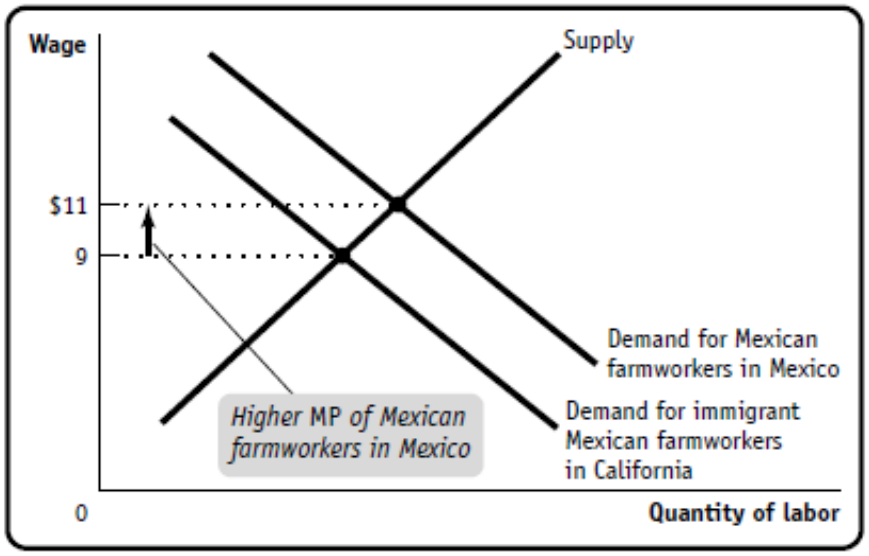
If the daily wage rate of driving instructors is $160, Jameel should hire 4 instructors: the fourth instructor has a value of the marginal product of $175, which is greater than the wage rate; but the fifth instructor would have a value of the marginal product of only $140, which is less than the wage 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

7. 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.

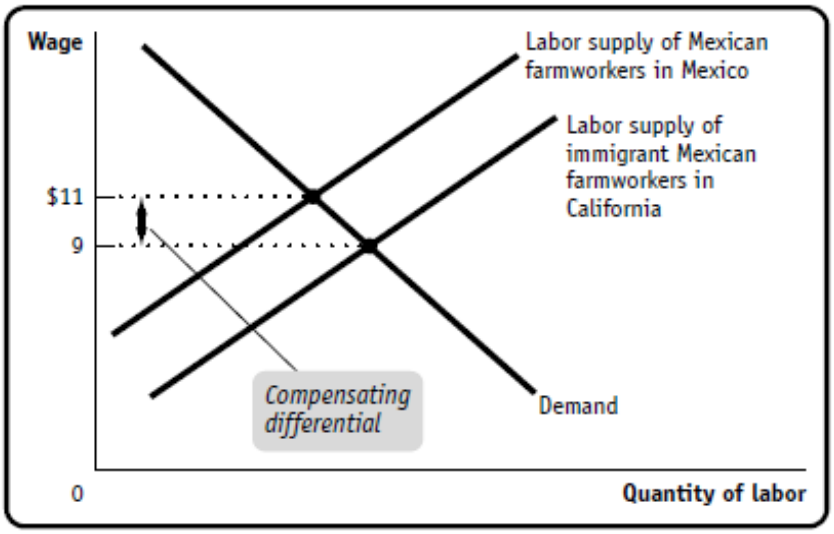
8. a. We know that farm workers are employed up to the point where the value of the marginal product of labor is just equal to the wage: $VMPL = P \times MPL = W$. In Mexico, this means that $P \times MPL_{Mexico}$ = $11 and in California $P \times MPL_{California}$ = $9. Since the price, P, is the same 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 farm workers as it is for immigrant Mexican farm workers 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 farm workers have 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 farm workers is evidence that they have higher marginal product of labor than their peers in California. Rather, the difference in wages is a compensating differential that compensates Mexican farm workers 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 farm workers 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.



9. 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.

