chapter:
# 2

Economic Models: Trade-offs and Trade

1. Two important industries on the island of Bermuda are fishing and tourism. According to data from the Food and Agriculture Organization of the United Nations and the Bermuda Department of Statistics, in the year 2009 the 306 registered fishermen in Bermuda caught 387 metric tons of marine fish. And the 2,719 people employed by hotels produced 554,400 hotel stays (measured by the number of visitor arrivals). Suppose that this production point is efficient in production. Assume also that the opportunity cost of 1 additional metric ton of fish is 2,000 hotel stays and that this opportunity cost is constant (the opportunity cost does not change).

    a. If all 306 registered fishermen were to be employed by hotels (in addition to the 2,719 people already working in hotels), how many hotel stays could Bermuda produce?

    b. If all 2,719 hotel employees were to become fishermen (in addition to the 306 fishermen already working in the fishing industry), how many metric tons of fish could Bermuda produce?

    c. Draw a production possibility frontier for Bermuda, with fish on the horizontal axis and hotel stays on the vertical axis, and label Bermuda's actual production point for the year 2009.

Solution

1.   **a.** Forgoing the production of 1 metric ton of fish allows Bermuda to produce 2,000 additional hotel stays. Therefore, forgoing the production of 387 metric tons of fish allows Bermuda to produce 2,000 × 387 = 774,000 additional hotel stays. If all fishermen worked in the hotel industry, Bermuda could produce 554,000 + 774,000 = 1,328,400 hotel stays.

    b. Forgoing the production of 2,000 hotel stays allows Bermuda to produce 1 additional metric ton of fish, so giving up 554,400 hotel stays allows Bermuda to produce 554,400/2,000 = 277.2 additional metric tons of fish. If all hotel employees worked in the fishing industry, Bermuda could produce 387 + 277.2 = 664.2 metric tons of fish.

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

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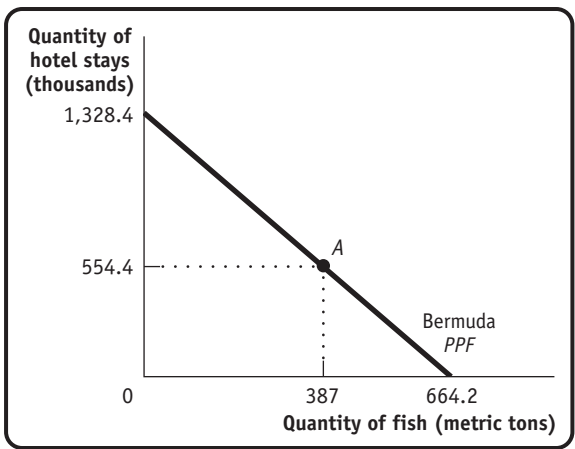
2. Atlantis is a small, isolated island in the South Atlantic. The inhabitants grow pota-
toes and catch fish. The accompanying table shows the maximum annual output
combinations of potatoes and fish that can be produced. Obviously, given their lim-
ited resources and available technology, as they use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

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

a. Draw a production possibility frontier with potatoes on the horizontal axis and
fish on the vertical axis illustrating these options, showing points *A–F.*

b. Can Atlantis produce 500 pounds of fish and 800 pounds of potatoes? Explain.
Where would this point lie relative to the production possibility frontier?

c. What is the opportunity cost of increasing the annual output of potatoes from
600 to 800 pounds?

d. What is the opportunity cost of increasing the annual output of potatoes from
200 to 400 pounds?

e. Can you explain why the answers to parts c and d are not the same? What does
this imply about the slope of the production possibility frontier?

Solution

2. **a.** The accompanying diagram shows the production possibility frontier for Atlantis.
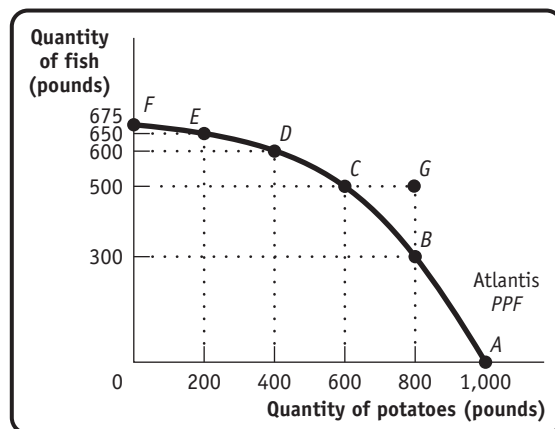
b. No, Atlantis cannot produce 500 pounds of fish and 800 pounds of potatoes. If
it produces 500 pounds of fish, the most potatoes it can produce is 600 pounds.
This point would lie outside the production possibility frontier, at point *G* on the
diagram.

c. The opportunity cost of increasing output from 600 to 800 pounds of potatoes is
200 pounds of fish. If Atlantis increases output from 600 to 800 pounds of pota-
toes, it has to cut fish production from 500 pounds to 300 pounds, that is, by 200
pounds.

