chapter

4

Demand and Supply, Offer Curves, and the Terms of Trade

LEARNING GOALS:

After reading this chapter, you should be able to:

- Show how the equilibrium price at which trade takes place is determined by demand and supply
- Show how the equilibrium price at which trade takes place is determined with offer curves
- Explain the meaning of the terms of trade and how they changed over time for the United States and other countries

4.1 Introduction

We saw in Chapter 3 that a difference in relative commodity prices between two nations in isolation is a reflection of their comparative advantage and forms the basis for mutually beneficial trade. The equilibrium-relative commodity price at which trade takes place was then found by trial and error at the level at which trade was balanced. In this chapter, we present a more rigorous theoretical way of determining the equilibrium-relative commodity price with trade. We will first do this with partial equilibrium analysis (i.e., by utilizing demand and supply curves) and then by the more complex general equilibrium analysis, which makes use of offer curves.

Section 4.2 shows how the equilibrium-relative commodity price with trade is determined with demand and supply curves (i.e., with partial equilibrium analysis). We then go on to general equilibrium analysis and derive the offer curves of Nation 1 and Nation 2 in Section 4.3. In Section 4.4, we examine how the interaction of the offer curves of the two nations defines the equilibrium-relative commodity price with trade. In Section 4.5, we look at the relationship between general and partial equilibrium analyses. Finally, Section 4.6 examines the meaning, measurement, and importance of the terms of trade. The appendix to this chapter presents the *formal* derivation of offer curves and examines the case of multiple and unstable equilibria.

4.2 The Equilibrium-Relative Commodity Price with Trade—Partial Equilibrium Analysis

Figure 4.1 shows how the equilibrium-relative commodity price with trade is determined by partial equilibrium analysis. Curves D_X and S_X in panels A and C of Figure 4.1 refer to the demand and supply curves for commodity X of Nation 1 and Nation 2, respectively. The vertical axes in all three panels of Figure 4.1 measure the relative price of commodity X (i.e., P_X/P_Y, or the amount of commodity Y that a nation must give up to produce one additional unit of X). The horizontal axes measure the quantities of commodity X.

Panel A of Figure 4.1 shows that in the absence of trade, Nation 1 produces and consumes at point A at the relative price of X of P_1, while Nation 2 produces and consumes at point A' at P_3. With the opening of trade, the relative price of X will be between P_1 and P_3 if both nations are large. At prices above P_1, Nation 1 will supply (produce) more than it will demand (consume) of commodity X and will export the difference or excess supply (see panel A). Alternatively, at prices below P_3, Nation 2 will demand a greater quantity of commodity X than it produces or supplies domestically and will import the difference or excess demand (see panel C).

Specifically, panel A shows that at P_1, the quantity supplied of commodity X (QS_X) equals the quantity demanded of commodity X (QD_X) in Nation 1, and so Nation 1 *exports* nothing of commodity X. This gives point A^* on curve S (Nation 1's supply curve of exports) in panel B. Panel A also shows that at P_2, the excess of BE of QS_X over QD_X represents the quantity of commodity X that Nation 1 would export at P_2. This is equal to B^*E^* in panel B and defines point E^* on Nation 1's S curve of exports of commodity X.

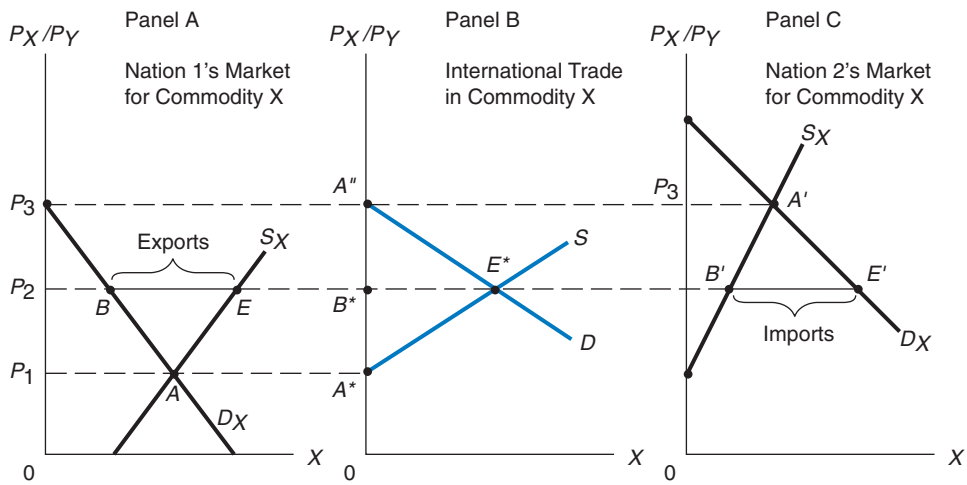

FIGURE 4.1. The Equilibrium-Relative Commodity Price with Trade with Partial Equilibrium Analysis. At P_X/P_Y larger than P_1, Nation 1's excess supply of commodity X in panel A gives rise to Nation 1's supply curve of exports of commodity X (S) in panel B. On the other hand, at P_X/P_Y lower than P_3, Nation 2's excess demand for commodity X in panel C gives rise to Nation 2's demand for imports of commodity X (D) in panel B. Panel B shows that only at P_2 does the quantity of imports of commodity X demanded by Nation 2 equal the quantity of exports supplied by Nation 1. Thus, P_2 is the equilibrium P_X/P_Y with trade. At $P_X/P_Y > P_2$, there will be an excess supply of exports of commodity X, and this will drive P_X/P_Y down to P_2. At $P_X/P_Y < P_2$, there will be an excess demand for imports of X, and this will drive P_X/P_Y up to P_2.

On the other hand, panel C shows that at P_3, $QD_X = QS_X$ (point A'), so Nation 2 does not demand any *imports* of commodity X. This defines point A'' on Nation 2's demand curve for imports of commodity X (D) in panel B. Panel C also shows that at P_2, the excess $B'E'$ of QD_X over QS_X represents the quantity of commodity X that Nation 2 would import at P_2. This is equal to B^*E^* in panel B and defines point E^* on Nation 2's D curve of imports of commodity X.

