a two-nation, two-commodity world, the United Kingdom would then have a comparative advantage in cloth.

According to the law of comparative advantage, the United States should specialize in producing wheat and export some of it in exchange for British cloth. This is exactly what we concluded earlier with the law of comparative advantage based on the labor theory of value, but now our explanation is based on the opportunity cost theory.

2.5C The Production Possibility Frontier under Constant Costs

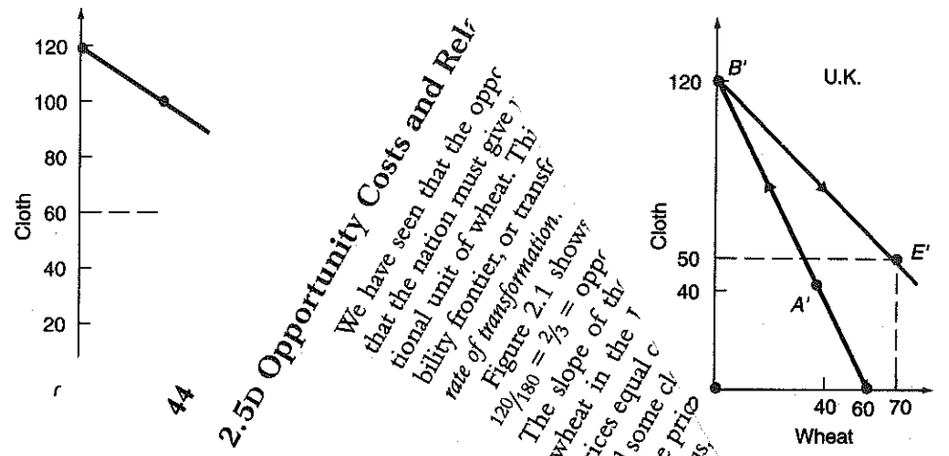
Opportunity costs can be illustrated with the production possibility frontier, or transformation curve. The **production possibility frontier** is a curve that shows the *alternative* combinations of the two commodities that a nation can produce by fully utilizing all of its resources with the best technology available to it.

Table 2.4 gives the (hypothetical) production possibility schedules of wheat (in million bushels/year) and cloth (in million yards/year) for the United States and the United Kingdom. We see that the United States can produce 180W and 0C, 150W and 20C, or 120W and 40C, down to 0W and 120C. For each 30W that the United States gives up, just enough resources are released to produce an additional 20C. That is, 30W = 20C (in the sense that both require the same amount of resources). Thus, the opportunity cost of one unit of wheat in the United States is 1W = ⅔C (the same as in Table 2.2) and remains constant. On the other hand, the United Kingdom can produce 60W and 0C, 50W and 20C, or 40W and 40C, down to 0W and 120C. It can increase its output by 20C for each 10W it gives up. Thus, the opportunity cost of wheat in the United Kingdom is 1W = 2C and remains constant.

The United States and United Kingdom production possibility schedules given in Table 2.4 are graphed as production possibility frontiers in Figure 2.1. Each point on a frontier represents one combination of wheat and cloth that the nation can produce. For example, at point A, the United States produces 90W and 60C. At point A', the United Kingdom produces 40W and 40C.

TABLE 2.4. *Production Possibility Schedules for Wheat and Cloth in the United States and the United Kingdom*

United States		United Kingdom	
Wheat	Cloth	Wheat	Cloth
180	0	60	0
150	20	50	20
120	40	40	40
90	60	30	60
60	80	20	80
30	100	10	100



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2.5D Opportunity Costs and Rel

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production possibility frontiers of both nations are straight lines reflects the
their opportunity costs are constant. That is, for each additional 1W to be produc
the United States must give up ⅔C and the United Kingdom must give up 2C, *no matter from which point on its production possibility frontier the nation starts.*

Constant opportunity costs arise when (1) resources or factors of production are either perfect substitutes for each other or used in fixed proportion in the production of both commodities, and (2) all units of the same factor are homogeneous or of exactly the same quality. Then, as each nation transfers resources from the production of cloth to the production of wheat, it will not have to use resources that are less and less suited to wheat production, no matter how much wheat it is already producing. The same is true for the production of more cloth. Thus, we have constant costs in the sense that the same amount of one commodity must be given up to produce each additional unit of the second commodity.

While opportunity costs are constant in each nation, they differ among nations, providing the basis for trade. Constant costs are not realistic, however. They are discussed only because they serve as a convenient introduction to the more realistic

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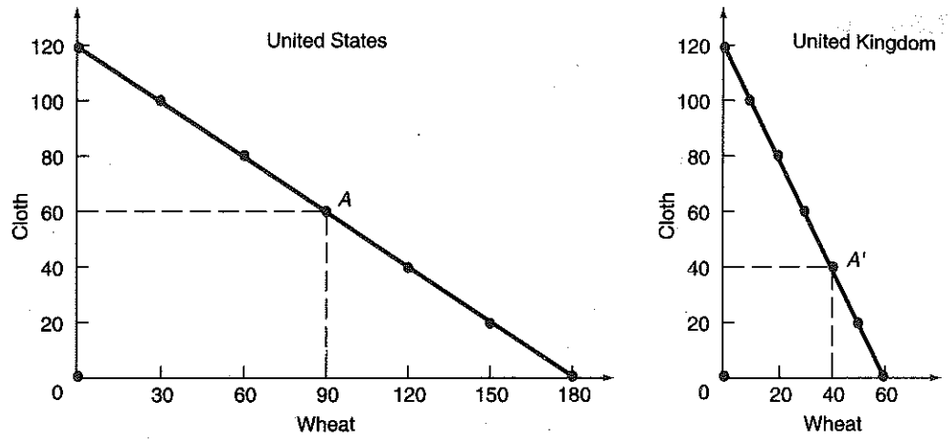

FIGURE 2.1. The Production Possibility Frontiers of the United States and the United Kingdom. The U.S. and U.K. production frontiers are obtained by plotting the values in Table 2.4. The frontiers are downward, or negatively sloped, indicating that as each nation produces more wheat, it must give up some cloth. Straight-line production possibility frontiers reflect constant opportunity costs.

Points inside, or below, the production possibility frontier are also possible but are inefficient, in the sense that the nation has some idle resources and/or is not using the best technology available to it. On the other hand, points above the production frontier cannot be achieved with the resources and technology currently available to the nation.

The downward, or negative, slope of the production possibility frontiers in Figure 2.1 indicates that if the United States and the United Kingdom want to produce more wheat, they must give up some of their cloth production. The fact that the production possibility frontiers of both nations are straight lines reflects the fact that their opportunity costs are constant. That is, for each additional 1W to be produced, the United States must give up ⅔C and the United Kingdom must give up 2C, *no matter from which point on its production possibility frontier the nation starts.*

Constant opportunity costs arise when (1) resources or factors of production are either perfect substitutes for each other or used in fixed proportion in the production of both commodities, and (2) all units of the same factor are homogeneous or of exactly the same quality. Then, as each nation transfers resources from the production of cloth to the production of wheat, it will not have to use resources that are less and less suited to wheat production, no matter how much wheat it is already producing. The same is true for the production of more cloth. Thus, we have constant costs in the sense that the same amount of one commodity must be given up to produce each additional unit of the second commodity.

While opportunity costs are constant in each nation, they differ among nations, providing the basis for trade. Constant costs are not realistic, however. They are discussed only because they serve as a convenient introduction to the more realistic

2.5D Opportunity Costs and Relative Commodity Prices

We have seen that the opportunity cost of wheat is equal to the amount of cloth that the nation must give up to release just enough resources to produce one additional unit of wheat. This is given by the (absolute) slope of the production possibility frontier, or transformation curve, and is sometimes referred to as the *marginal rate of transformation.*

Figure 2.1 shows that the (absolute) slope of the U.S. transformation curve is $^{120}/_{180} = {}^{2}/_{3}$ = opportunity cost of wheat in the United States and remains constant. The slope of the U.K. transformation curve is $^{120}/_{60} = 2$ = opportunity cost of wheat in the United Kingdom and remains constant. On the assumptions that prices equal costs of production and that the nation does produce both some wheat and some cloth, the opportunity cost of wheat is equal to the price of wheat relative to the price of cloth (P_w/P_c)

Thus, $P_w/P_c = {}^{2}/_{3}$ in the United States, and inversely $P_c/P_w = {}^{3}/_{2} = 1.5$. In the United Kingdom, $P_W/P_C = 2$, and $P_C/P_W = {}^{1}/_{2}$. The lower P_W/P_C in the United States (${}^{2}/_{3}$ as opposed to 2) is a reflection of the U.S. comparative advantage in wheat. Similarly, the lower P_c/P_w in the United Kingdom (${}^{1}/_{2}$ as opposed to ${}^{2}/_{3}$) reflects its comparative advantage in cloth. Note that under constant costs, P_w/P_c is determined exclusively by production, or supply, considerations in each nation. Demand considerations do not enter at all in the determination of **relative commodity prices.**

To conclude, we can say that the difference in relative commodity prices between the two nations (given by the difference in the slope of their transformation curves) is a reflection of their comparative advantage and provides the basis for mutually beneficial trade.

2.6 The Basis for and the Gains from Trade under Constant Costs

In the absence of trade, a nation can only consume the commodities that it produces. As a result, the nation's production possibility frontier also represents its *consumption frontier.* Which combination of commodities the nation actually chooses to produce and consume depends on the people's tastes, or demand considerations.

2.6A Illustration of the Gains from Trade

In the absence of trade, the United States might choose to produce and consume combination A (90W and 60C) on its production possibility frontier (see Figure 2.2), and the United Kingdom might choose combination A' (40W and 40C).