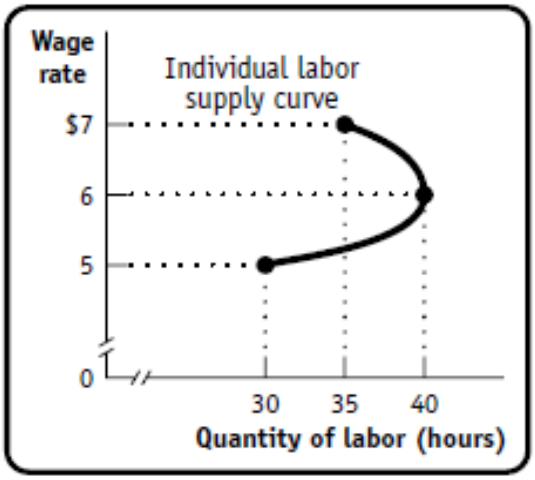
b. The three conditions are: (1) Kendra's current value of the marginal product of land > r_L*. Only if this is satisfied should Kendra increase the amount of land she employs. (2) Kendra's current value of the marginal product of labor > w*. Kendra must hire more labor if she employs more land. Thus, 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.

10. 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.

11. 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.

12. a. Wendy's individual labor supply curve has the backward-bending shape shown in the accompanying diagram.



b. Wendy's behavior has a perfectly rational explanation. As the wage rate increases, the opportunity cost of leisure increases. So the substitution effect says to consume less leisure and work more. At the same time, an increase in the wage rate makes Wendy richer in a real sense. And since leisure is a normal good,

the income effect says to consume more leisure and work less. Income and substitution effects work in opposite directions. As Wendy's wage rate rises from $5 to $6, the substitution effect dominates the income effect. As her wage rate rises further to $7, the income effect dominates the substitution effect.

13. a. 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.

b. 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.

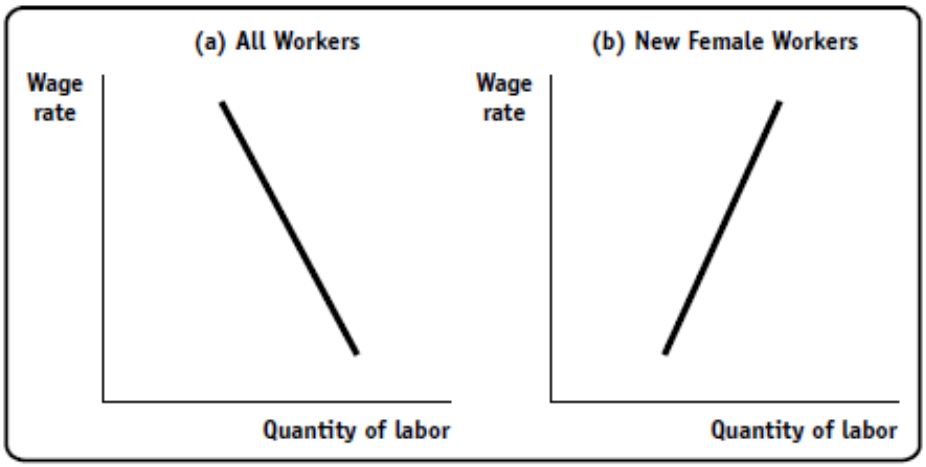
c. This policy will unambiguously encourage people to work more. The increase in the property tax rate makes people feel poorer, and as a result, they will consume less of all normal goods. Since leisure is a normal good, people will consume less leisure and work more. This policy influences how much 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.

14. a. As wage rates rise, the substitution effect says to consume less leisure, because leisure has just become relatively more expensive. However, the income effect says to consume more leisure, because a wage rate increase makes consumers richer and leisure is a normal good. Since the overall effect has been for leisure time to increase as a result of the wage rate increase, the income effect must have been stronger than the substitution effect.

b. As wage rates rise, income and substitution effects work in the same ways as in part a. However, since female labor force participation has increased, the substitution effect must have been stronger for new

female workers. (Why is this? For individuals who are not participating in the labor market, an increase in the wage rate has only a substitution effect, leading them to consume less leisure since its opportunity cost has risen—that is, leading them to work more. Since they are not earning income from work, an increase in the wage rate has no income effect.)

c. The accompanying diagram shows a typical labor supply curve for all workers in panel (a) and for new female workers in panel (b).