At P_2, the quantity of imports of commodity X demanded by Nation 2 ($B'E'$ in panel C) equals the quantity of exports of commodity X supplied by Nation 1 (BE in panel A). This is shown by the intersection of the D and S curves for trade in commodity X in panel B. Thus, P_2 is the equilibrium-relative price of commodity X with trade. From panel B we can also see that at $P_X/P_Y > P_2$ the quantity of exports of commodity X supplied exceeds the quantity of imports demanded, and so the relative price of X (P_X/P_Y) will fall to P_2. On the contrary, at $P_X/P_Y < P_2$, the quantity of imports of commodity X demanded exceeds the quantity of exports supplied, and P_X/P_Y will rise to P_2.

The same could be shown with commodity Y. Commodity Y is exported by Nation 2 and imported by Nation 1. At any relative price of Y higher than equilibrium, the quantity of

CASE STUDY 4-1 Demand, Supply, and the International Price of Petroleum

Table 4.1 shows that the price of petroleum fluctuated widely from 1972 to 2011. As a result of supply shocks during the Arab-Israeli War in fall 1973 and the Iranian revolution in 1979–1980, OPEC (Organization of Petroleum Exporting Countries) was able to increase the price of petroleum from an average of $2.89 per barrel in 1972 to $11.60 in 1974 and to $36.68 per barrel in 1980. These increases stimulated energy conservation and expanded exploration and petroleum production by non-OPEC countries. In the face of excess supplies during the 1980s and 1990s, OPEC was unable to prevent the price of petroleum from falling to a low of $14.17 in 1986 and $13.07 in 1998. The price of petroleum then rose to $28.23 in 2000 and $104.00 in 2011 (the all-time monthly high was $132.60 in July 2008).

If we consider, however, that all prices have risen over time, we can see from Table 4.1 that the real (i.e., inflation-adjusted) price of petroleum rose from $2.89 per barrel in 1972 to $9.51 in 1974 and to $17.14 in 1980; it then fell to $4.69 in 1986 and $2.90 in 1998, but it subsequently rose to $5.73 in 2000 and $14.83 in 2008, and it was $15.80 in 2011. Thus, the real price of petroleum was 5.47 times higher (15.80/2.89) in 2011 than in 1972, rather than by 35.99 times in nominal prices.

TABLE 4.1. Nominal and Real Petroleum Prices, Selected Years, 1972–2011

Year	1972	1973	1974	1978	1979	1980	1985
Petroleum Prices ($/barrel)	2.89	3.24	11.60	13.39	30.21	36.68	27.37
Real Petroleum Prices ($/barrel)	2.89	3.00	9.51	7.70	15.82	17.14	9.34
Year	**1986**	**1990**	**1998**	**2000**	**2005**	**2008**	**2011**
Petroleum Prices ($/barrel)	14.17	22.99	13.07	28.23	53.40	97.03	140.00
Real Petroleum Prices ($/barrel)	4.69	6.51	2.90	5.73	8.99	14.83	15.80

Source: Elaborated from data in International Monetary Fund, *International Financial Statistics* (Washington, D.C.: IMF, various issues).

exports of Y supplied by Nation 2 would exceed the quantity of imports of Y demanded by Nation 1, and the relative price of Y would fall to the equilibrium level. On the other hand, at any P_Y/P_X below equilibrium, the quantity of imports of Y demanded would exceed the quantity of exports of Y supplied, and P_Y/P_X would rise to the equilibrium level. (You will be asked to show this graphically in Problem 1.) Case Study 4-1 shows the international price of petroleum in nominal and real (i.e., inflation-adjusted) terms from 1972 to 2010, while Case Study 4-2 shows the index of export to import prices for the United States over the same period.

CASE STUDY 4-2 The Index of Export to Import Prices for the United States

Figure 4.2 shows the index of U.S. export to import prices or terms of trade from 1972 to 2011. This index declined almost continuously from 1972 to 1980, it rose from 1980 to 1986, and then it remained in the 96–107 range (with 2000 = 100), except in 2008, when it fell to 92. The decline in the index was particularly large during the two "oil shocks" of 1973–74 and 1979–80, and from 2002 to 2008 when the price of petroleum and other primary commodities imports rose sharply. From the figure, we see that the average *relative* price of U.S. exports declined from 127.1 in 1972 to 90.2 in 1980, and 91.8 in 2008, and it was 94.6 in 2011. This means that, on the average, the United States had to export 34 percent more of its goods and services in 1980, 32 percent more in 2008, and 29 percent more in 2011 to import the same quantity of goods and services that it did in 1972.

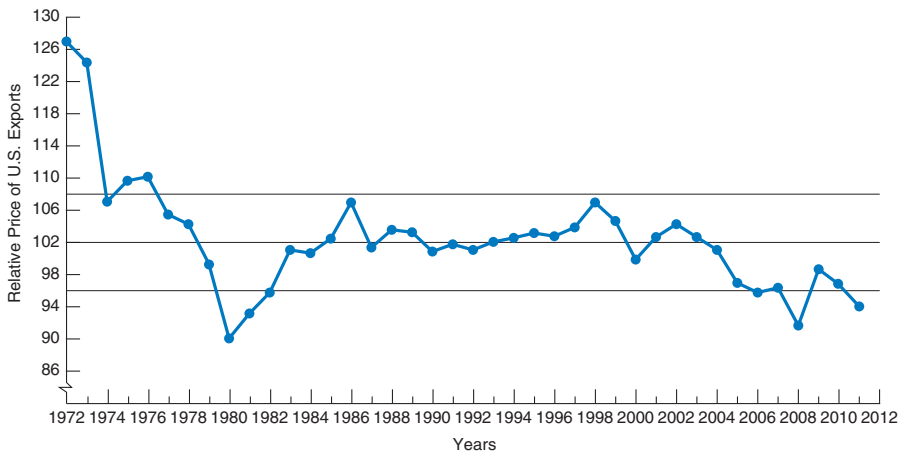

FIGURE 4.2. Index of Relative U.S. Export Prices, 1972–2011 (2000 = 100).
The index of U.S. export to import prices declined from 127.1 in 1972 to 107.2 in 1974 (due to the sharp increase in petroleum prices in 1973 and 1974) and to 90.2 in 1980, as a result of the second "oil shock." The index then rose to 107.1 in 1986, but it fell to 91.8 in 2008 as a result of the sharp increase in the price of petroleum and other primary commodities imports. The index was 94.6 in 2011.
Source: Elaborated from data in International Monetary Fund, *International Financial Statistics* Washington, D.C.: IMF, various issues.