With trade possible, the United States would specialize in the production of wheat (the commodity of its comparative advantage) and produce at point B (180W

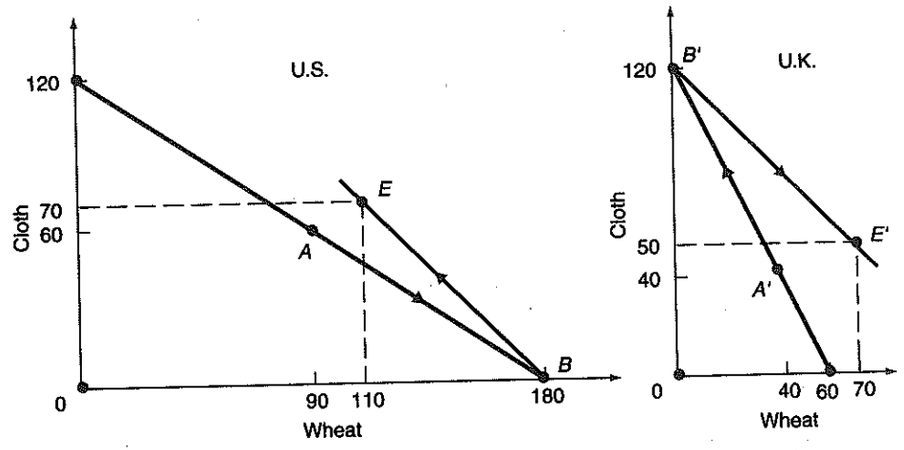

FIGURE 2.2. The Gains from Trade. In the absence of trade, the United States produces and consumes at A, and the United Kingdom at A'. With trade, the United States specializes in the production of wheat and produces at B, while the United Kingdom specializes in the production of cloth and produces at B'. By exchanging 70W for 70C with the United Kingdom, the United States ends up consuming at E (and gains 20W and 10C), while the United Kingdom ends up consuming at E' (and gains 30W and 10C).

United States then exchanges 70W for 70C with the United Kingdom, it ends up consuming at point E (110W and 70C), and the United Kingdom ends up consuming at E' (70W and 50C). Thus, the United States gains 20W and 10C from trade (compare point E with point A in Figure 2.2), and the United Kingdom gains 30W and 10C (compare point A' with point E').

The increased consumption of both wheat and cloth in both nations was made possible by the increased output that resulted as each nation specialized in the production of the commodity of its comparative advantage. That is, in the absence of trade, the United States produced 90W and the United Kingdom 40W, for a total of 130W. With specialization in production and trade, 180W are produced (all in the United States). Similarly, in the absence of trade, the United States produced 60C and the United Kingdom 40C, for a total of 100C. With specialization in production and trade, 120C are produced (all in the United Kingdom).

It is this increase in output of 50W and 20C resulting from specialization in production that is shared by the United States and the United Kingdom and represents their gains from trade. Recall that in the absence of trade, the United States would not specialize in the production of wheat because it also wanted to consume some cloth. Similarly, the United Kingdom would not specialize in the production of cloth in the absence of trade because it also wanted to consume some wheat.

2.6B Relative Commodity Prices with Trade

We can gain a deeper understanding of our trade model by using the supply and demand curves for wheat and cloth shown in Figure 2.3. Figure 2.3 will also help us

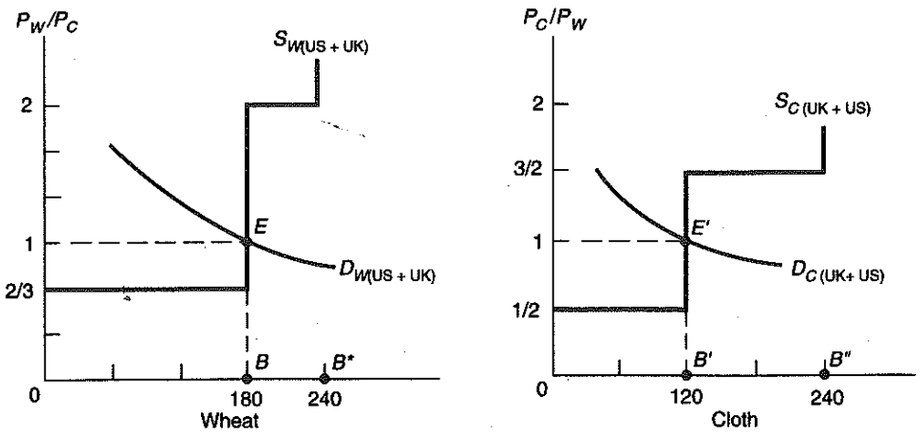

FIGURE 2.3. Equilibrium-Relative Commodity Prices with Demand and Supply. In the left panel, $S_{W(US+UK)}$ is the combined U.S. and U.K. supply curve of wheat. It shows that the United States could produce a maximum of 180W = $0B$ at $P_W/P_C = 2/3$, while the United Kingdom could produce a maximum of 60W = BB^* at $P_W/P_C = 2$. $D_{W(US+UK)}$ is the combined demand curve for wheat of the United States and the United Kingdom with trade. $D_{W(US+UK)}$ intersects $S_{W(US+UK)}$ at point E, resulting in the equilibrium quantity of 180W (all of which is produced in the United States) and equilibrium price of $P_W/P_C = 1$ with trade. The right panel shows equilibrium for cloth at the intersection of $D_{C(UK+US)}$ with $S_{C(UK+US)}$ at point E' with 120C (all of which is produced in the United Kingdom) and $P_C/P_W = 1$.

see how the equilibrium-relative commodity price with specialization in production and trade is determined.

In the left panel of Figure 2.3, $S_{W(US+UK)}$ is the combined supply curve of wheat of the United States and the United Kingdom if both countries used all of their resources to produce only wheat. Distance $0B$ = 180W represents the maximum quantity of wheat that the United States could produce with complete specialization in wheat production at the constant opportunity cost of $P_W/P_C = 2/3$ (just as in the left panel of Figure 2.2). Distance BB^* = 60W is the maximum quantity of wheat that the United Kingdom could produce at the constant opportunity cost of $P_W/P_C = 2$ (as in the right panel of Figure 2.2). Thus, 240W is the maximum combined total quantity of wheat that the United States and the United Kingdom could produce if both nations used all of their resources to produce wheat. As a result, the $S_{W(US+UK)}$ curve is vertical at 240W.

Suppose that, with trade, the combined demand curve for wheat of the United States and the United Kingdom is $D_{W(US+UK)}$, as shown in the left panel of Figure 2.3. $D_{W(US+UK)}$ intersects $S_{W(US+UK)}$ at point E, determining the equilibrium quantity of 180W and the equilibrium relative price of $P_W/P_C = 1$ with trade (the same as in the left panel of Figure 2.2). Note that, with trade, wheat is produced only in the United States, and the United States specializes completely in the production of wheat.

We can do the same for cloth. In the right panel of Figure 2.3, $S_{C(UK+US)}$ is the

both countries used all of their resources to produce only cloth. The United Kingdom can produce a maximum of 120C = $0B'$ at the constant $P_C/P_W = 1/2$ and the United States can produce a maximum of another 120C = $B'B''$ at the constant $P_C/P_W = 3/2$ (as in Figure 2.2).

Suppose that, with trade, the combined demand for wheat of the United Kingdom and the United States is $D_{C(UK+US)}$, as shown in the right panel of Figure 2.3. $D_{C(UK+US)}$ intersects $S_{C(UK+US)}$ at point E', determining the equilibrium quantity of 120C and the equilibrium-relative price of $P_C/P_W = P_W/P_C = 1$ (the same as in the right panel of Figure 2.2). Note that, with trade, cloth is produced only in the United Kingdom, and the United Kingdom specializes completely in the production of cloth.

Finally, note that with **complete specialization** in production in both countries, the equilibrium-relative commodity price of each commodity is between the pretrade relative commodity price in each nation (see both panels of Figure 2.3). However, if in the left panel of Figure 2.3 $D_{W(US+UK)}$ were lower and intersected $S_{W(US+UK)}$ between points 0 and B on the horizontal portion of $S_{W(US+UK)}$ at $P_W/P_C = 2/3$, trade would take place at the pretrade relative commodity price of wheat of $P_W/P_C = 2/3$ in the United States and the United Kingdom would receive all the gains from trade. This would occur if the United Kingdom were a small country that specialized completely in the production of cloth and the United States were larger and did not specialize completely in the production of wheat (see Problem 10, with answer at the end of the book). This is known as the **small-country case** and shows the "importance of being unimportant." This benefit, however, is not without cost since the small nation (here, the United Kingdom) faces the risk of a possible future reduction in demand for the only commodity it produces.

2.7 Empirical Tests of the Ricardian Model

We now examine the results of empirical tests of the Ricardian trade model. We will see that if we allow for different labor productivities in various industries in different nations, the Ricardian trade model does a reasonably good job at explaining the pattern of trade.

The first such empirical test of the Ricardian trade model was conducted by *MacDougall* in 1951 and 1952, using labor productivity and export data for 25 industries in the United States and the United Kingdom for the year 1937.

Since wages were twice as high in the United States as in the United Kingdom, MacDougall argued that costs of production would be lower in the United States in those industries where American labor was more than twice as productive as British labor. These would be the industries in which the United States had a comparative advantage with respect to the United Kingdom and in which it would undersell the United Kingdom in third markets (i.e., in the rest of the world). On the other hand, the United Kingdom would have a comparative advantage and undersell the United States in those industries where the productivity of British labor was more than one-half the productivity of American labor.

In his test MacDougall excluded trade between the United States and the United

the differences in labor productivity between the two nations. At the same time, both nations faced generally equal tariffs in third markets. The exclusion of trade between the United States and the United Kingdom did not bias the test because their exports to each other constituted less than 5 percent of their total exports.

Figure 2.4 summarizes MacDougall's results. The vertical axis measures the ratio of output per U.S. worker to output per U.K. worker. The higher this ratio, the greater the relative productivity of U.S. labor. The horizontal axis measures the ratio of U.S. to U.K. exports to third markets. The higher this ratio, the larger are U.S. exports in relation to U.K. exports to the rest of the world. Note that the scales are logarithmic (so that equal distances refer to equal *percentage* changes) rather than arithmetic (where equal distances would measure equal *absolute* changes).

The points in the figure exhibit a clear *positive* relationship (shown by the colored line) between labor productivity and exports. That is, those industries where the productivity of labor is relatively higher in the United States than in the United Kingdom are the industries with the higher ratios of U.S. to U.K. exports. This was true for the 20 industries shown in the figure (out of the total of 25 industries studied by MacDougall). The positive relationship between labor productivity and exports for the United States and the United Kingdom was confirmed by subsequent studies by *Balassa* using 1950 data and *Stern* using 1950 and 1959. Additional and more recent confirmation of the Ricardian trade model is provided by *Golub* (see Case Study 2-4).