AP Krugman Economics Section 14 Problems Solutions

AP Krugman Microeconomics Section 8 Problems Solutions

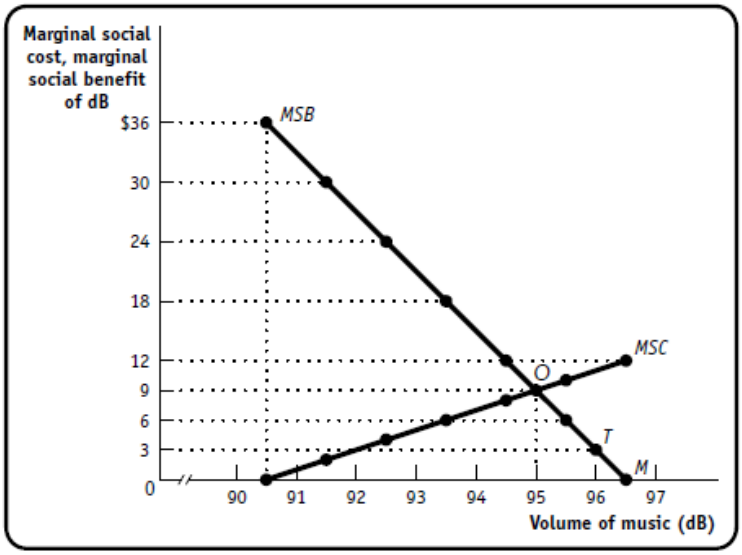
1. a. This is a positive externality: since other people enjoy looking at Mr. Chau's flowers, the marginal social benefit of looking at the flowers is greater than the marginal benefit to Mr. Chau of looking at them. As a result, fewer flowers will be planted than is socially optimal.

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. 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.

3. 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.

4. The accompanying table shows the marginal revenue, marginal cost, and marginal social cost from steel production. The marginal social cost of a given ton of steel is equal to its marginal cost plus $60, the marginal external cost per ton.

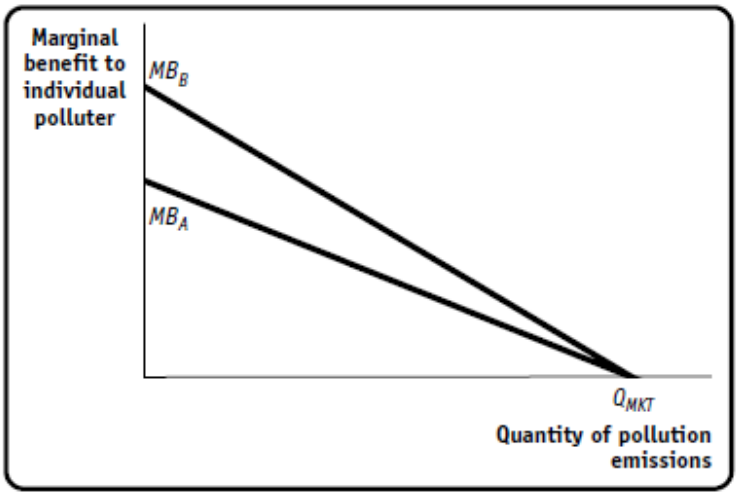
Quantity of steel (tons)	Total revenue	Marginal revenue per ton	Total cost to steel producers per ton	Marginal cost to steel producers per ton	Marginal social cost per ton
1	$115		$10		
		$95		$20	$80
2	210		30		
		75		30	90
3	285		60		
		55		40	100
4	340		100		
		35		50	110
5	375		150		

b. The market equilibrium quantity of steel production is 4 tons. The marginal revenue from producing the fourth ton is $55, which is more than $40, the marginal cost to steel producers of the fourth ton. But the marginal revenue from the fifth ton, $35, is less than its marginal cost to steel producers, $50.

c. The socially optimal level of steel production is 2 tons. The marginal revenue from producing the second ton is $95, more than its marginal social cost, which is $80. But the marginal revenue from the third ton is $75, less than its marginal social cost, which is $90.

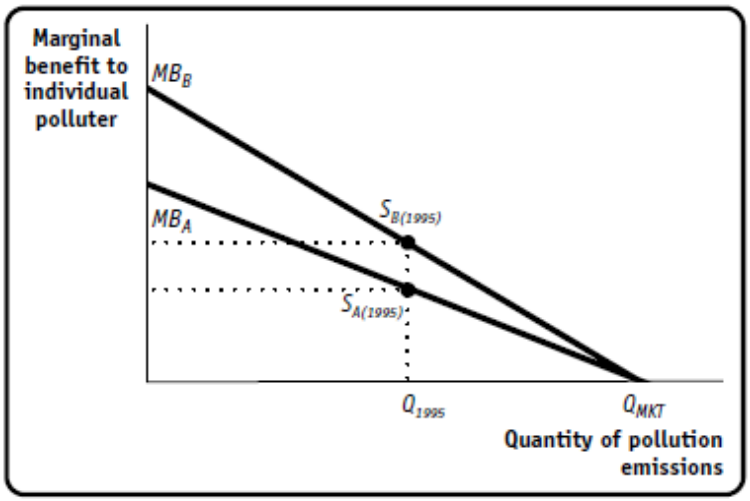
d. An optimal Pigouvian tax makes steel producers' marginal cost equal to the marginal social cost of producing steel which means the optimal Pigouvian tax should be $60 per ton.