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

e. The answers to parts c and d imply that the more potatoes Atlantis produces, the higher the opportunity cost becomes. For instance, as you grow more and more potatoes, you have to use less and less suitable land to do so. As a result, you have to divert increasingly more resources away from fishing as you grow more potatoes, meaning that you can produce increasingly less fish. This implies, of course, that the production possibility frontier becomes steeper the farther you move along it to the right; that is, the production possibility frontier is bowed out. (Mathematicians call this shape *concave*.)

3. According to data from the U.S. Department of Agriculture's National Agricultural Statistics Service, 124 million acres of land in the United States were used for wheat or corn farming in 2004. Of those 124 million acres, farmers used 50 million acres to grow 2.158 billion bushels of wheat and 74 million acres of land to grow 11.807 billion bushels of corn. Suppose that U.S. wheat and corn farming is efficient in production. At that production point, the opportunity cost of producing 1 additional bushel of wheat is 1.7 fewer bushels of corn. However, because farmers have increasing opportunity costs, additional bushels of wheat have an opportunity cost greater than 1.7 bushels of corn. For each of the following production points, decide whether that production point is (i) feasible and efficient in production, (ii) feasible but not efficient in production, (iii) not feasible, or (iv) unclear as to whether or not it is feasible.

a. Farmers use 40 million acres of land to produce 1.8 billion bushels of wheat, and they use 60 million acres of land to produce 9 billion bushels of corn. The remaining 24 million acres are left unused.

b. From their original production point, farmers transfer 40 million acres of land from corn to wheat production. They now produce 3.158 billion bushels of wheat and 10.107 bushels of corn.

c. Farmers reduce their production of wheat to 2 billion bushels and increase their production of corn to 12.044 billion bushels. Along the production possibility frontier, the opportunity cost of going from 11.807 billion bushels of corn to 12.044 billion bushels of corn is 0.666 bushel of wheat per bushel of corn.

Solution

3. 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 1 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 possibility frontier, the economy must forgo 0.666 bushel of wheat per additional bushel of corn. So the increase in corn production from 11.807 billion bushels to 12.044 billion bushels costs the economy (12.044 – 11.807) billion bushels of corn × 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.

4. In the ancient country of Roma, only two goods, spaghetti and meatballs, are produced. There are two tribes in Roma, the Tivoli and the Frivoli. By themselves, the Tivoli each month can produce either 30 pounds of spaghetti and no meatballs, or 50 pounds of meatballs and no spaghetti, or any combination in between. The Frivoli, by themselves, each month can produce 40 pounds of spaghetti and no meatballs, or 30 pounds of meatballs and no spaghetti, or any combination in between.

    a. Assume that all production possibility frontiers are straight lines. Draw one diagram showing the monthly production possibility frontier for the Tivoli and another showing the monthly production possibility frontier for the Frivoli. Show how you calculated them.

    b. Which tribe has the comparative advantage in spaghetti production? In meatball production?

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

    c. Draw the new monthly production possibility frontier for the Frivoli.

    d. After the innovation, which tribe now has an absolute advantage in producing meatballs? In producing spaghetti? Which has the comparative advantage in meatball production? In spaghetti production?