These empirical studies all seem to support the Ricardian theory of comparative advantage. That is, the actual pattern of trade seems to be based on the different labor productivities in different industries in the two nations. Production costs other

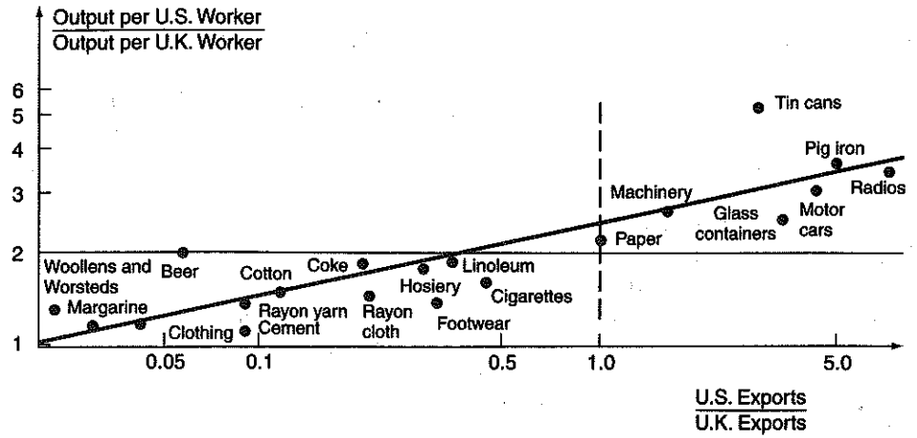

FIGURE 2.4. Relative Labor Productivities and Comparative Advantage—United States and United Kingdom. The figure shows a positive relationship between labor productivity and export shares for 20 industries in the United States and the United Kingdom, thus confirming the Ricardian trade model.

Source: Adapted from G.D.A. MacDougall, "British and American Exports: A Study Suggested by the

Case Study 2-4 Relative Unit Labor Costs and Relative Exports—United States and Japan

In a 1995 study of the Ricardian trade model, Golub examined relative unit labor costs (the ratio of wages to unit labor productivity) and the exports of the United States relative to those of the United Kingdom, Japan, Germany, Canada, and Australia and found that, in general, relative unit labor costs and exports were inversely related. That is, the higher the relative unit labor costs in the nation, the lower the relative exports of the nation, and vice versa. This relationship is particularly strong for U.S.-Japanese trade.

The colored line in Figure 2.5 shows a clear negative correlation between relative unit labor costs and relative exports for the 33 industries that Golub studied for trade between the United States and Japan for 1990, thus lending additional support to the Ricardian trade model. Note that the relationship between relative unit

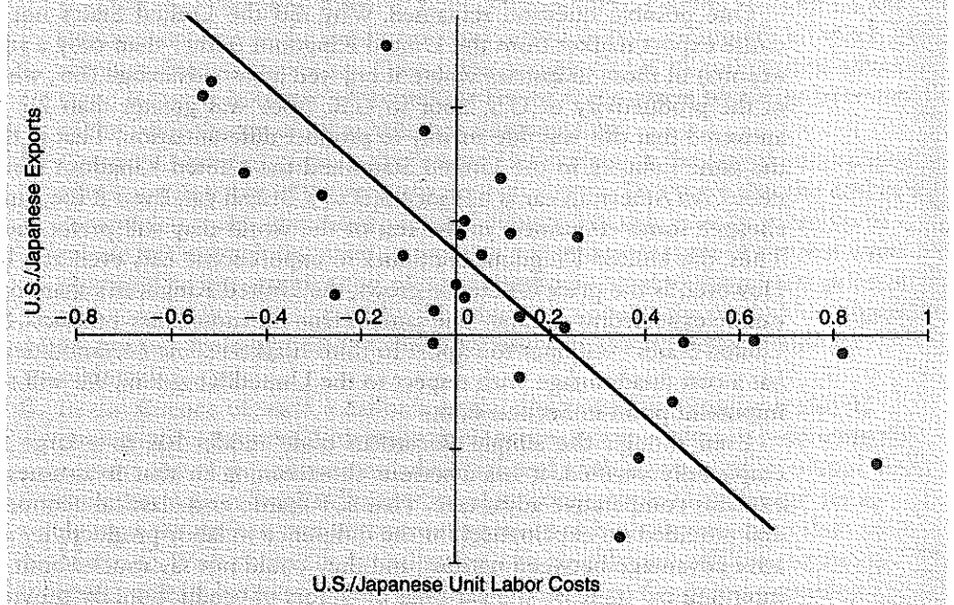

FIGURE 2.5. Relative Exports and Relative Unit Costs—United States and Japan. The figure shows a clear negative correlation between relative exports and relative unit labor costs for 33 industries between the United States and Japan. It shows that the higher are U.S. relative labor costs, the lower are its exports in relation to Japan, thus supporting the Ricardian trade model.

Source: Adapted from S. S. Golub, *Comparative and Absolute Advantage in the Asia-Pacific Region* (San Francisco: Federal Reserve Bank of San Francisco, Center for Pacific Basin Monetary and Economic Studies 1995), p. 46; and S. S. Golub and C. T. Hsieh, "The Classical Ricardian Theory of Comparative Advantage Revisited," *Review of International Economics*, May 2000, pp. 221–234.

(continued)

Case Study 2-4 (continued)

labor *costs* and relative exports is negative in Figure 2.5, whereas the relationship between relative unit labor *productivities* and exports shares is positive in Figure 2.4 because relative unit labor costs are the inverse of relative unit labor productivities. The above results were confirmed in a 2000 study by Golub and Hsieh for trade in the products of 39 sectors between the United States and nine other countries (Japan, Germany, the United Kingdom, France, Italy, Canada, Australia, Mexico, and Korea) from 1972 to 1991.

than labor costs, demand considerations, political ties, and various obstructions to the flow of international trade did not break the link between relative labor productivity and export shares.

One possible question remained. Why did the United States not capture the entire export market from the United Kingdom (rather than only a rising share of exports) in those industries where it enjoyed a cost advantage (i.e., where the ratio of the productivity of U.S. labor to U.K. labor was greater than 2)? MacDougall answered that this was due mainly to product differentiation. That is, the output of the same industry in the United States and the United Kingdom is not homogeneous. An American car is not identical to a British car. Even if the American car is cheaper, some consumers in the rest of the world may still prefer the British car. Thus, the United Kingdom continues to export some cars even at a higher price. However, as the price difference grows, the United Kingdom's share of car exports can be expected to decline. The same is true for most other products. Similarly, the United States continues to export to third markets some commodities in which it has a cost disadvantage with respect to the United Kingdom. We will return to this important point in Section 6.4A.

Even though the simple Ricardian trade model has to a large extent been empirically verified, it has a serious shortcoming in that it assumes rather than explains comparative advantage. That is, Ricardo and classical economists in general provided no explanation for the difference in labor productivity and comparative advantage between nations, and they could not say much about the effect of international trade on the earnings of factors of production. By providing answers to both of these important questions, the Heckscher–Ohlin model (discussed in Chapter 5) theoretically improves upon the Ricardian model.

Summary

1. This chapter examined the development of trade theory from the mercantilists to Smith, Ricardo, and Haberler and sought to answer two basic questions: (a) What is the basis for and what are the gains from trade? and (b) What is the

2. The mercantilists believed that a nation could gain in international trade only at the expense of other nations. As a result, they advocated restrictions on imports, incentives for exports, and strict government regulation of all economic activities.
3. According to Adam Smith, trade is based on absolute advantage and benefits both nations. (The discussion assumes a two-nation, two-commodity world.) That is, when each nation specializes in the production of the commodity of its absolute advantage and exchanges part of its output for the commodity of its absolute disadvantage, both nations end up consuming more of both commodities. Absolute advantage, however, explains only a small portion of international trade today.
4. David Ricardo introduced the law of comparative advantage. This postulates that even if one nation is less efficient than the other nation in the production of both commodities, there is still a basis for mutually beneficial trade (as long as the absolute disadvantage that the first nation has with respect to the second is not in the same proportion in both commodities). The less efficient nation should specialize in the production and export of the commodity in which its absolute disadvantage is less. (This is the commodity of its comparative advantage.) Ricardo, however, explained the law of comparative advantage in terms of the labor theory of value, which is unacceptable.
5. Gottfried Haberler came to the "rescue" by explaining the law of comparative advantage in terms of the opportunity cost theory. This states that the cost of a commodity is the amount of a second commodity that must be given up to release just enough resources to produce one additional unit of the first commodity. The opportunity cost of a commodity is equal to the relative price of that commodity and is given by the (absolute) slope of the production possibility frontier. A straight-line production possibility frontier reflects constant opportunity costs.
6. In the absence of trade, a nation's production possibility frontier is also its consumption frontier. With trade, each nation can specialize in producing the commodity of its comparative advantage and exchange part of its output with the other nation for the commodity of its comparative disadvantage. By so doing, both nations end up consuming more of both commodities than without trade. With complete specialization, the equilibrium-relative commodity prices will be between the pretrade-relative commodity prices prevailing in each nation.
7. The first empirical test of the Ricardian trade model was conducted by MacDougall in 1951 and 1952 using 1937 data. The results indicated that those industries where labor productivity was relatively higher in the United States than in the United Kingdom were the industries with the higher ratios of U.S. to U.K. exports to third markets. These results were confirmed by Balassa using 1950 data, Stern using 1950 and 1959 data, Golub using 1990 data, and Golub and Hsieh using 1972–1991 data. Thus, it can be seen that comparative advantage seems to be based on a difference in labor productivity or costs, as postulated by Ricardo. However, the Ricardian model explains neither the reason for the difference in labor productivity or costs across nations nor the effect of interna-

A Look Ahead

In Chapter 3, we will examine the basis for and the gains from trade, as well as the pattern of trade in the more realistic case of increasing costs. Our model will then be completed in Chapter 4, where we will see formally how the rate at which commodities are exchanged in international trade is actually determined. This will also determine how the gains from trade are in fact divided between the two trading nations.