5. 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, *Q1995*. Both firms had to reduce their emissions by the same amount. This was not necessarily efficient: since at the quantity *Q1995*, 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.

6. a. At the current level of consumption, the optimal after-tax retail price of a pack of cigarettes in each state should be equal to the CDC's estimate for smoking costs. In each of the states listed in the table, the current retail price is lower than the optimal price. The current level of consumption is too high because smokers are not bearing the full cost of their actions. So smokers consume more cigarettes than is optimal for society.

b. Taxes are not set at the optimal level because the social cost of smoking is still greater than the individual cost at the current tax rates.

c. The size of an additional Pigouvian tax should be equal to the difference between the social cost and the private cost, as shown in the accompanying table. (*Note:* This is true only because we assume that the social costs per pack do not change with a reduction in demand due to an increased retail price of cigarettes.)

State	**Cigarette retail price with taxes (per pack)**	**CDC estimate for smoking cost in 2006 (per pack)**	**Pigouvian tax**
California	$4.40	$15.10	$10.70
New York	5.82	21.91	16.09
Florida	3.80	10.14	6.34
Texas	4.76	9.94	5.18
Ohio	4.60	9.19	4.59

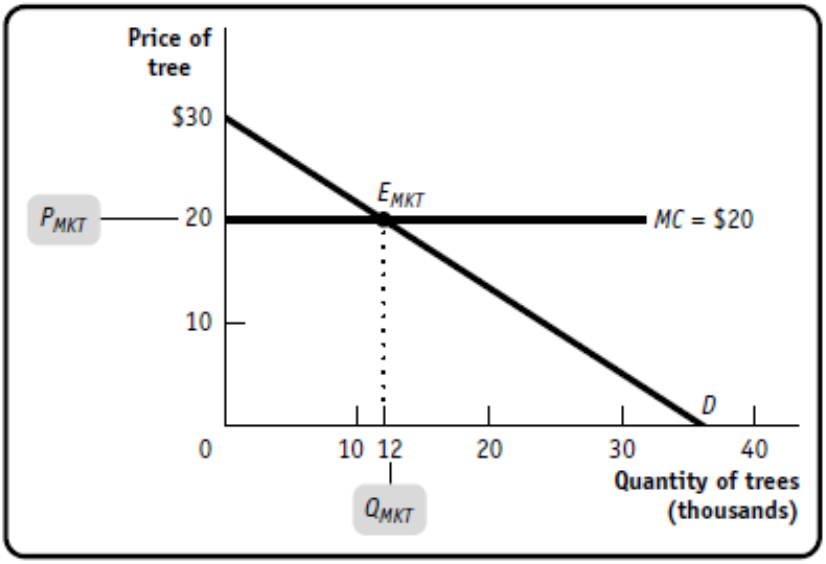
7. a. Sian's market equilibrium number of years of education is 12 years: at a smaller number of years, Sian's marginal benefit exceeds her marginal cost; at a greater number of years, her marginal cost exceeds her marginal benefit.

b. The marginal social benefit includes not only Sian's benefit but also the external benefit to society. The accompanying table calculates the marginal social benefit. From the table you can see that the socially optimal number of years of education would be 16 years.