Solution

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

(a) Production possibility frontier for the Tivoli

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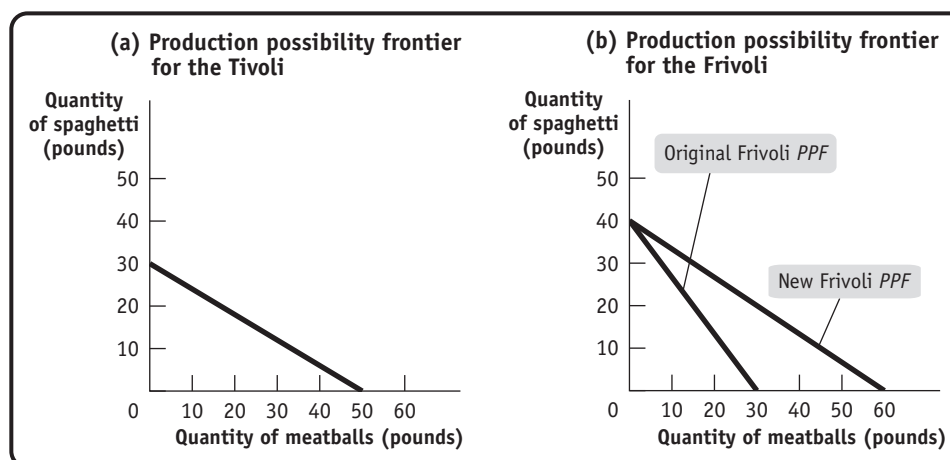
The production possibility frontier for the Tivoli was calculated as follows: the Tivoli can produce either 30 pounds of spaghetti and no meatballs, or they can produce no spaghetti but 50 pounds of meatballs. That is, the opportunity cost of 1 pound of meatballs is $\frac{3}{5}$ of a pound of spaghetti: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

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

c. The Frivoli's new production possibility frontier is the line labeled "New Frivoli *PPF*" in panel (b) of the diagram. Instead of producing 30 pounds of meatballs (if they produce no spaghetti), they can now produce 60 pounds.

d. Now the Frivoli have the absolute advantage in both meatball production and spaghetti production. The Frivoli's opportunity cost of meatballs has now fallen to $\frac{4}{6}$ = $\frac{2}{3}$; that is, for each pound of meatballs that the Frivoli now produce, they have to give up producing $\frac{2}{3}$ of a pound of spaghetti. Since the Frivoli's opportunity cost of meatballs ($\frac{2}{3}$) is still higher than the Tivoli's ($\frac{3}{5}$), the Tivoli still have the comparative advantage in meatball production. The Frivoli's opportunity cost of spaghetti is $\frac{3}{2}$ pounds of meatballs and the Tivoli's is $\frac{5}{3}$ pounds of meatballs, so the Frivoli have the comparative advantage in spaghetti production.

5. According to the U.S. Census Bureau, in July 2006 the United States exported aircraft worth $1 billion to China and imported aircraft worth only $19,000 from China. During the same month, however, the United States imported $83 million worth of men's trousers, slacks, and jeans from China but exported only $8,000 worth of trousers, slacks, and jeans to China. Using what you have learned about how trade is determined by comparative advantage, answer the following questions.

a. Which country has the comparative advantage in aircraft production? In production of trousers, slacks, and jeans?

b. Can you determine which country has the absolute advantage in aircraft production? In production of trousers, slacks, and jeans?

Solution

5. a. Since countries gain from specializing in production of the goods and services in which they have a comparative advantage, the United States must have the comparative advantage in aircraft production, and China must have the comparative advantage in production of trousers, slacks, and jeans.

b. Since trade has nothing to do with absolute advantage, we cannot determine from these data which country has an absolute advantage in either of these goods.

6. Peter Pundit, an economics reporter, states that the European Union (EU) is increasing its productivity very rapidly in all industries. He claims that this productivity advance is so rapid that output from the EU in these industries will soon exceed that of the United States and, as a result, the United States will no longer benefit from trade with the EU.

a. Do you think Peter Pundit is correct or not? If not, what do you think is the source of his mistake?

b. If the EU and the United States continue to trade, what do you think will characterize the goods that the EU exports to the United States and the goods that the United States exports to the EU?

Solution

6. 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.

7. You are in charge of allocating residents to your dormitory's baseball and basketball teams. You are down to the last four people, two of whom must be allocated to baseball and two to basketball. The accompanying table gives each person's batting average and free-throw average.

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

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

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

Solution

7. a. Let's begin by establishing the opportunity cost of free throws for each player. If you allocate Kelley to the basketball team, the team gains a player with a 60% free-throw average and the baseball team loses a player with a 70% batting average. That is, the opportunity cost of allocating Kelley to the basketball team is $7/6$. Similarly, Jackie's opportunity cost of playing basketball is 1; Curt's opportunity cost of playing basketball is $1/3$, and Gerry's opportunity cost of playing basketball is $8/7$. Jackie and Curt have the lowest opportunity costs of playing basketball; that is, they have the comparative advantage in basketball. Therefore, they should be allocated to the basketball team. Kelley and Gerry have the comparative advantage in baseball and should therefore play on the baseball team.

b. It is likely that the basketball team will be unhappy with this arrangement. Both Jackie and Curt have an absolute disadvantage at playing basketball, compared to the other two players. (They also have an absolute disadvantage at playing baseball, but they are comparatively less bad at basketball than at baseball.) The baseball team is likely to be happy about this allocation because both Kelley and Gerry have an absolute advantage at playing baseball. However, if you are concerned with the total number of wins for the dormitory (as an economist who would be concerned about efficiency), this allocation is the best one: it maximizes the overall chances of the dormitory winning at any sport.