Key Terms

Basis for trade
Gains from trade
Pattern of trade
Mercantilism
Absolute advantage
Laissez-faire
Law of comparative advantage
Labor theory of value
Opportunity cost theory
Production possibility frontier
Constant opportunity costs
Relative commodity prices
Complete specialization
Small-country case

Questions for Review

1. What are the basic questions that we seek to answer in this chapter? In what way is the model presented in this chapter an abstraction or a simplification of the real world? Can the model be generalized?
2. What were the mercantilists' views on trade? How does their concept of national wealth differ from today's view?
3. Why is it important to study the mercantilists' views on trade? How were their views different from those of Adam Smith? What is the relevance of all this today?
4. What was the basis for and the pattern of trade according to Adam Smith? How were gains from trade generated? What policies did Smith advocate in international trade? What did he think was the proper function of government in the economic life of the nation?
5. In what way was Ricardo's law of comparative advantage superior to Smith's theory of absolute advantage? How do gains from trade arise with tion of all commodities export anything to the second nation?
6. What is the exception to the law of comparative advantage? How prevalent is it?
7. Why is Ricardo's explanation of the law of comparative advantage unacceptable? What acceptable theory can be used to explain the law?
8. What is the relationship between opportunity costs and the production possibility frontier of a nation? How does the production possibility frontier look under constant opportunity costs? What is the relationship between the opportunity cost of a commodity and the relative price of that commodity? How can they be visualized graphically?
9. Why is a nation's production possibility frontier the same as its consumption frontier in the absence of trade? How does the nation decide how much of each commodity to consume in the absence of trade?

gain from trade in the first instance but only the small nation in the second?

11. How is the combined supply curve of both nations for each of the traded commodities determined? How is the equilibrium-relative commodity price determined with trade?
12. What are the results of empirical testing of the Ricardian model?

Problems

1. Table 2.5 shows bushels of wheat and the yards of cloth that the United States and the United Kingdom can produce with one hour of labor time under four different hypothetical situations. In each case, identify the commodity in which the United States and the United Kingdom have an absolute advantage or disadvantage.

*2. With respect to Table 2.5, indicate in each case the commodity in which each nation has a comparative advantage or disadvantage.

TABLE 2.5. *Production Possibilities in the United States and the United Kingdom*

	Case A		Case B		Case C		Case D	
	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.	U.S.	U.K.
Wheat (bushels/man-hour)	4	1	4	1	4	1	4	2
Cloth (yards/man-hour)	1	2	3	2	2	2	2	1

3. With respect to Table 2.5, indicate in each case whether or not trade is possible and the basis for trade.

*4. Suppose that in Case B in Table 2.5 the United States exchanges 4W for 4C with the United Kingdom.
   (a) How much does the United States gain?
   (b) How much does the United Kingdom gain?
   (c) What is the range for mutually beneficial trade?
   (d) How much would each nation gain if they exchanged 4W for 6C instead?

5. Use the information for Case B in Table 2.5 and assume that labor is the only factor of production and is homogeneous (i.e., all of one type).
   (a) What is the cost *in terms of labor content* of producing wheat and cloth in the United States and the United Kingdom?
   (b) What is the dollar price of wheat and cloth in the United States if the wage rate is $6?
   (c) What is the pound price of wheat and cloth in the United Kingdom if the wage rate is £1?

6. Answer the following questions with reference to Problem 5.
   (a) What is the dollar price of wheat and cloth in the United Kingdom if the exchange rate between the pound and the dollar is £1 = $2? Would the United States be able to export wheat to the United Kingdom at this exchange rate? Would the United Kingdom be able to export cloth to the United States at this exchange rate?
   (b) What if the exchange rate between the dollar and the pound were £1 = $4?
   (c) What if the exchange rate were £1 = $1?
   (d) What is the *range* of exchange rates that will allow the United States to export

United Kingdom to export cloth to the United States?

7. Assume that the data in Case B in Table 2.5 refer to millions of bushels of wheat and millions of yards of cloth.

(a) Plot on graph paper the production frontiers of the United States and the United Kingdom.

(b) What is the relative price of wheat (i.e., P_W/P_C in the United States and in the United Kingdom?

(c) What is the relative price of cloth (i.e., P_C/P_W in the United States and in the United Kingdom?

8. Using the United States and United Kingdom production frontiers from Problem 7, assume that the no-trade or autarky point is 3W and $\frac{3}{4}$C (in million units) in the United States and $\frac{1}{2}$W and 1C in the United Kingdom. Also assume that with the opening of trade the United States exchanges 1W for 1C with the United Kingdom. Show graphically for the United States and the United Kingdom the autarky (or no-trade) point of production and consumption, the point of production and consumption with trade, and the gains from trade.

9. (a) What would be the equilibrium-relative commodity price of wheat if $D_{W(US+UK)}$ shifted up by one-third in the left panel of Figure 2.3? How much wheat and cloth would the United States and the United Kingdom then produce?

(b) What does the answer to part (a) imply for $D_{C(UK+US)}$ in the right panel of Figure 2.3?

***10.** What would happen if $D_{W(US+UK)}$ intersected the horizontal portion of $S_{W(US+UK)}$ at $P_W/P_C = \frac{2}{3}$ and 120W in the left panel of Figure 2.3? What would this imply for specialization in production and the distribution in the gains from trade between the two nations?

11. Draw a figure similar to Figure 2.2 showing that the United Kingdom is now a small country, half the size shown in the right panel of Figure 2.2, and trades 20C for 30W with the United States at $P_W/P_C = \frac{2}{3}$.

12. (a) How was the Ricardian trade model tested empirically?

(b) In what way can the results be said to confirm the Ricardian model?

(c) Why do we then need other trade models?

13. How would you counter the argument that the United States needs to restrict textile imports in order to save American jobs?

Appendix

We now extend the theory of comparative advantage first to the case of more than two commodities and then to the case of more than two nations. In each case, we will see that the theory of comparative advantage is easily generalized.

A2.1 Comparative Advantage with More Than Two Commodities

Table 2.6 shows the dollar and the pound cost, or price, of five commodities in the United States and the United Kingdom. (In economics, "cost" includes the return to all factors, including "normal profits"; thus, "cost" and "price" are used interchangeably here.)

To determine which commodities will be exported and imported by the United States

between the dollar and the pound is £1 = \$2, the *dollar* prices of the commodities in the United Kingdom are:

Commodity	A	B	C	D	E
Dollar price in the U.K.	12	8	6	4	2

At this exchange rate, the dollar prices of commodities A and B are lower in the United States than in the United Kingdom; commodity C is equally priced in the two nations; and the dollar prices of commodities D and E are lower in the United Kingdom. As a result, the United States will export commodities A and B to the United Kingdom and import commodities D and E from the United Kingdom. Commodity C will not be traded.

TABLE 2.6. *Commodity Prices in the United States and United Kingdom*

Commodity	Price in the U.S.	Price in the U.K.
A	\$2	£6
B	4	4
C	6	3
D	8	2
E	10	1

Now assume that the exchange rate between the dollar and the pound is £1 = \$3. The dollar prices of the commodities in the United Kingdom would be:

Commodity	A	B	C	D	E
Dollar price in the U.K.	18	12	9	6	3

At this higher exchange rate, the dollar prices of commodities A, B, and C are lower in the United States, while the dollar prices of commodities D and E are lower in the United Kingdom. Thus, the United States would export commodities A, B, and C to the United Kingdom and import commodities D and E from the United Kingdom. Note that commodity C, which was not traded at the exchange rate of £1 = \$2, is now exported by the United States at the exchange rate of £1 = \$3.

Finally, if the exchange rate were £1 = \$1, the dollar prices of the commodities in the United Kingdom would be:

Commodity	A	B	C	D	E
Dollar price in the U.K.	6	4	3	2	1

In this case, the United States would export only commodity A to the United Kingdom and import all other commodities, with the exception of commodity B (which would not

The actual exchange rate between the dollar and the pound will settle at the level at which *the value of U.S. exports to the United Kingdom exactly equals the value of the U.S. imports from the United Kingdom* (in the absence of other international transactions). Once this equilibrium exchange rate is established, we will be able to determine exactly which commodities are exported by the United States and which are exported by the United Kingdom. Each nation will then have a comparative advantage in the commodities that it exports at the particular equilibrium exchange rate established. (We abstract here from the situation where the exchange rate remains out of equilibrium for long periods of time.)

What we can say on the basis of Table 2.6 is that the U.S. comparative advantage is greatest in commodity A, and the United States must export at least this commodity. For this to be possible, the exchange rate between the dollar and the pound must be £1 > \$0.33. The United Kingdom's comparative advantage is highest in commodity E, so that the United Kingdom must export at least commodity E. For this to be possible, the exchange rate between the dollar and the pound must be £1 < \$10. This discussion can be generalized to cover any number of commodities.

A2.2 Comparative Advantage with More Than Two Nations

Suppose that, instead of two nations and five commodities, we have two commodities (wheat and cloth) and five nations (A, B, C, D, and E). Table 2.7 ranks these nations from lowest to highest in terms of their internal P_W/P_C values. With trade, the equilibrium P_W/P_C will settle somewhere between 1 and 5. That is, $1 < P_W/P_C < 5$.

If the equilibrium $P_W/P_C = 3$ with trade, Nations A and B will export wheat to Nations D and E in exchange for cloth. Nation C will not engage in international trade in this case because its pretrade P_W/P_C equals the equilibrium P_W/P_C with trade. Given a trade equilibrium $P_W/P_C = 4$, Nations A,B, and C will export wheat to Nation E in exchange for cloth, and Nation D will not engage in international trade. If the equilibrium $P_W/P_C = 2$ with trade, Nation A will export wheat to all the other nations, with the exception of Nation B, in exchange for cloth.

This discussion can easily be extended to any number of countries. However, generalizing our analysis to many commodities *and* many nations at the same time becomes cumbersome and is unnecessary. What is important at this point is that the conclusions reached on the basis of our simple model with only two nations and two commodities *can* be generalized and are indeed applicable to the case of many nations and many commodities.

TABLE 2.7. *Ranking of Nations in Terms of Internal P_W/P_C*

Nation	A	B	C	D	E
P_W/P_C	1	2	3	4	5

Problem Set up an example of trade with three commodities and three nations in such a way that each of the three nations exports one of the commodities to, and imports one of the commodities from, each of the other two nations.