4.3 Offer Curves

In this section, we define offer curves and note their origin. We then derive the offer curves of the two nations and examine the reasons for their shape.

4.3A Origin and Definition of Offer Curves

Offer curves (sometimes referred to as **reciprocal demand curves**) were devised and introduced into international economics by *Alfred Marshall* and *Ysidro Edgeworth*, two British economists, at the turn of the twentieth century. Since then, offer curves have been used extensively in international economics, especially for pedagogical purposes.

The offer curve of a nation shows how much of its import commodity the nation demands for it to be willing to supply various amounts of its export commodity. As the definition indicates, offer curves incorporate elements of both demand and supply. Alternatively, we can say that the offer curve of a nation shows the nation's willingness to import and export at various relative commodity prices.

The offer curve of a nation can be derived rather easily and somewhat informally from the nation's production frontier, its indifference map, and the various hypothetical relative commodity prices at which trade could take place. The formal derivation of offer curves presented in the appendix is based on the work of *James Meade*, another British economist and Nobel Prize winner.

4.3B Derivation and Shape of the Offer Curve of Nation 1

In the left panel of Figure 4.3, Nation 1 starts at the no-trade (or autarky) point A, as in Figure 3.3. If trade takes place at $P_B = P_X/P_Y = 1$, Nation 1 moves to point B in production, trades 60X for 60Y with Nation 2, and reaches point E on its indifference curve III. (So far this is exactly the same as in Figure 3.4.) This gives point E in the right panel of Figure 4.3.

At $P_F = P_X/P_Y = \frac{1}{2}$ (see the left panel of Figure 4.3), Nation 1 would move instead from point A to point F in production, exchange 40X for 20Y with Nation 2, and reach point H on its indifference curve II. This gives point H in the right panel. Joining the origin with points H and E and other points similarly obtained, we generate Nation 1's offer curve in the right panel. The offer curve of Nation 1 shows how many imports of commodity Y Nation 1 requires to be willing to export various quantities of commodity X.

To keep the left panel simple, we omitted the autarky price line $P_A = \frac{1}{4}$ and indifference curve I tangent to the production frontier and P_A at point A. Note that P_A, P_F, and P_B in the right panel refer to the same P_X/P_Y as P_A, P_F, and P_B in the left panel because they refer to the same *absolute* slope.

The offer curve of Nation 1 in the right panel of Figure 4.3 lies above the autarky price line of $P_A = \frac{1}{4}$ and bulges toward the X-axis, which measures the commodity of its comparative advantage and export. To induce Nation 1 to export more of commodity X, P_X/P_Y must rise. Thus, at $P_F = \frac{1}{2}$, Nation 1 would export 40X, and at $P_B = 1$, it would export 60X. There are two reasons for this: (1) Nation 1 incurs increasing opportunity costs in producing more of commodity X (for export), and (2) the more of commodity Y and the less of commodity X that Nation 1 consumes with trade, the more valuable to the nation is a unit of X at the margin compared with a unit of Y.

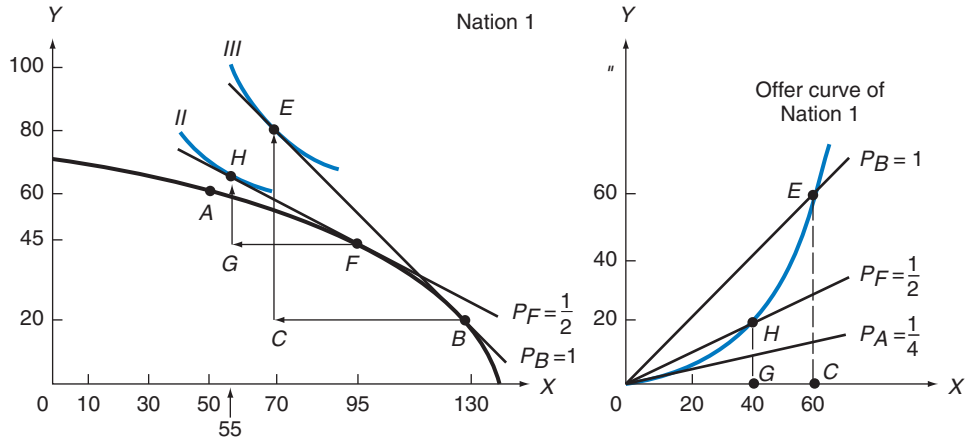

FIGURE 4.3. Derivation of the Offer Curve of Nation 1.
In the left panel, Nation 1 starts at pretrade-equilibrium point *A*. If trade takes place at $P_B = 1$, Nation 1 moves to point *B* in production, exchanges 60X for 60Y with Nation 2, and reaches point *E*. This gives point *E* in the right panel. At $P_F = \frac{1}{2}$ in the left panel, Nation 1 would move instead from point *A* to point *F* in production, exchange 40X for 20Y with Nation 2, and reach point *H*. This gives point *H* in the right panel. Joining the origin with points *H* and *E* in the right panel, we generate Nation 1's offer curve. This shows how many imports of commodity Y Nation 1 requires to be willing to export various quantities of commodity X.

4.3c Derivation and Shape of the Offer Curve of Nation 2

In the left panel of Figure 4.4, Nation 2 starts at the autarky equilibrium point A', as in Figure 3.3. If trade takes place at $P_{B'} = P_X/P_Y = 1$, Nation 2 moves to point B' in production, exchanges 60Y for 60X with Nation 1, and reaches point E' on its indifference curve III′. (So far this is exactly the same as in Figure 3.4.) Trade triangle $B'C'E'$ in the left panel of Figure 4.4 corresponds to trade triangle $O'C'E'$ in the right panel, and we get point E' on Nation 2's offer curve.