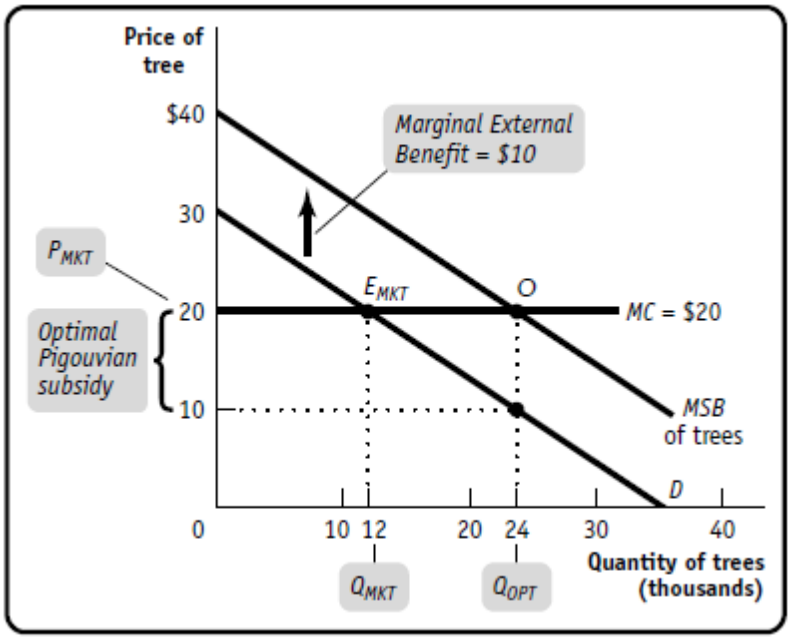
Quantity of education (years)	Sian's marginal benefit per year	Marginal social benefit per year	Sian's marginal cost per year
9			
	$20,000	$28,000	$15,000
10			
	19,000	27,000	16,000
11			
	18,000	26,000	17,000
12			
	17,000	25,000	18,000
13			
	16,000	24,000	19,000
14			
	15,000	23,000	20,000
15			
	14,000	22,000	21,000
16			
	13,000	21,000	22,000
17			

c. You would choose to use a Pigouvian subsidy to increase Sian's marginal benefit so that it equals the marginal social benefit. That is, you should introduce a Pigouvian subsidy of $8,000 per year of education.

8. a. The market equilibrium quantity is 12,000 trees, with an equilibrium price of $20 as you can see in the accompanying diagram.



b. As the accompanying diagram indicates, planting a tree generates a positive externality; as a result, the market equilibrium quantity is inefficiently low. The *MSB* curve corresponds to the demand curve, *D*, shifted up by the amount of the marginal external benefit, $10. The intersection of the *MSB* curve and the *MC* curve shows the optimal outcome, leading to an optimal quantity of 24,000 trees planted, twice as many as the market equilibrium quantity.



c. The optimal policy in this case is to adopt a Pigouvian subsidy of $10 per tree. This lowers the price to consumers from $20 per tree to $10, leading them to purchase and plant the optimal amount, 24,000 trees.

9. 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. An interstate highway without tolls is rival in consumption (if I use the highway, I create a negative externality for you—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.

10. 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.

11. 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 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.

12. a. Security services are 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.

MC	MB	MSB
$150	$10	$1,000
$150	$6	$600
$150	$2	$200
$150	$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.

13. a. 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.

b. 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			
	$10	$8	$18
1			
	6	4	10
2			
	2	1	3
3			

c. 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.

14. 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.

15. 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.

16. a. Since the marginal cost of delivering the good to one additional consumer is zero, the efficient price would be zero.

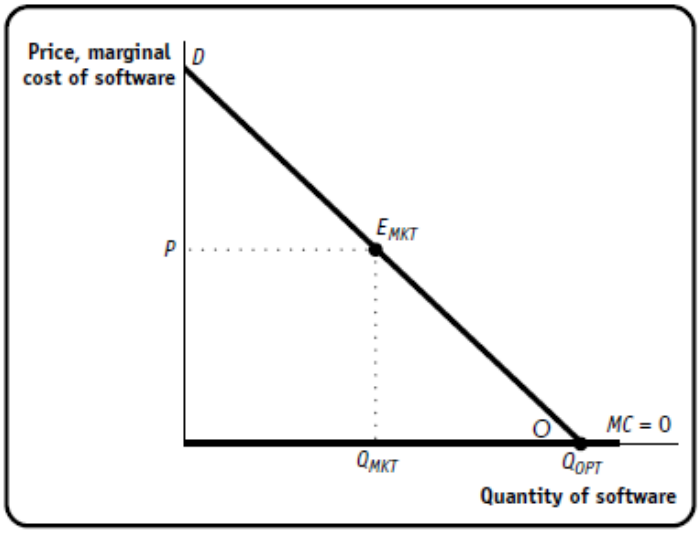
b. Since each of the six consumers has a marginal benefit greater than zero, all six will download the file. Adriana's individual consumer surplus will be $2, Bhagesh's $15, Chizuko's $1, Denzel's $10, Emma's $5, and Frank's $4. The total consumer surplus is therefore $2 + $15 + $1 + $10 + $5 + $4 = $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 × $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.