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INTERNet

For trade policies of all the member countries of the World Trade Organization, see:

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For information and description of new reports and analyses on international trade theory and policies, generally supporting a liberal trading system, published by the Institute for International Economics, see:

http://www.iie.com

The case against free trade is made by the Public Citizen Global Trade Watch, an organization created by Ralph Nader (the consumer advocate), which is found at:

CHAPTER 3

The Standard Theory of International Trade

3.1 Introduction

This chapter extends our simple trade model to the more realistic case of increasing opportunity costs. Tastes or demand preferences are introduced with community indifference curves. We then see how these forces of supply and demand determine the equilibrium-relative commodity price in each nation in the absence of trade under increasing costs. This will also indicate the commodity of comparative advantage for each nation.

Subsequently, we examine how, with trade, each nation gains by specializing in the production of the commodity of its comparative advantage and exporting some of its output in exchange for the commodity of its comparative disadvantage. The last section of the chapter shows how mutually beneficial trade is possible even when two nations are exactly alike except for tastes under increasing cost conditions.

In this and in the following chapters, it will be convenient to generalize the presentation and deal with Nation 1 and Nation 2 (instead of the United States and United Kingdom) and commodity X and commodity Y (instead of cloth and wheat).

The appendix to this chapter is a review of those aspects of production theory that are essential for understanding the material presented in the appendices of the chapters that follow. This and the subsequent appendices can be omitted without loss of continuity in the text.

3.2 The Production Frontier with Increasing Costs

It is more realistic for a nation to face increasing rather than constant opportunity costs. **Increasing opportunity costs** mean that the nation must give up more and more of one commodity to release just enough resources to produce each additional unit of another commodity. Increasing opportunity costs results in a production frontier that is concave from the origin (rather than a straight line).

3.2A Illustration of Increasing Costs

Figure 3.1 shows the hypothetical production frontier of commodities X and Y for Nation 1 and Nation 2. Both production frontiers are concave from the origin, reflecting the fact that each nation incurs increasing opportunity costs in the production of *both* commodities.

Suppose that Nation 1 wants to produce more of commodity X, starting from point *A* on its production frontier. Since at point *A* the nation is already utilizing all of its resources with the best technology available, the nation can only produce more of X by reducing the output of commodity Y. (In Chapter 2, we saw that this is the reason production frontiers are negatively sloped.)

Figure 3.1 shows that for each additional batch of 20X that Nation 1 produces, it must give up more and more Y. The increasing opportunity costs in terms of Y that Nation 1 faces are reflected in the longer and longer downward arrows in the figure, and result in a production frontier that is concave from the origin.

Nation 1 also faces increasing opportunity costs in the production of Y. This could be demonstrated graphically by showing that Nation 1 has to give up increasing amounts of X for each additional batch of 20Y that it produces. However, instead of showing this for Nation 1, we demonstrate increasing opportunity costs in the production of Y with the production frontier of Nation 2 in Figure 3.1.

Moving upward from point *A'* along the production frontier of Nation 2, we observe leftward arrows of increasing length, reflecting the increasing amounts of X that Nation 2 must give up to produce each additional batch of 20Y. Thus, concave production frontiers for Nation 1 and Nation 2 reflect increasing opportunity costs in each nation in the production of *both* commodities.

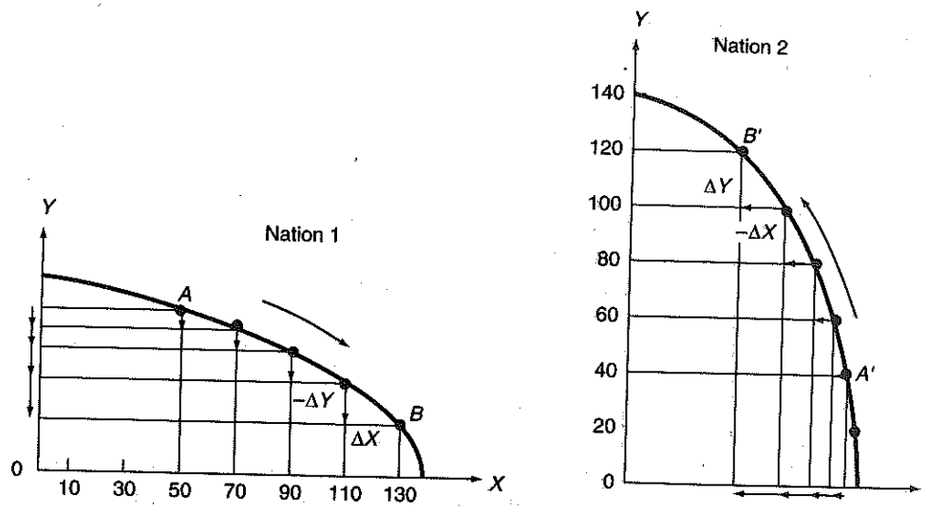

FIGURE 3.1. Production Frontiers of Nation 1 and Nation 2 with Increasing Costs. Concave production frontiers reflect increasing opportunity costs in each nation in the production of *both* commodities. Thus, Nation 1 must give up more and more of Y for each additional batch of 20X that it produces. This is illustrated by downward arrows of increasing length. Similarly, Nation 2 incurs increasing opportunity costs in terms of forgone X (illustrated by the increasing length of the leftward arrows) for each additional batch of 20Y it produces.

3.2B The Marginal Rate of Transformation

The **marginal rate of transformation (MRT)** of X for Y refers to the amount of Y that a nation must give up to produce each additional unit of X. Thus, MRT is another name for the opportunity cost of X (the commodity measured along the horizontal axis) and is given by the (absolute) *slope* of the production frontier at the point of production.

If in Figure 3.1 the slope of the production frontier (MRT) of Nation 1 at point *A* is 1/4, this means that Nation 1 must give up 1/4 of a unit of Y to release just enough resources to produce one additional unit of X at this point. Similarly, if the slope, or MRT, equals 1 at point *B*, this means that Nation 1 must give up one unit of Y to produce one additional unit of X at this point.

Thus, a movement from point *A* down to point *B* along the production frontier of Nation 1 involves an increase in the slope (MRT) from 1/4 (at point *A*) to 1 (at point *B*) and reflects the increasing opportunity costs in producing more X. This is in contrast to the case of a straight-line production frontier (as in Chapter 2), where the opportunity cost of X is constant regardless of the level of output and is given by the constant value of the slope (MRT) of the production frontier.

3.2C Reasons for Increasing Opportunity Costs and Different Production Frontiers

We have examined the meaning of increasing opportunity costs as reflected in concave production frontiers. But how do increasing opportunity costs arise? And why are they more realistic than constant opportunity costs?

Increasing opportunity costs arise because resources or factors of production (1) are not homogeneous (i.e., all units of the same factor are not identical or of the same quality) and (2) are not used in the *same* fixed proportion or intensity in the production of all commodities. This means that as the nation produces more of a commodity, it must utilize resources that become progressively less efficient or less suited for the production of that commodity. As a result, the nation must give up more and more of the second commodity to release just enough resources to produce each additional unit of the first commodity.

For example, suppose some of a nation's land is flat and suited for growing wheat, and some is hilly and better suited for grazing and milk production. The nation originally specialized in wheat but now wants to concentrate on producing milk. By transferring its hilly areas from wheat growing to grazing, the nation gives up very little wheat and obtains a great deal of milk. Thus, the opportunity cost of milk in terms of the amount of wheat given up is initially small. But if this transfer process continues, eventually flat land, which is better suited for wheat growing, will have to be used for grazing. As a result, the opportunity cost of milk will rise, and the production frontier will be concave from the origin.

The difference in the production frontiers of Nation 1 and Nation 2 in Figure 3.1 is due to the fact that the two nations have different factor endowments or resources at their disposal and/or use different technologies in production. In the real world, the production frontiers of different nations will usually differ, since practically no two nations have indentical factor endowments (even if they could have access to the same technology).

As the supply or availability of factors and/or technology changes over time, a nation's production frontier shifts. The type and extent of these shifts depend on the type and extent of the changes that take place. These changes are examined in detail in Chapter 7, which deals with economic growth and its effect on international trade.

3.3 Community Indifference Curves

So far, we have discussed production, or supply, considerations in a nation, as reflected in its production frontier. We now introduce the tastes, or demand preferences, in a nation. These are given by community (or social) indifference curves.

A **community indifference curve** shows the various combinations of two commodities that yield equal satisfaction to the community or nation. Higher curves refer to greater satisfaction, lower curves to less satisfaction. Community indifference curves are negatively sloped and convex from the origin. To be useful, (Readers familiar with an individual's indifference curves will

3.3A Illustration of Community Indifference Curves

Figure 3.2 shows three hypothetical indifference curves for Nation 1 and Nation 2. They differ on the assumption that tastes, or demand preferences, are different in the two nations.

Points N and A give equal satisfaction to Nation 1, since they are both on indifference curve I. Points T and H refer to a higher level of satisfaction, since they are on a higher indifference curve (II). Even though T involves more of Y but less of X than A, satisfaction is greater at T because it is on indifference curve II. Point E refers to still greater satisfaction, since it is on indifference curve III. For Nation 2, $A' = R' < H' < E'$.

Note that the community indifference curves in Figure 3.2 are negatively sloped. This is always the case because as a nation consumes more of X, it must consume less of Y if the nation is to have the same level of satisfaction (i.e., remain on the same level of satisfaction). Thus, as Nation 1 moves from N to A on indifference curve I, it consumes more of X but less of Y. Similarly, as Nation 2 moves from A' to R' on indifference curve I', it consumes more of X but less of Y. If a nation continued to consume the same amount of Y as it increased its consumption of X, the nation would necessarily move to a higher indifference curve.