At $P_{F'} = P_X/P_Y = 2$ in the left panel, Nation 2 would move instead to point F' in production, exchange 40Y for 20X with Nation 1, and reach point H' on its indifference curve II′. Trade triangle $F'G'H'$ in the left panel corresponds to trade triangle $O'G'H'$ in the right panel, and we get point H' on Nation 2's offer curve. Joining the origin with points H' and E' and other points similarly obtained, we generate Nation 2's offer curve in the right panel. The offer curve of Nation 2 shows how many imports of commodity X Nation 2 demands to be willing to export various quantities of commodity Y.

Once again, we omitted the autarky price line $P_{A'} = 4$ and indifference curve I′ tangent to the production frontier and $P_{A'}$ at point A'. Note that $P_{A'}$, $P_{F'}$, and $P_{B'}$ in the right panel refer to the same P_X/P_Y as $P_{A'}$, $P_{F'}$, and $P_{B'}$ in the left panel because they refer to the same *absolute* slope.

The offer curve of Nation 2 in the right panel of Figure 4.4 lies *below* its autarky price line of $P_{A'} = 4$ and bulges toward the Y-axis, which measures the commodity of its comparative advantage and export. To induce Nation 2 to export more of commodity Y, the

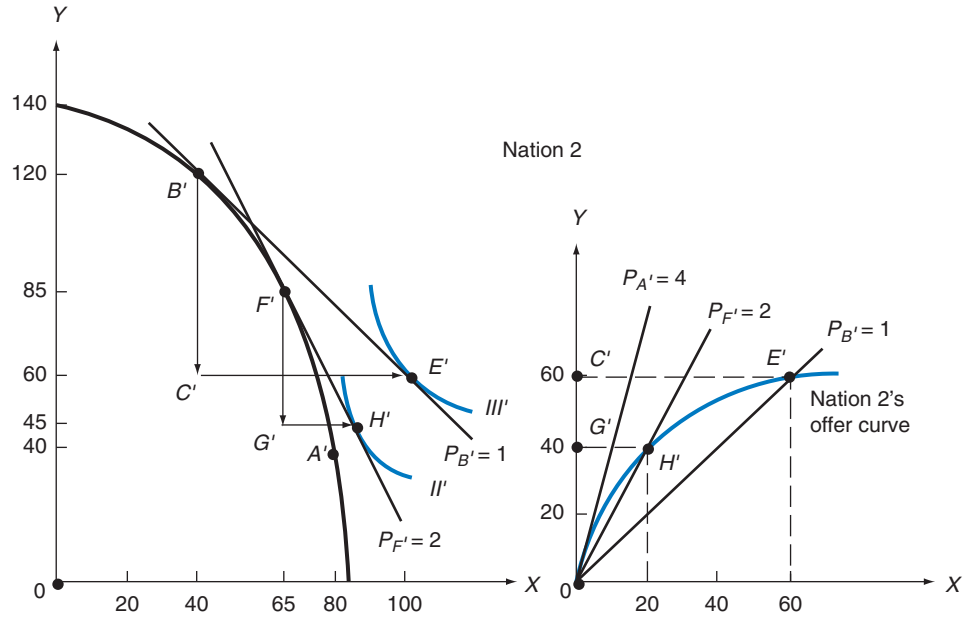

FIGURE 4.4. Derivation of the Offer Curve of Nation 2.
In the left panel, Nation 2 starts at pretrade equilibrium point A'. If trade takes place at $P_{B'} = 1$, Nation 2 moves to point B' in production, exchanges 60Y for 60X with Nation 1, and reaches point E'. This gives point E' in the right panel. At $P_{F'} = 2$ in the left panel, Nation 2 would move instead from A' to F' in production, exchange 40Y for 20X with Nation 1, and reach H'. This gives point H' in the right panel. Joining the origin with points H' and E' in the right panel, we generate Nation 2's offer curve. This shows how many imports of commodity X Nation 2 demands to be willing to supply various amounts of commodity Y for export.

relative price of Y must rise. This means that its reciprocal (i.e., P_X/P_Y) must fall. Thus, at $P_{F'} = 2$, Nation 2 would export 40Y, and at $P_{B'} = 1$, it would export 60Y. Nation 2 requires a higher relative price of Y to be induced to export more of Y because (1) Nation 2 incurs increasing opportunity costs in producing more of commodity Y (for export), and (2) the more of commodity X and the less of commodity Y that Nation 2 consumes with trade, the more valuable to the nation is a unit of Y at the margin compared with a unit of X.

4.4 The Equilibrium-Relative Commodity Price with Trade—General Equilibrium Analysis

The intersection of the offer curves of the two nations defines the equilibrium-relative commodity price at which trade takes place between them. Only at this equilibrium price will trade be balanced between the two nations. At any other relative commodity price, the *desired* quantities of imports and exports of the two commodities would not be equal. This would put pressure on the relative commodity price to move toward its equilibrium level. This is shown in Figure 4.5.

The offer curves of Nation 1 and Nation 2 in Figure 4.5 are those derived in Figures 4.3 and 4.4. These two offer curves intersect at point E, defining equilibrium $P_X/P_Y = P_B = P_{B'} = 1$. At P_B, Nation 1 offers 60X for 60Y (point E on Nation 1's offer curve), and Nation 2 offers exactly 60Y for 60X (point E' on Nation 2's offer curve). Thus, trade is in equilibrium at P_B.

At any other P_X/P_Y, trade would not be in equilibrium. For example, at $P_F = \frac{1}{2}$, the 40X that Nation 1 would export (see point H in Figure 4.5) would fall short of the imports of commodity X demanded by Nation 2 at this relatively low price of X. (This is given by a point, not shown in Figure 4.5, where the extended price line P_F crosses the extended offer curve of Nation 2.)

The excess import demand for commodity X at $P_F = \frac{1}{2}$ by Nation 2 tends to drive P_X/P_Y up. As this occurs, Nation 1 will supply more of commodity X for export (i.e., Nation 1 will move up its offer curve), while Nation 2 will reduce its import demand for commodity X (i.e., Nation 2 will move down its offer curve). This will continue until supply and demand become equal at P_B. The pressure for P_F to move toward P_B could also be explained in terms of commodity Y and arises at any other P_X/P_Y, such as $P_F \neq P_B$.