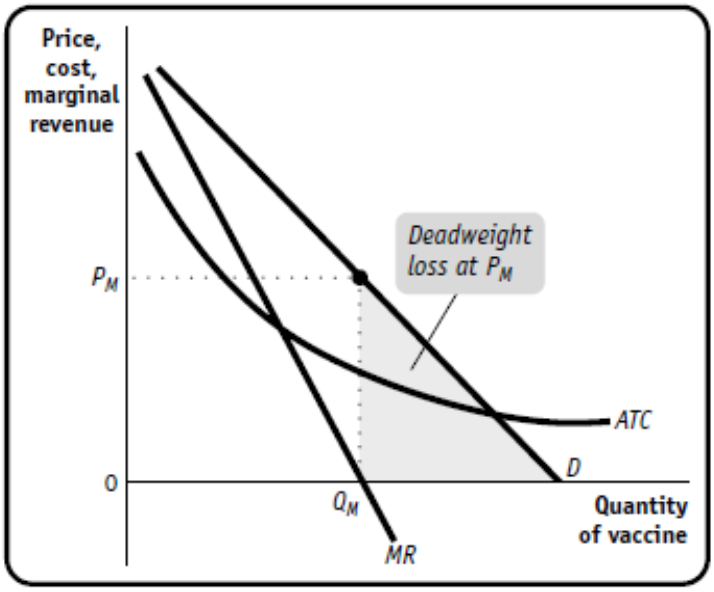
17. a. In principle, the developers of open-source software are not strictly monitored. Some developers may shirk and write poor code in the hope that others in the development community will correct their mistakes. A free-rider problem is created because individual developers are not held responsible 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}.

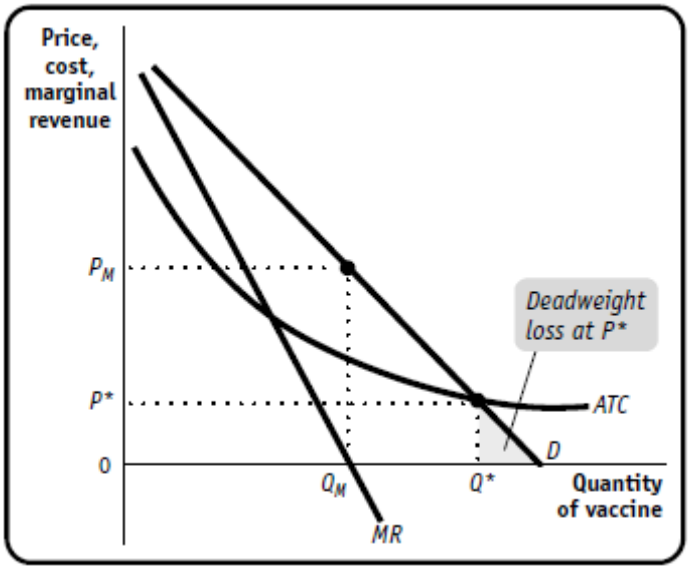


18. a. If the company is unregulated, it will behave like a monopolist and choose a quantity, Q_M, at which marginal revenue is equal to marginal cost, which is equal to zero. This leads to the price P_M. The efficient price, however, is zero. There is a deadweight loss equal to the shaded area in the 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.

19. 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 reach cultural and social achievements from which all of society benefits.

20. An individual fisherman makes decisions about how much 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.

21. a. College Cleaners would have to reduce its pollution level by 130 units, costing it 130 × $5 = $650. Big Green Cleaners would have to reduce its pollution level by 20 units, costing it 20 × $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 × $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 × $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.

22. a. The Coase theorem states that an economy can always reach an efficient solution, as long as transaction costs are sufficiently low. Here, transaction costs are not low: Carla has to spend several days

traveling to negotiate with Ronald. Since the transaction cost is large, it is likely that no efficient solution will be reached.

b. Now transaction costs are zero: it is costless for Carla and Ronald to negotiate with each other. There are two possible solutions: either Carla pays Ronald to reduce pollution of her drinking water or Ronald pays Carla to accept some waste in her water. Either way, negotiation will result in a socially efficient outcome, in which Carla and Ronald internalize the externality.