3.3B The Marginal Rate of Substitution

The **marginal rate of substitution** (MRS) of X for Y in consumption refers to the amount of Y that a nation could give up for one extra unit of X and *still remain on the same indifference curve.* This is given by the (absolute) slope of the community

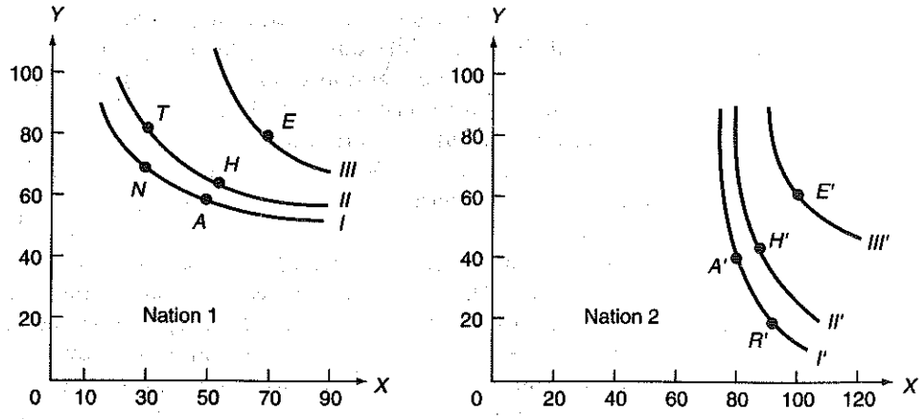

FIGURE 3.2. Community Indifference Curves for Nation 1 and Nation 2. A community indifference curve shows the various combinations of X and Y that yield equal satisfaction to the community or nation. A higher curve refers to a higher level of satisfaction. Community indifference curves are downward, or negatively, sloped and convex from the origin; to be useful, they must not cross. The declining slope of the curve reflects the dimin-

indifference curve at the point of consumption and declines as the nation moves down the curve. For example, the slope, or MRS, of indifference curve I is greater at point N than at point A (see Figure 3.2). Similarly, the slope, or MRS, of indifference curve I′ is greater at point A' than at R'.

The decline in MRS or absolute slope of an indifference curve is a reflection of the fact that the more of X and the less of Y a nation consumes, the more valuable to the nation is a unit of Y at the margin compared with a unit of X. Therefore, the nation can give up less and less of Y for each additional unit of X it wants.

Declining MRS means that community indifference curves are convex from the origin. Thus, while *increasing* opportunity cost in production is reflected in *concave* production frontiers, a *declining* marginal rate of substitution in consumption is reflected in *convex* community indifference curves. In Section 3.4, we will see that this convexity property of indifference curves is necessary to reach a unique (i.e., a single) equilibrium consumption point for the nation.

3.3C Some Difficulties with Community Indifference Curves

As we said earlier, to be useful, community indifference curves must not intersect (cross). A point of intersection would refer to equal satisfaction on two different community indifference curves, which is inconsistent with their definition. Thus, the indifference curves of Nation 1 and Nation 2 in Figure 3.2 are drawn as nonintersecting.

However, a particular set, or map, of community indifference curves refers to a particular *income distribution* within the nation. A different income distribution would result in a completely new set of indifference curves, which might intersect previous indifference curves.

This is precisely what may happen as a nation opens trade or expands its level of trade. Exporters will benefit, while domestic producers competing with imports will suffer. There is also a differential impact on consumers, depending on whether an individual's consumption pattern is oriented more toward the X or the Y good. Thus, trade will change the distribution of real income in the nation and *may* cause indifference curves to intersect. In that case, we could not use community indifference curves to determine whether the opening or the expansion of trade increased the nation's welfare.

One way out of this impasse is through the so-called *compensation principle.* According to this principle, the nation benefits from trade if the gainers would be better off (i.e., retain some of their gain) even after fully compensating the losers for their losses. This is true whether or not compensation actually occurs. (One way that compensation would occur is for the government to tax enough of the gain to fully compensate the losers with subsidies or tax relief.) Alternatively, we could make a number of restrictive assumptions about tastes, incomes, and patterns of consumption that would preclude intersecting community indifference curves.

Although the compensation principle or restrictive assumptions do not completely eliminate all the conceptual difficulties inherent in using community indif-

3.4 Equilibrium in Isolation

In Section 3.2, we discussed production frontiers, which illustrate the production, or supply, conditions in a nation. In Section 3.3, we examined community indifference curves, which reflect the tastes, or demand preferences, in a nation. We will now see how the interaction of these forces of demand and supply determines the equilibrium point, or point of maximum social welfare, in a nation in isolation (i.e., in the absence of trade).

In the absence of trade, a nation is in equilibrium when it reaches the highest indifference curve possible given its production frontier. This occurs at the point where a community indifference curve is tangent to the nation's production frontier. The common slope of the two curves at the tangency point gives the internal equilibrium-relative commodity price in the nation and reflects the nation's comparative advantage. Let us see what all this means.

3.4A Illustration of Equilibrium in Isolation

Figure 3.3. brings together the production frontiers of Figure 3.1 and the community indifference curves of Figure 3.2. We see in Figure 3.3 that indifference curve I is the highest indifference curve that Nation 1 can reach with its production frontier. Thus, Nation 1 is in equilibrium, or maximizes its welfare, when it produces and consumes at point A in the absence of trade, or **autarky.** Similarly, Nation 2 is in equilibrium at point A', where its production frontier is tangent to indifference curve I′.

Note that since community indifference curves are convex from the origin and drawn as nonintersecting, there is only one such point of tangency, or equilibrium. Furthermore, we can be certain that one such equilibrium point exists because there are an infinite number of indifference curves (i.e., the indifference map is dense). Points on lower indifference curves are possible but would not maximize the nation's welfare. On the other hand, the nation cannot reach higher indifference curves with the resources and technology presently available.

3.4B Equilibrium-Relative Commodity Prices and Comparative Advantage

The **equilibrium-relative commodity price in isolation** is given by the slope of the common tangent to the nation's production frontier and indifference curve at the autarky point of production and consumption. Thus, the equilibrium-relative price of X in isolation is $P_A = P_X/P_Y = 1/4$ in Nation 1 and $P_{A'} = P_X/P_Y = 4$ in Nation 2 (see Figure 3.3). Relative prices are different in the two nations because their production frontiers and indifference curves differ in shape and location.

Since in isolation $P_A < P_{A'}$ Nation 1 has a comparative advantage in commodity X and Nation 2 in commodity Y. It follows that both nations can gain if Nation 1 specializes in the production of and exports X in exchange for Y from Nation 2. How this takes place will be seen in the next section.

Figure 3.3 illustrates that the forces of supply (as given by the nation's produc-

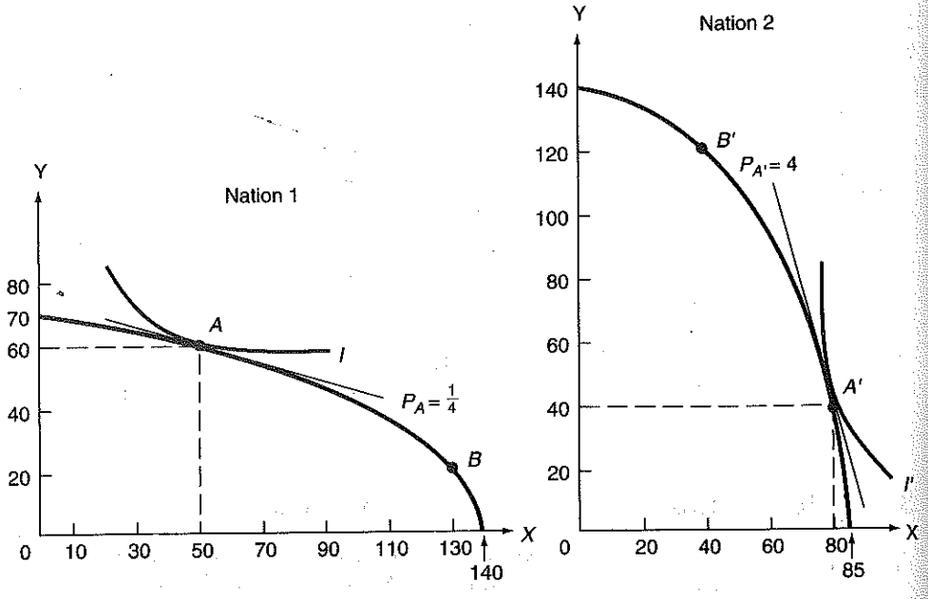

FIGURE 3.3. Equilibrium in Isolation. Nation 1 is in equilibrium, or maximizes its welfare, in isolation by producing and consuming at point A, where its production frontier reaches (is tangent to) indifference curve I (the highest possible). Similarly, Nation 2 is in equilibrium at point A', where its production frontier is tangent to indifference curve I'. The equilibrium relative price of X in Nation 1 is given by the slope of the common tangent to its production frontier and indifference curve I at point A. This is $P_A = 1/4$. For Nation 2, $P_{A'} = 4$. Since the relative price of X is lower in Nation 1 than in Nation 2, Nation 1 has a comparative advantage in commodity X and Nation 2 in commodity Y.

ence map) *together* determine the equilibrium-relative commodity prices in each nation in autarky. For example, if indifference curve I had been of a different shape, it would have been tangent to the production frontier at a different point and would have determined a different relative price of X in Nation 1. The same would be true for Nation 2. This is in contrast to the constant costs case, where the equilibrium P_X/P_Y is constant in each nation regardless of the level of output and conditions of demand, and is given by the constant slope of the nation's production frontier.

Case Study 3-1 examines the present, real-world or **revealed comparative advantage** of the United States, the European Union, and Japan.

3.5 The Basis for and the Gains from Trade with Increasing Costs

Case Study 3-1 Comparative Advantage of the United States, the European Union, and Japan

The revealed comparative advantage of the United States, the European Union, and Japan can be measured by the excess in the percentage of total exports over the percentage of total imports in each major commodity group for each country or region. The 15-member European Union (EU) refers to Germany, France, the United Kingdom, Italy, Spain, the Netherlands, Belgium, Denmark, Portugal, Greece, Ireland, Luxembourg, Austria, Finland, and Sweden. Although international trade is not balanced for many countries, especially the United States and Japan, and trade restrictions distort comparative advantage, they usually do not completely obscure it.

Table 3-1 shows that the United States has a revealed comparative advantage in food (since U.S. food exports as a percentage of total overall U.S. exports exceed U.S. food imports as a percentage of total U.S. imports), but a strong revealed comparative disadvantage in fuels. In manufactures, the United States has a revealed comparative advantage in chemicals and in telecommunications equipment, but a revealed comparative disadvantage in automotive products, and textiles and clothing.

The EU seems to have a comparative advantage in automotive products and chemicals, and a comparative disadvantage in all other commodity groups. Japan seems to have a very strong comparative advantage in manufactures (other than textiles and clothing) and an equally strong comparative disadvantage in primary commodities. Product differentiation is the reason for intra-industry trade (i.e., for the same type of product being both exported and imported by the same nation or region; intra-industry trade is examined in detail in Section 6.4).