Note that the equilibrium-relative commodity price of $P_B = 1$ with trade (determined in Figure 4.5 by the intersection of the offer curves of Nation 1 and Nation 2) is identical to that found by trial and error in Figure 3.4. At $P_B = 1$, both nations happen to gain equally from trade (refer to Figure 3.4).

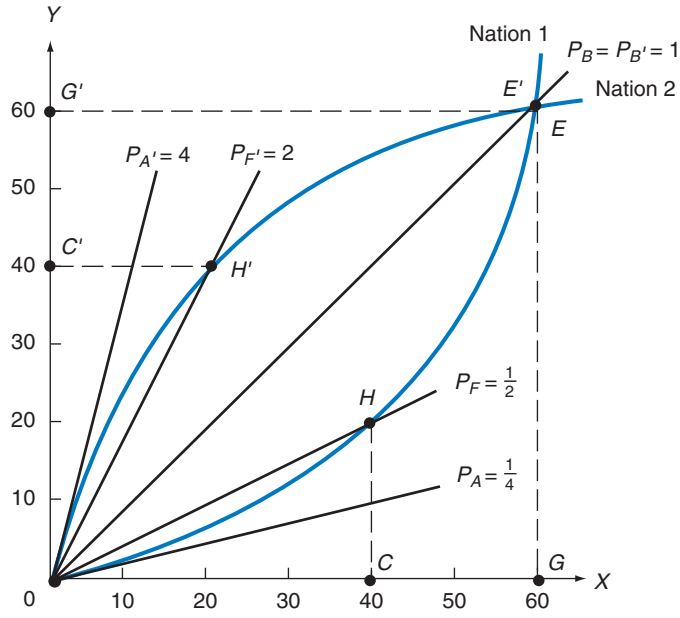

FIGURE 4.5. Equilibrium-Relative Commodity Price with Trade.
The offer curves of Nation 1 and Nation 2 are those of Figures 4.3 and 4.4. The offer curves intersect at point E, defining the equilibrium-relative commodity price $P_B = 1$. At P_B, trade is in equilibrium because Nation 1 offers to exchange 60X for 60Y and Nation 2 offers exactly 60Y for 60X. At any $P_X/P_Y < 1$, the quantity of exports of commodity X supplied by Nation 1 would fall short of the quantity of imports of commodity X demanded by Nation 2. This would drive the relative commodity price up to the equilibrium level. The opposite would be true at $P_X/P_Y > 1$.

4.5 Relationship between General and Partial Equilibrium Analyses

We can also illustrate equilibrium for our two nations with demand and supply curves and thus show the relationship between the general equilibrium analysis of Section 4.4 and the partial equilibrium analysis of Section 4.2. This is shown with Figure 4.6.

In Figure 4.6, S is Nation 1's supply curve of exports of commodity X and is derived from Nation 1's production frontier and indifference map in the left panel of Figure 4.3 (the same information from which Nation 1's offer curve in the right panel of Figure 4.3 is derived). Specifically, S shows that the quantity supplied of exports of commodity X by Nation 1 is zero (point A) at $P_X/P_Y = \frac{1}{4}$, 40 (point H) at $P_X/P_Y = \frac{1}{2}$, and 60 (point E) at $P_X/P_Y = 1$ *(as indicated in the left panel of Figure 4.3 and on Nation 1's offer curve in the right panel of Figure 4.3)*. The export of 70X by Nation 1 at $P_X/P_Y = 1\frac{1}{2}$ (point R on the S curve in Figure 4.6) can similarly be obtained from the left panel of Figure 4.3 and is shown as point R on Nation 1's offer curve in Figure 4.9 in Appendix A4.3.

On the other hand, D refers to Nation 2's demand for Nation 1's exports of commodity X and is derived from Nation 2's production frontier and indifference map in the left panel of Figure 4.4 (the same information from which Nation 2's offer curve in the right panel of Figure 4.4 is derived). Specifically, D in Figure 4.6 shows that the quantity demanded of Nation 1's exports of commodity X by Nation 2 is 60 (point E) at $P_X/P_Y = 1$ (as in the left panel of Figure 4.4), 120 (point H') at $P_X/P_Y = \frac{1}{2}$, but 40 (point R') at $P_X/P_Y = 1\frac{1}{2}$.

D and S intersect at point E in Figure 4.6, determining the equilibrium $P_X/P_Y = 1$ and the equilibrium quantity of exports of 60X (as in Figure 4.5). Figure 4.6 shows that at

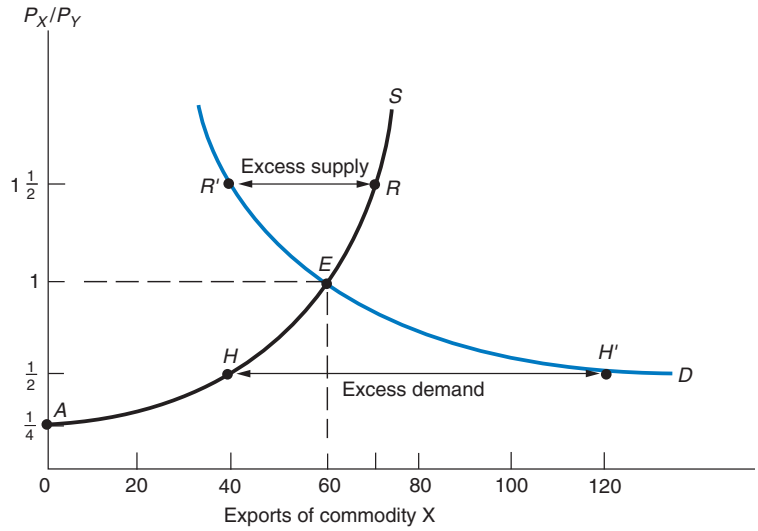

FIGURE 4.6. Equilibrium-Relative Commodity Price with Partial Equilibrium Analysis.
S refers to Nation 1's supply curve of exports of commodity X, while D refers to Nation 2's demand curve for Nation 1's exports of commodity X. S and D are derived from the left panel of Figures 4.3 and 4.4, and show the same basic information as Figure 4.5. D and S intersect at point E, determining the equilibrium $P_X/P_Y = 1$ and the equilibrium quantity of exports of 60X. At $P_X/P_Y = 1\frac{1}{2}$, there is an excess supply of exports of $R'R = 30$X, and P_X/P_Y falls toward equilibrium $P_X/P_Y = 1$. At $P_X/P_Y = \frac{1}{2}$, there is an excess demand of exports of $HH' = 80$X, and P_X/P_Y rises toward $P_X/P_Y = 1$.