23. 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 EMarketplace, also drawing more buyers to EAuction over 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. 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.

AP Krugman Economics Section 14 Appendix Problems Solutions

AP Krugman Microeconomics Section 9 Appendix Problems Solutions

1. 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 × $10,000) + (0.5 × $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.

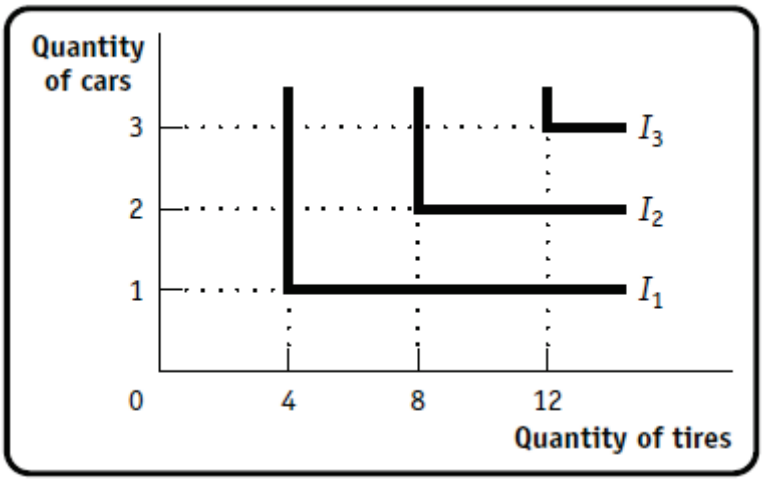
2. a. When you hire an additional worker, there is a 0.5 chance you will get a fast worker and a 0.5 chance you will get a slow worker. So the expected value of your additional revenue is (0.5 × $100) + (0.5 × $50) = $50 + $25 = $75.

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.

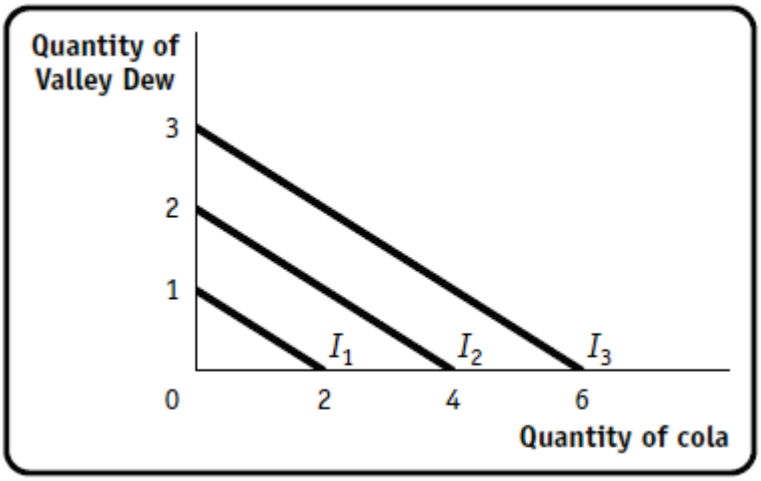
c. You prefer to hire a fast worker. With a fast worker you earn $100 - $80 = $20 per day, but only earn $50 - $40 = $10 per day with a slow worker. Any compensation scheme that pays a worker $80 per day if at least 10 chairs are produced, but less than $40 per day if less than 10 chairs are produced, will guarantee that only a fast worker will choose to work for you.

3. Following are Isabella's indifference curve maps for each of the situations described.

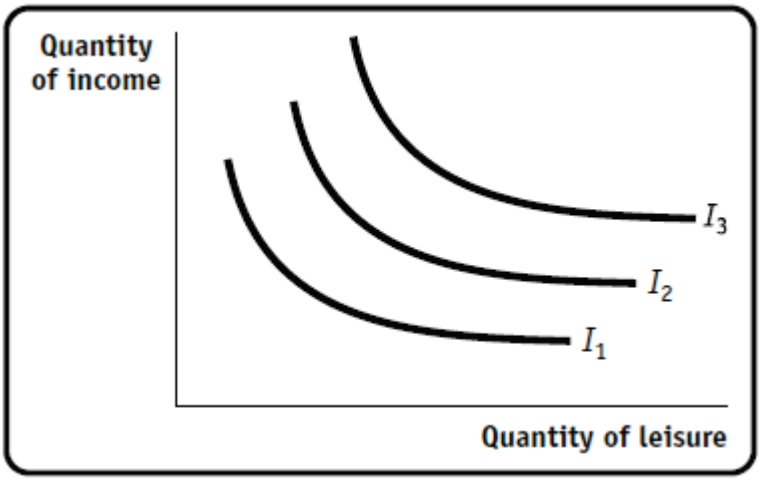
a.