TABLE 3.1. *Composition of Exports and Imports of the United States, the European Union, and Japan in 2001 and Their Revealed Comparative Advantage*

	United States % of Total		European Union % of Total		Japan % of Total	
	Exports	Imports	Exports	Imports	Exports	Imports
Primary commodities	13.2	18.9	15.1	21.2	3.0	41.5
Food	7.4	4.4	7.8	8.2	0.8	13.1
Fuels	1.8	10.9	3.6	8.0	0.4	20.1
Manufactures	82.4	76.7	82.1	75.4	92.8	56.7
Automotive products	8.7	14.0	11.8	9.8	19.9	2.6
Chemicals	11.3	6.9	13.8	11.1	7.6	7.2
Office and telecommunications equipment	17.3	14.6	10.6	12.2	20.5	15.1
Textiles and clothing	2.4	6.9	4.3	5.3	1.7	6.9

Source: WTO, *International Trade* Statistics (Geneva, 2002), Appendix tables A12, A14, and A19.

nation with the lower relative price for a commodity has a comparative advantage in that commodity and a comparative disadvantage in the other commodity, with respect to the second nation. Each nation should then specialize in the production of the commodity of its comparative advantage (i.e., produce more of the commodity than it wants to consume domestically) and exchange part of its output with the other nation for the commodity of its comparative disadvantage.

However, as each nation specializes in producing the commodity of its comparative advantage, it incurs increasing opportunity costs. Specialization will continue until relative commodity prices in the two nations become equal at the level at which trade is in equilibrium. By then trading with each other, both nations end up consuming more than in the absence of trade.

3.5A Illustrations of the Basis for and the Gains from Trade with Increasing Costs

We have seen (Figure 3.3) that in the absence of trade the equilibrium-relative price of X is $P_A = 1/4$ in Nation 1 and $P_{A'} = 4$ in Nation 2. Thus, Nation 1 has a comparative advantage in commodity X and Nation 2 in commodity Y.

Suppose that trade between the two nations becomes possible (e.g., through the elimination of government obstacles to trade or a drastic reduction in transportation costs). Nation 1 should now specialize in the production and export of commodity X in exchange for commodity Y from Nation 2. How this takes place is illustrated by Figure 3.4.

Starting from point A (the equilibrium point in isolation), as Nation 1 specializes in the production of X and moves *down* its production frontier, it incurs increasing opportunity costs in the production of X. This is reflected in the increasing *slope* of its production frontier. Starting from point A', as Nation 2 specializes in the production of Y and moves *upward* along its production frontier, it experiences increasing opportunity costs in the production of Y. This is reflected in the *decline in the slope* of its production frontier (a reduction in the opportunity cost of X, which means a rise in the opportunity cost of Y).

This process of specialization in production continues until relative commodity prices (the slope of the production frontiers) become equal in the two nations. The common relative price (slope) with trade will be somewhere between the pretrade relative prices of 1/4 and 4, at the level at which trade is balanced. In Figure 3.4, this is $P_B = P_{B'} = 1$.

With trade, Nation 1 moves from point A down to point B in production. By then exchanging 60X for 60Y with Nation 2 (see trade triangle BCE), Nation 1 ends up consuming at point E (70X and 80Y) on its indifference curve III. This is the highest level of satisfaction that Nation 1 can reach with trade at $P_X/P_Y = 1$. Thus, Nation 1 gains 20X and 20Y from its no-trade equilibrium point. (Compare point E on indifference curve III with point A on indifference curve I.)

Similarly, Nation 2 moves from point A' up to point B' in production, and, by exchanging 60Y for 60X with Nation 1 (see trade triangle $B'C'E'$), it ends up consuming at point E' (100X and 60Y) on its indifference curve III'. Thus, Nation 2

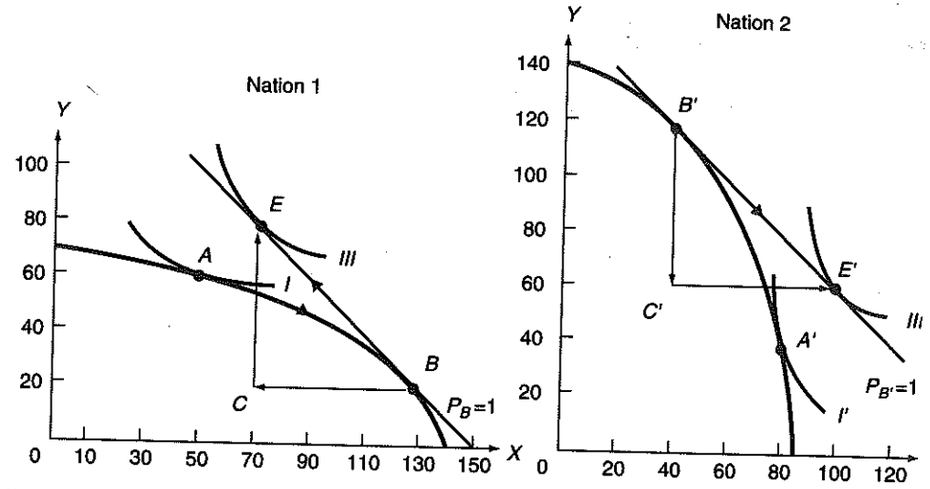

FIGURE 3.4. The Gains from Trade with Increasing Costs. With trade, Nation 1 moves from point A to point B in production. By then exchanging 60X for 60Y with Nation 2 (see trade triangle BCE), Nation 1 ends up consuming at point E (on indifference curve III). Thus, Nation 1 gains 20X and 20Y from trade (compare autarky point A with point E). Similarly, Nation 2 moves from A' to B' in production. By then exchanging 60Y for 60X with Nation 1 (see trade triangle $B'C'E'$), Nation 2 ends up consuming at point E' and also gains 20X and 20Y. $P_B = P_{B'} = 1$ is the equilibrium-relative price—the price at which trade is balanced.

Note that with specialization in production and trade, each nation can consume outside its production frontier (which also represents its no-trade consumption frontier).

3.5B Equilibrium-Relative Commodity Prices with Trade

The **equilibrium-relative commodity price with trade** is the common relative price in both nations at which trade is balanced. In Figure 3.4, this is $P_B = P_{B'} = 1$. At this relative price, the amount of X that Nation 1 wants to export (60X) equals the amount of X that Nation 2 wants to import (60X). Similarly, the amount of Y that Nation 2 wants to export (60Y) exactly matches the amount of Y that Nation 1 wants to import at this price (60Y).

Any other relative price could not persist because trade would be unbalanced. For example, at $P_X/P_Y = 2$, Nation 1 would want to export more of X than Nation 2 would be willing to import at this high price. As a result, the relative price of X would fall toward the equilibrium level of 1. Similarly, at a relative price of X lower than 1, Nation 2 would want to import more of X than Nation 1 would be willing to export at this low price, and the relative price of X would rise. Thus, the relative price of X would gravitate toward the equilibrium price of 1. (The same conclu-

The equilibrium-relative price in Figure 3.4 was determined by trial and error; that is, various relative prices were tried until the one that balanced trade was found. There is a more rigorous theoretical way to determine the equilibrium-relative price with trade. This makes use of either the total demand and supply curve of each commodity in each nation, or the so-called offer curves, and is discussed in the next chapter.

All we need to say at this point is that the greater is Nation 1's desire for Y (the commodity exported by Nation 2) and the weaker is Nation 2's desire for X (the commodity exported by Nation 1), the closer the equilibrium price with trade will be to ¼ (the pretrade equilibrium price in Nation 1) and the smaller will be Nation 1's share of the gain. Once the equilibrium-relative price with trade is determined, we will know exactly how the gains from trade are divided between the two nations, and our trade model will be complete. In Figure 3.4, the equilibrium-relative price of X with trade ($P_B = P_B' = 1$) results in equal gains (20X and 20Y) for Nation 1 and Nation 2, but this need not be the case.

Of course, if the *pretrade-relative* price had been the same in both nations (an unlikely occurrence), there would be no comparative advantage or disadvantage to speak of in either nation, and no specialization in production or mutually beneficial trade would take place.

3.5C Incomplete Specialization

There is one basic difference between our trade model under increasing costs and the constant opportunity costs case. Under constant costs, both nations specialize completely in production of the commodity of their comparative advantage (i.e., produce only that commodity). For example, in Figures 2.2 and 2.3, the United States specialized completely in wheat production, and the United Kingdom specialized completely in cloth production. Since it paid for the United States to exchange some wheat for British cloth, it paid for the United States to obtain *all* of its cloth from the United Kingdom in exchange for wheat because the opportunity cost of wheat remained constant in the United States. The same was true for the United Kingdom in terms of cloth production.

In contrast, under increasing opportunity costs, there is **incomplete specialization** in production in both nations. For example, while Nation 1 produces more of X (the commodity of its comparative advantage) with trade, it continues to produce some Y (see point B in Figure 3.4). Similarly, Nation 2 continues to produce some X with trade (see point B' in Figure 3.4).

The reason for this is that as Nation 1 specializes in the production of X, it incurs increasing opportunity costs in producing X. Similarly, as Nation 2 produces more Y, it incurs increasing opportunity costs in Y (which means declining opportunity costs of X). Thus, as each nation specializes in producing the commodity of its comparative advantage, relative commodity prices move toward each other (i.e., become less unequal) until they are identical in both nations.

At that point, it does not pay for either nation to continue to expand production of the commodity of its comparative advantage (see Case Study 3-2). This occurs before either nation has completely specialized in production. In Figure 3.4, $P_B =$

Case Study 3-2 Specialization and Export Concentration in Selected Countries

Because of increasing costs, no nation specializes completely in the production of only one product in the real world. The closest to complete specialization in production and trade that any nation comes is Kuwait, where petroleum exports represented 92.8 percent of the total value of its exports in 2001. For Argentina, another developing nation with highly specialized natural resources, food exports represent 45.7 percent of its total exports. As Table 3.2 shows, the largest export product for the United States, Germany, and Japan represents less than one quarter of their total exports.

TABLE 3.2. *Leading Export as a Percentage of Total Exports of Selected Countries in 2001*

United States	Office and telecommunications equipment	17.3
Japan	Office and telecommunications equipment	20.5
Germany	Automotive products	23.2
Korea	Office and telecommunications equipment	29.4
Argentina	Food	45.7
Kuwait	Fuels	92.8

Source: WTO, *International Trade Statistics* (Geneva, 2002).