$P_X/P_Y = 1\frac{1}{2}$ there is an excess supply of exports of $R'R = 30$X, and P_X/P_Y falls toward equilibrium $P_X/P_Y = 1$. On the other hand, at $P_X/P_Y = \frac{1}{2}$, there is an excess demand of exports of $HH' = 80$X, and P_X/P_Y rises toward $P_X/P_Y = 1$. Thus, the relative price of X gravitates toward the equilibrium price of $P_X/P_Y = 1$, given by point E in Figure 4.6 (the same as in Figure 4.5). The same conclusion would be reached in terms of Y (see Problem 8, with answer at www.wiley.com/college/salvatore).

If, on the other hand, Nation 2 were small, its demand curve for Nation 1's exports of commodity X would intersect the horizontal portion of Nation 1's supply curve of exports of commodity X (near the vertical axis). In that case, Nation 2 would trade at the pretrade price of $P_X/P_Y = \frac{1}{4}$ in Nation 1, and Nation 2 would receive all of the gains from trade. (This could also be shown with offer curves; see Problem 10, with the answer on the Web.)

Going back to our Figure 4.6, we see that it shows the same basic information as Figure 4.5, and both are derived from the nations' production frontiers and indifference maps. There is a basic difference, however, between the two figures. Figure 4.5 refers to general equilibrium analysis and considers all markets together, not just the market for commodity X. This is important because changes in the market for commodity X affect other markets, and these may give rise to important repercussions on the market for commodity X itself. On the other hand, the partial equilibrium analysis of Figure 4.6, which utilizes D and S curves, does not consider these repercussions and the connections that exist between the market for commodity X and the market for all other commodities in the economy. Partial equilibrium analysis is often useful as a first approximation, but for the complete and full answer, the more difficult general equilibrium analysis is usually required.

4.6 The Terms of Trade

In this section, we define the terms of trade of each nation and illustrate their measurement. We also discuss the meaning of a change in a nation's terms of trade. Finally, we pause to take stock of what we have accomplished up to this point and examine the usefulness of our trade model.

4.6A Definition and Measurement of the Terms of Trade

The **terms of trade** of a nation are defined as the ratio of the price of its export commodity to the price of its import commodity. Since in a two-nation world, the exports of a nation are the imports of its trade partner, the terms of trade of the latter are equal to the inverse, or reciprocal, of the terms of trade of the former.

In a world of many (rather than just two) traded commodities, the terms of trade of a nation are given by the ratio of the price *index* of its exports to the price *index* of its imports. This ratio is usually multiplied by 100 in order to express the terms of trade in percentages. These terms of trade are often referred to as the **commodity or net barter terms of trade** to distinguish them from other measures of the terms of trade presented in Chapter 11 in connection with trade and development.

As supply and demand considerations change over time, offer curves will shift, changing the volume and the terms of trade. This matter will be examined in Chapter 7, which deals with growth and change, and international trade. An improvement in a nation's terms of trade is usually regarded as beneficial to the nation in the sense that the prices that the nation receives for its exports rise relative to the prices that it pays for imports.

4.6B Illustration of the Terms of Trade

Since Nation 1 exports commodity X and imports commodity Y, the terms of trade of Nation 1 are given by P_X/P_Y. From Figure 4.5, these are $P_X/P_Y = P_B = 1$ or 100 (in percentages). If Nation 1 exported and imported many commodities, P_X would be the *index* of its export prices, and P_Y would be the *index* of its import prices.

Since Nation 2 exports commodity Y and imports commodity X, the terms of trade of Nation 2 are given by P_Y/P_X. Note that this is the inverse, or reciprocal, of Nation 1's terms of trade and also equals 1 or 100 (in percentages) in this case.

If through time the terms of trade of Nation 1 rose, say, from 100 to 120, this would mean that Nation 1's export prices rose 20 percent in relation to its import prices. This would also mean that Nation 2's terms of trade have deteriorated from 100 to (100/120)100 = 83. Note that we can always set a nation's terms of trade equal to 100 in the base period, so that changes in its terms of trade over time can be measured in percentages.

Even if Nation 1's terms of trade improve over time, we cannot conclude that Nation 1 is *necessarily* better off because of this, or that Nation 2 is necessarily worse off because of the deterioration in its terms of trade. Changes in a nation's terms of trade are the result of many forces at work both in that nation and in the rest of the world, and we cannot determine their net effect on a nation's welfare by simply looking at the change in the nation's terms of trade. To answer this question, we need more information and analysis, and we will postpone that until Chapter 11. Case Study 4-3 shows the terms of trade of

CASE STUDY 4-3 The Terms of Trade of the G-7 Countries

Table 4.2 gives the terms of trade of the Group of 7 largest advanced countries (G-7) for selected years from 1972 to 2011. The terms of trade were measured by dividing the index of export unit value by the index of import unit value, taking 2000 as 100. Table 4.2 shows that the terms of trade of the G-7 countries fluctuated very widely over the years and were much lower in 2011 than in 1972 for the United States, Germany, and especially Japan; a little lower for the United Kingdom, France, and Italy; and much higher in the past decade for Canada (primarily because of the sharp increase in the price of petroleum and of other primary commodities, of which Canada is a major exporter).