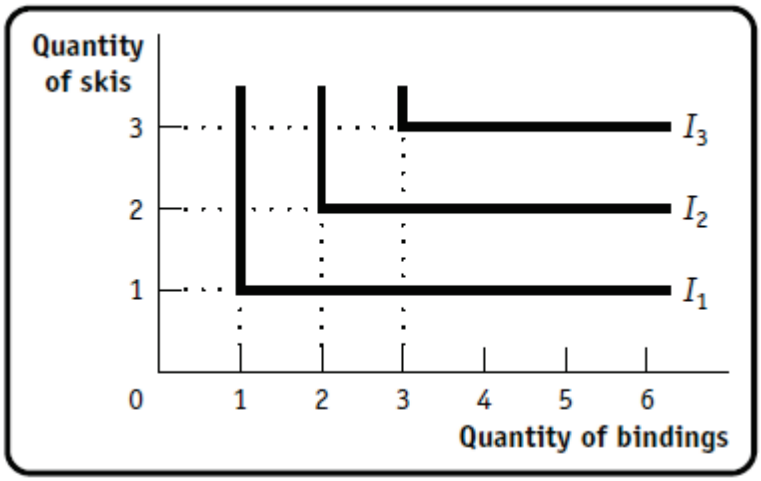
b.



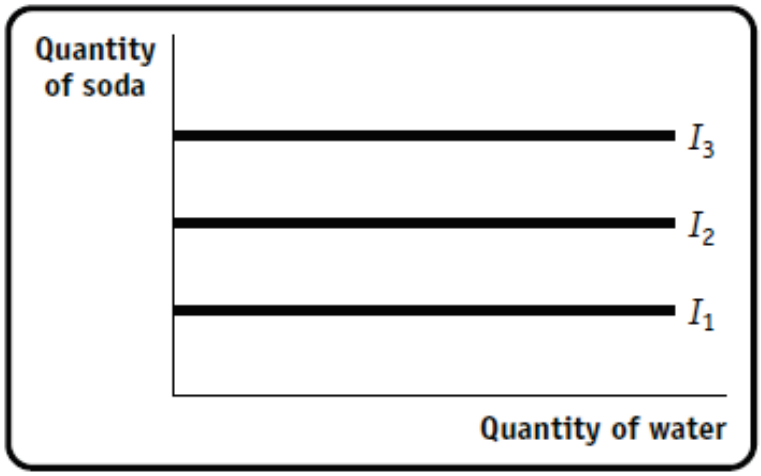
c.


Quantity of income
I_3
I_2
I_1
Quantity of leisure

d.


Quantity of skis
3
2
1
I_3
I_2
I_1
0
1
2
3
4
5
6
Quantity of bindings

e.


Quantity of soda
I_3
I_2
I_1
Quantity of water

4. a. Because bundle *B* has more movie tickets and more cafeteria meals than bundle *A,* it is preferred. The reason is that more is better.

b. Compared to bundle *A,* bundle *B* has the same number of cafeteria meals but more movie tickets. Again, because more is better, bundle *B* is preferred.

c. Bundle *A* has more videos than bundle *B,* but bundle *B* has more bags of chips than bundle *A.* The "more is better" principle does not help us rank these two bundles. Without more information, they cannot be ranked.

d. Since we know that you are indifferent between bundle *A* and bundle *B,* we know that they lie on the same indifference curve. Note in the accompanying diagram that bundle *C* lies on a straight line between bundles *A* and *B.* Since we know that indifference curves for ordinary goods are convex (they get flatter as we move along them to the right), bundle *C* has to be on a higher indifference curve than bundle *A* (and bundle *B*). Since the number of goods in bundle *C* is exactly the average of the numbers in bundles *A* and *B,* sometimes this property of indifference curves is known as "averages are preferred to extremes."