3.5D Small-Country Case with Increasing Costs

Recall that under constant costs, the only exception to complete specialization in production occurred in the small-country case. There, only the small nation specialized completely in production of the commodity of its comparative advantage. The large nation continued to produce both commodities even with trade (see Figure 2.3) because the small nation could not satisfy all of the demand for imports of the large nation. In the increasing costs case, however, we find incomplete specialization even in the small nation.

We can use Figure 3.4 to illustrate the small-country case with increasing costs. Let us assume that Nation 1 is now a very small country, which is in equilibrium at point A (the same as before) in the absence of trade, and that Nation 2 is a very large country or even the rest of the world. (The diagram for Nation 2 in Figure 3.4 is to be completely disregarded in this case.)

Suppose that the equilibrium-relative price of X on the world market is 1 ($P_w = 1$), and it is not affected by trade with small Nation 1. Since in the absence of trade, the relative price of X in Nation 1 ($P_A = ¼$) is lower than the world market price, Nation 1 has a comparative advantage in X. With the opening of trade, Nation 1 specializes in the production of X until it reaches point B on its production frontier, where $P_B = 1 = P_W$. Even though Nation 1 is now considered to be a small country, it still does not specialize completely in the production of X (as would be the

By exchanging 60X for 60Y, Nation 1 reaches point E on indifference curve III and gains 20X and 20Y (compared with its autarky point A on indifference curve I). Note that this is exactly what occurred when Nation 1 was *not* considered to be small. The only difference is that now Nation 1 does not affect relative prices in Nation 2 (or the rest of the world), and Nation 1 captures all the benefits from trade (which now amount to only 20X and 20Y).

3.5E The Gains from Exchange and from Specialization

A nation's gains from trade can be broken down into two components: the gains from exchange and the gains from specialization. Figure 3.5 illustrates this breakdown for *small* Nation 1. (For simplicity, the autarky price line, $P_A = 1/4$, and indifference curve I are omitted from the figure.)

Suppose that, for whatever reason, Nation 1 could *not* specialize in the production of X with the opening of trade but continued to produce at point A, where MRT = 1/4. Starting from point A, Nation 1 could export 20X in exchange for 20Y at the prevailing world relative price of $P_W = 1$ and end up consuming at point T on indifference curve II. Even though Nation 1 consumes less of X and more of Y at point T in relation to point A, it is better off than it was in autarky because T is on higher indifference curve II. The movement from point A to point T in consumption measures the **gains from exchange.**

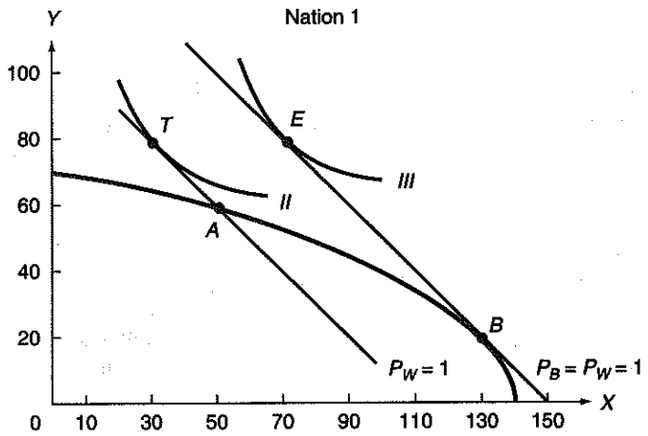

FIGURE 3.5. The Gains from Exchange and from Specialization. If Nation 1 could not specialize in the production of X with the opening of trade but continued to produce at point A, Nation 1 could export 20X in exchange for 20Y at the prevailing world price of $P_W = 1$ and end up consuming at point T on indifference curve II. The increase in consumption from point A (in autarky) to point T represents the gains from exchange alone. If Nation 1 subsequently did specialize in the production of X and produced at point B, it

If subsequently Nation 1 also specialized in the production of X and produced at point B, it could then exchange 60X for 60Y with the rest of the world and consume at point E on indifference curve III (thereby gaining even more). The movement from T to E in consumption measures the **gains from specialization** in production.

In sum, the movement from A (on indifference curve I) to T (on indifference curve II) is made possible by exchange alone. This takes place even if Nation 1 remains at point A (the autarky point) in production. The movement from point T to point E (on indifference curve III) represents the gains resulting from specialization in production.

Note that Nation 1 is not in equilibrium in production at point A with trade because MRT < P_W. To be in equilibrium in production, Nation 1 should expand its production of X until it reaches point B, where $P_B = P_W = 1$. Nation 2's gains from trade can similarly be broken down into gains from exchange and gains from specialization.

Case Study 3-3 illustrates the reallocation of labor in the United States as a real-world example of comparative advantage at work, while Case Study 3-4 shows that **deindustrialization** in the industrial countries as a group, in the United States, the European Union, and Japan was due mainly to increases in labor productivity or internal causes rather than to foreign trade.

3.6 Trade Based on Differences in Tastes

The difference in *pretrade-relative* commodity prices between Nation 1 and Nation 2 in Figures 3.3 and 3.4 was based on the difference in the production frontiers and indifference curves in the two nations. This determined the comparative advantage of each nation and set the stage for specialization in production and mutually beneficial trade.

With increasing costs, even if two nations have identical production possibility frontiers (which is unlikely), there will still be a basis for mutually beneficial trade if tastes, or demand preferences, in the two nations differ. The nation with the relatively smaller demand or preference for a commodity will have a lower autarky relative price for, and a comparative advantage in, that commodity. The process of specialization in production and trade would then follow, exactly as described in the previous section.

3.6A Illustration of Trade Based on Differences in Tastes

Trade based solely on differences in tastes is illustrated in Figure 3.6. Since the production frontiers of the two nations are now assumed to be identical, they are represented by a single curve. With indifference curve I tangent to the production frontier at point A for Nation 1 and indifference curve I′ tangent at point A' for Nation 2, the pretrade-relative price of X is lower in Nation 1. Thus, Nation 1 has a comparative advantage in commodity X and Nation 2 in commodity Y.

With the opening of trade, Nation 1 specializes in the production of X (and

Case Study 3-3 Job Losses in High U.S. Import-Competing Industries, 1979–1999

Table 3.3 shows the number of workers who lost their jobs (i.e., were displaced) in various high import-competing industries in the United States between 1979 and 1999. High import-competing industries were broadly defined as those in the top 25 percent in import shares. From the table, we see that almost 6.5 million workers lost their jobs in these industries over the 1979–1999 period, with the electrical machinery and apparel industries leading the list, with 1,181,000 and 1,136,000 jobs lost, respectively. As we will see in Case Study 3–4, however, most of the jobs lost in these industries were not due to imports but to purely internal or domestic causes such as technological change, changes in consumer demand, and restructuring. Highly import competitive industries did, however, experience a higher job loss than other manufacturing industries because of imports. This is evident from the fact that although high import-competing industries accounted for 30 percent of manufacturing employment, they experienced 38.4 percent of manufacturing job losses over the 1979–1999 period.

TABLE 3.3. *Job Losses in High Import-Competing Industries, 1979–1999*

Industry	Job Lost (thousands)	Industry	Job Lost (thousands)
Electrical machinery	1,181	Textiles	159
Apparel	1,136	Toys and sporting goods	156
Motor vehicles	918	Primary metals other than steel	133
Electronic computing equipment	513	Photographic equipment	68
Radio and television	395	Leather products	57
Steel	361	Office and accounting machines	41
Construction machinery	351	Pottery and related products	24
Tires and other rubber products	193	Watches and clocks	9
Footwear	184	Leather, tanning and finishing	5
Scientific instruments	164	Other industries	406
		Total	6,454

Source: L. G. Kletzer, *Job Loss from Imports: Measuring the Costs* (Washington, D.C.: Institute for International Economics, 2001), pp. 18–19.

up its own production frontier). Specialization continues until PX/PY is the same in both nations and trade is balanced. This occurs at point B (which coincides with point B$\not{c}$), where PB = PB$\not{c}$ = 1. Nation 1 then exchanges 60X for 60Y with Nation 2 (see trade triangle BCE) and ends up consuming at point E on its indifference curve III. Nation 1 thus gains 20X and 20Y as compared with point A. Similarly, Nation 2 exchanges 60Y for 60X with Nation 1 (see trade triangle

Case Study 3-4 International Trade and Deindustrialization in the United States, the European Union, and Japan

Since the 1970s, the United States has been concerned with the problem of **deindustrialization**, as reflected in its declining share of manufacturing employment. But this phenomenon occurred in all industrial countries and was not primarily the result of foreign trade, as was sometimes claimed. Table 3.4 shows the relative importance of the different factors accounting for deindustrialization in all industrial countries as a group in the United States, the European Union, and Japan from 1970 to 1994.

TABLE 3.4. *Factors Responsible for Deindustrialization, 1970–1994*

	Industrial Countries	United States	European Union	Japan
Share of manufacturing Employment (in percent)				
1970	27.6	26.4	30.4	27.0
1994	18.0	16.0	20.2	23.2
Change	–9.6	–10.4	–10.2	–3.8
Percentage of change due to:				
Productivity growth	65.6	65.4	59.8	157.9
Trade	(–)2.1	9.6	(–)2.9	(–)30.0
Investment	18.8	3.8	20.6	71.1
Other	17.7	21.2	22.5	(–)51.7
Total	100.0	100.0	100.0	100.0

Source: International Monetary Fund, *Staff Studies for the World Economic Outlook* (Washington, D.C., December 1997), p. 68.

The table shows that from 1970 to 1994 the average share of manufacturing employment declined by about 10 percentage points in industrial countries as a group, in the United States and in the European Union, and 4 percentage points in Japan. The table also shows that most of this decline resulted from the growth of labor productivity, which made possible higher levels of output with less labor. Growing trade deficits in manufactures were responsible for only 9.6 percent of the loss of manufacturing employment in the United States, while growing trade surpluses in manufactures resulted in a 30-percent *increase* in manufacturing employment in Japan. The trade effect in the European Union and all industrial nations as a group was very small. The decline in the rate of investment also contributed to the reduction in the share of manufacturing employment, as did the changes in other factors (such as shifts in the pattern of consumption away from manufactures to services), except in Japan.