TABLE 4.2. The Terms of Trade of the G-7 Countries, Selected Years, 1972–2011 (Export Unit Value ÷ Import Unit Value; 2000 = 100)

	1972	1974	1980	1985	1990	1995	2000	2005	2010	2011	% Change 1972–2011
United States	127	107	90	103	101	103	100	97	97	95	−29
Canada	96	109	107	94	97	97	100	117	120	122	24
Japan	109	81	59	66	84	115	100	83	68	60	−58
Germany	118	105	98	94	110	108	100	105	103	99	−18
United Kingdom	107	82	103	102	101	100	100	105	103	103	−4
France	101	89	90	89	100	107	100	111	100*	100*	−1*
Italy	106	80	78	78	94	96	100	101	99	96	−10

*refers to 2008

Source: Elaborated from data in International Monetary Fund, *International Financial Statistics* (Washington, D.C.: IMF, various issues).

CASE STUDY 4-4 The Terms of Trade of Advanced and Developing Countries

Table 4.3 gives the terms of trade of advanced countries and developing countries as a whole, as well as for African, Asian, European, Middle Eastern, and Western Hemispheric developing countries for selected years from 1972 to 2010. The terms of trade were measured by dividing the index of export unit value by the index of import unit value, with 2000 as 100.

Table 4.3 shows that the terms of trade of advanced countries declined from 1972 to 1985 but then rose until 1995, and they were 98 in 2010, as compared with 110 in 1972. For developing countries, the terms of trade rose sharply from 1972 to 1980 primarily as a result of the very sharp increase in the terms of trade of Western Hemispheric countries, but they then declined until 1985 and they were 102 in 2010, as compared with 61 in 1972. The terms of trade of Africa increased from 85 in 1972 to 108 in 2005 (more recent data were not available). From 1972 to 2010, the terms of trade rose for Asia from 101 to 104 and declined for European developing countries from 112 to 95. The term of trade rose sharply for the Western Hemispheric countries from 39 in 1972 to 92 in 2010 and for the Middle East from 94 in 1972 to 167 in 2007 (more recent data were not available).

Although the terms of trade of industrial and developing countries reflected to a large extent the large fluctuations in the price of petroleum over the period examined, other forces were also clearly at work (note, for example, that the largest fluctuation was in the terms of trade of the Western Hemispheric countries, whose exports were mostly nonpetroleum and that the terms of trade of the Middle East as a whole declined between 1972 and 1974 because many Middle Eastern countries did not export petroleum). A detailed analysis and data of the forces that determine the terms of trade of developing countries are presented in Chapter 10.

TABLE 4.3. The Terms of Trade of Advanced and Developing Countries, Selected Years, 1972–2010 (Export Unit Value ÷ Import Unit Value; 2000 = 100)

	1972	1974	1980	1985	1990	1995	2000	2005	2010
Industrial countries	110	97	89	87	100	105	100	101	98
Developing countries	61	86	107	101	103	102	100	99	102
Africa	85	118	117	115	100	103	100	108	—
Asia	101	101	101	98	103	107	100	92	104
Europe	112	101	69	64	69	106	100	102	95
Middle East	94	75	90	80	109	68	100	140	167*
Western Hemisphere	39	110	194	189	130	107	100	104	92

*refers to 2007

Source: International Monetary Fund, *International Financial Statistics* (Washington, D.C.: IMF, various issues).

the G-7 countries, and Case Study 4-4 gives the terms of trade of advanced and developing countries for selected years over the 1972–2010 period.

4.6c Usefulness of the Model

The trade model presented thus far summarizes clearly and concisely a remarkable amount of useful information and analysis. It shows the conditions of production, or supply, in the two nations, the tastes, or demand preferences, the autarky point of production and

consumption, the equilibrium-relative commodity price in the absence of trade, and the comparative advantage of each nation (refer to Figure 3.3). It also shows the degree of specialization in production with trade, the volume of trade, the terms of trade, the gains from trade, and the share of these gains going to each of the trading nations (see Figures 3.5 and 4.5).

Because it deals with only two nations (Nation 1 and Nation 2), two commodities (X and Y), and two factors (labor and capital), our trade model is a completely **general equilibrium model**. It can be used to examine how a change in demand and/or supply conditions in a nation would affect the terms of trade, the volume of trade, and the share of the gains from trade in each nation. This is done in Chapter 7.

Before doing that, however, our trade model must be extended in two important directions: (1) to identify the *basis* for (i.e., what determines) comparative advantage and (2) to examine the effect of international trade on the returns, or earnings, of resources or factors of production in the two trading nations. This is done in the next chapter.

SUMMARY

1. In this chapter, we derived the demand for imports and the supply of exports of the traded commodity, as well as the offer curves for the two nations, and used them to determine the equilibrium volume of trade and the equilibrium-relative commodity price at which trade takes place between the two nations. The results obtained here confirm those reached in Chapter 3 by a process of trial and error.

2. The excess supply of a commodity above the no-trade equilibrium price gives one nation's export supply of the commodity. On the other hand, the excess demand of a commodity below the no-trade equilibrium price gives the other nation's import demand for the commodity. The intersection of the demand curve for imports and the supply curve for exports of the commodity defines the partial equilibrium-relative price and quantity of the commodity at which trade takes place.

3. The offer curve of a nation shows how much of its import commodity the nation demands to be willing to supply various amounts of its export commodity. The offer curve of a nation can be derived from its production frontier, its indifference map, and the various relative commodity prices at which trade could take place. The offer curve of each nation bends toward the axis measuring the commodity of its comparative advantage. The offer curves of two nations will lie between their pretrade, or autarky, relative commodity prices. To induce a nation to export more of a commodity, the relative price of the commodity must rise.

4. The intersection of the offer curves of two nations defines the equilibrium-relative commodity price at which trade takes place between them. Only at this equilibrium price will trade be balanced. At any other relative commodity price, the desired quantities of imports and exports of the two commodities would not be equal. This would put pressure on the relative commodity price to move toward its equilibrium level.

5. We can also illustrate the equilibrium-relative commodity price and quantity with trade with partial equilibrium analysis. This makes use of the demand and supply curves for the traded commodities. These are derived from the nations' production frontiers and indifference maps—the same basic information from which the nations' offer curves (which are used in general equilibrium analysis) are derived.