8. The inhabitants of the fictional economy of Atlantis use money in the form of cowry shells. Draw a circular-flow diagram showing households and firms. Firms produce potatoes and fish, and households buy potatoes and fish. Households also provide the land and labor to firms. Identify where in the flows of cowry shells or physical things (goods and services, or resources) each of the following impacts would occur. Describe how this impact spreads around the circle.

a. A devastating hurricane floods many of the potato fields.

b. A very productive fishing season yields a very large number of fish caught.

c. The inhabitants of Atlantis discover Shakira and spend several days a month at dancing festivals.

Solution

8. The accompanying diagram illustrates the circular flow for Atlantis.
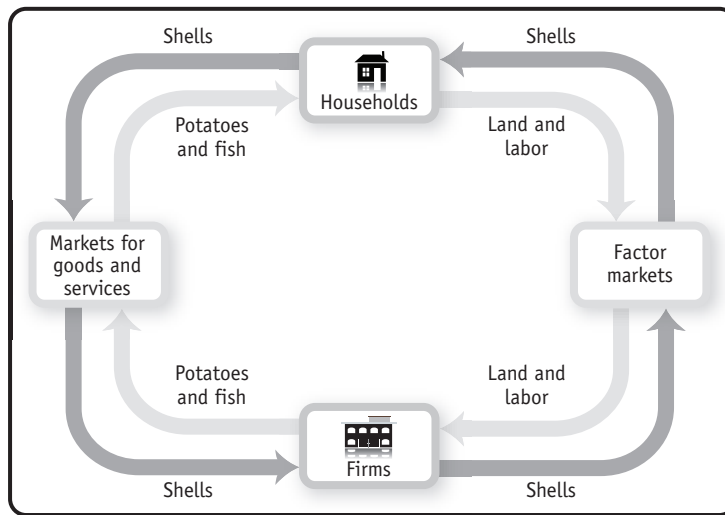
a. The flooding of the fields will destroy the potato crop. Destruction of the potato crop reduces the flow of goods from firms to households: fewer potatoes produced by firms now are sold to households. An implication, of course, is that fewer cowry shells flow from households to firms as payment for the potatoes in the market for goods and services. Since firms now earn fewer shells, they have fewer shells to pay to households in the factor markets. As a result, the amount of factors flowing from households to firms is also reduced.

b. The productive fishing season leads to a greater quantity of fish produced by firms to flow to households. An implication is that more money flows from households to firms through the markets for goods and services. As a result, firms want to buy more factors from households (the flow of shells from firms to households increases) and, in return, the flow of factors from households to firms increases.

c. Time spent at dancing festivals reduces the flow of labor from households to firms and therefore reduces the number of shells flowing from firms to households through the factor markets. In return, households now have fewer shells to buy goods with (the flow of shells from households to firms in the markets for goods and services is reduced), implying that fewer goods flow from firms to households.

9. An economist might say that colleges and universities "produce" education, using faculty members and students as inputs. According to this line of reasoning, education is then "consumed" by households. Construct a circular-flow diagram to represent the sector of the economy devoted to college education: colleges and universities represent firms, and households both consume education and provide faculty and students to universities. What are the relevant markets in this diagram? What is being bought and sold in each direction? What would happen in the diagram if the government decided to subsidize 50% of all college students' tuition?

Solution

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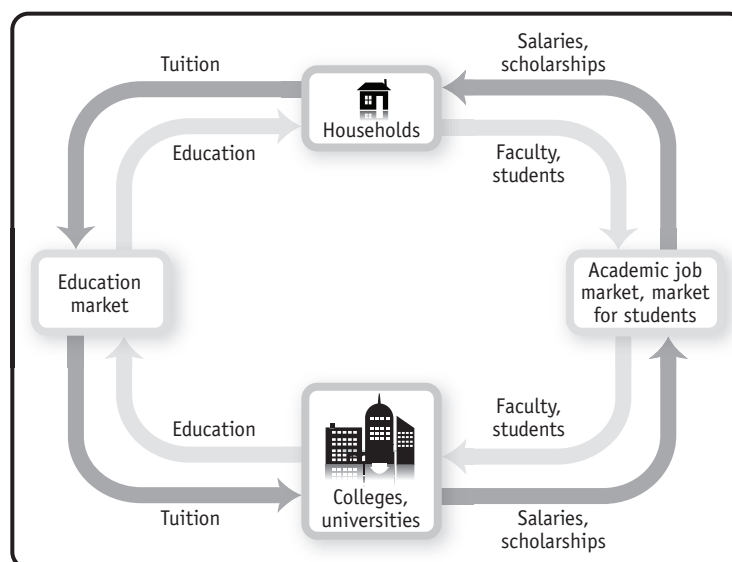
Colleges and universities buy faculty on the academic job market and attract students from the market for students. (Many colleges and universities actively try to attract good students by offering scholarships and the like.) They sell education to households in the market for education, and households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

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

10. Your dormitory roommate plays loud music most of the time; you, however, would prefer more peace and quiet. You suggest that she buy some earphones. She responds that although she would be happy to use earphones, she has many other things that she would prefer to spend her money on right now. You discuss this situation with a friend who is an economics major. The following exchange takes place:

He: How much would it cost to buy earphones?
You: $15.
He: How much do you value having some peace and quiet for the rest of the semester?
You: $30.
He: It is efficient for you to buy the earphones and give them to your roommate. You gain more than you lose; the benefit exceeds the cost. You should do that.
You: It just isn't fair that I have to pay for the earphones when I'm not the one making the noise.

a. Which parts of this conversation contain positive statements and which parts contain normative statements?

b. Construct an argument supporting your viewpoint that your roommate should be the one to change her behavior. Similarly, construct an argument from the viewpoint of your roommate that you should be the one to buy the earphones. If your dormitory has a policy that gives residents the unlimited right to play music, whose argument is likely to win? If your dormitory has a rule that a person must stop playing music whenever a roommate complains, whose argument is likely to win?

Solution

10. a. "It is efficient for you to buy the earphones" is a positive statement (it is either right or wrong); that is, it is about description. "You should do that" (that is, buy the earphones) is strictly speaking a normative statement; that is, it is about prescription (although you would find all economists agree that all trades that improve efficiency should be made). "It just isn't fair" is a normative statement—that is, it is about prescription—and you would likely find much disagreement about the fairness of the proposed trade.

b. One argument that your roommate should buy the earphones is that everyone has the right to peace and quiet. If your roommate therefore wants to listen to music, she should have to be responsible for making sure that others' peace and quiet is not disturbed. Your roommate might argue that since she has the right to play as much music as she wants, it is your responsibility to make sure that you are not disturbed—for instance, by buying her earphones. If the dormitory has a policy that establishes the right to unlimited music, your roommate's argument wins. If the rule is that there is a right to peace and quiet, your argument wins.

11. A representative of the American clothing industry recently made the following statement: "Workers in Asia often work in sweatshop conditions earning only pennies an hour. American workers are more productive and as a result earn higher wages. In order to preserve the dignity of the American workplace, the government should enact legislation banning imports of low-wage Asian clothing."

a. Which parts of this quote are positive statements? Which parts are normative statements?

b. Is the policy that is being advocated consistent with the preceding statements about the wages and productivities of American and Asian workers?

c. Would such a policy make some Americans better off without making any other Americans worse off? That is, would this policy be efficient from the viewpoint of all Americans?

d. Would low-wage Asian workers benefit from or be hurt by such a policy?

Solution

11. 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.

12. Are the following statements true or false? Explain your answers.

    a. "When people must pay higher taxes on their wage earnings, it reduces their incentive to work" is a positive statement.

    b. "We should lower taxes to encourage more work" is a positive statement.

    c. Economics cannot always be used to completely decide what society ought to do.

    d. "The system of public education in this country generates greater benefits to society than the cost of running the system" is a normative statement.

    e. All disagreements among economists are generated by the media.

12. **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.

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

13. 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.

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

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

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

   a. How much vaccine will be in stock in the city by the end of November?

   b. If we offer to pay 10% more per dose to the pharmaceutical companies providing the vaccines, will they provide additional doses?

   c. If there is a shortage of vaccine in the city, whom should we vaccinate first—the elderly or the very young? (Assume that a person from one group has an equal likelihood of dying from influenza as a person from the other group.)

   d. If the city charges $25 per shot, how many people will pay?

   e. If the city charges $25 per shot, it will make a profit of $10 per shot, money that can go to pay for inoculating poor people. Should the city engage in such a scheme?

Solution

15. **a.** Positive

   b. Positive

   c. Normative

   d. Positive

   e. Normative

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

Solution

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