6. The terms of trade of a nation are defined as the ratio of the price of its export commodity to the price of its import commodity. The terms of trade of the trade partner are then equal to the inverse, or reciprocal, of the terms of trade of the other nation. With more than two commodities traded, we use the index of export to import prices and multiply by 100 to express the terms of trade in percentages. Our trade model is a general equilibrium model except for the fact that it deals with only two nations, two commodities, and two factors.

A LOOK AHEAD

In Chapter 5, we extend our trade model in order to identify one of the most important determinants of the difference in the pretrade-relative commodity prices and the comparative advantage among nations. This also allows us to examine the effect that international trade has on the relative price and income of the various factors of production. Our trade model so extended is referred to as the *Heckscher–Ohlin model*. In Chapter 6, we present other more recent trade models.

KEY TERMS

Commodity or net barter terms of trade, p. 94
General equilibrium model, p. 97
Law of reciprocal demand, p. 104
Offer curves, p. 89
Reciprocal demand curves, p. 89
Terms of trade, p. 94
Trade indifference curve, p. 100

QUESTIONS FOR REVIEW

1. How can the supply curve of exports and the demand curve of imports of a commodity be derived from the total demand and supply curves of a commodity in the two nations?
2. How is the equilibrium-relative commodity price with trade determined with demand and supply curves?
3. What is the usefulness of offer curves? How are they related to the trade model of Figure 3.4?
4. What do offer curves show? How are they derived? What is their shape? What explains their shape?
5. How do offer curves define the equilibrium-relative commodity price at which trade takes place?
6. What are the forces that would push any nonequilibrium-relative commodity price toward the equilibrium level?
7. How is a nation's supply curve of its export commodity and demand for its import commodity derived from the nation's production frontier and indifference map?
8. Why does the use of demand and supply curves of the traded commodity refer to partial equilibrium analysis? In what way is partial equilibrium analysis of trade related to general equilibrium analysis?
9. Under what condition will trade take place at the pretrade-relative commodity price in one of the nations?
10. What do the terms of trade measure? What is the relationship between the terms of trade in a world of two trading nations? How are the terms of trade measured in a world of more than two traded commodities?
11. What does an improvement in a nation's terms of trade mean? What effect does this have on the nation's welfare?
12. In what way does our trade model represent a general equilibrium model? In what way does it not? In what ways does our trade model require further extension?

PROBLEMS

1. Show graphically how the equilibrium-relative commodity price of commodity Y with trade can be derived from Figure 4.1.
2. Without looking at the text, derive a nation's offer curve from its production frontier, its indifference map, and two relative commodity prices at which

trade could take place (i.e., sketch a figure similar to Figure 4.3).

3. Do the same as Problem 2 for the trade partner (i.e., sketch a figure similar to Figure 4.4).

4. Bring together on another graph the offer curves that you derived in Problems 2 and 3 and determine the equilibrium-relative commodity prices at which trade would take place (i.e., sketch a figure similar to Figure 4.5).

5. In what way is a nation's offer curve similar to:

(a) a demand curve?

(b) a supply curve?

In what way is the offer curve *different* from the usual demand and supply curves?

***6.** Sketch a figure similar to Figure 4.5.

(a) Extend the $P_{F'}$ price line, and the offer curve of Nation 1 until they cross. (In extending it, let the offer curve of Nation 1 bend backward.)

(b) Using the figure you sketched, explain the forces that push $P_{F'}$ toward P_B in terms of commodity Y.

(c) What does the backward-bending (negatively sloped) segment of Nation 1's offer curve indicate?

7. To show how nations can share unequally in the benefits from trade:

(a) Sketch a figure showing the offer curve of a nation having a much greater curvature than the offer curve of its trade partner.

(b) Which nation gains more from trade, the nation with the greater offer curve or the one with the lesser curvature?

(c) Can you explain why?

***8.** From the left panel of Figure 4.4, derive Nation 2's supply curve of exports of commodity Y. From the left panel of Figure 4.3, derive Nation 1's demand curve for Nation 2's exports of commodity Y. Use the demand and supply curves that you derived to show how the equilibrium-relative commodity price of commodity Y with trade is determined.

9. **(a)** Why does the analysis in the answer to Problem 8 refer to partial equilibrium analysis?

(b) Why does the analysis of Figure 4.5 refer to general equilibrium analysis?

(c) What is the relationship between partial and general equilibrium analysis?

***10.** Draw the offer curves for Nation 1 and Nation 2, showing that Nation 2 is a small nation that trades at the pretrade-relative commodity prices in Nation 1. How are the gains from trade distributed between the two nations? Why?

11. Draw a figure showing the equilibrium point with trade for two nations that face constant opportunity costs.

12. Suppose that the terms of trade of a nation improved from 100 to 110 over a given period of time.

(a) By how much did the terms of trade of its trade partner deteriorate?

(b) In what sense can this be said to be unfavorable to the trade partner? Does this mean that the welfare of the trade partner has definitely declined?

13. It has often been said that OPEC (Organization of Petroleum Exporting Countries) operates as a cartel and is able to set petroleum prices by restricting supplies. Do you agree? Explain.

* = Answer provided at www.wiley.com/college/salvatore.

APPENDIX

This appendix presents the formal derivation of offer curves, using a technique perfected by James Meade. In Section A4.1, we derive a trade indifference curve for Nation 1, and in Section A4.2, its trade indifference map. In Section A4.3, Nation 1's offer curve is derived

from its trade indifference map and various relative commodity prices at which trade could take place. Section A4.4 outlines the derivation of Nation 2's offer curve in relation to Nation 1's offer curve. In Section A4.5, we present the complete general equilibrium model showing production, consumption, and trade in both nations simultaneously. Finally, in Section A4.6 we examine multiple and unstable equilibria.

A4.1 Derivation of a Trade Indifference Curve for Nation 1

The second (upper-left) quadrant of Figure 4.7 shows the familiar production frontier and community indifference curve I for Nation 1. The only difference between this and Figure 3.3 is that now the production frontier and community indifference curve I are in the second rather than the first quadrant, and quantities are measured from right to left instead of from left to right. (The reason for this will become evident in a moment.) As in Figure 3.3, Nation 1 is in equilibrium at point A in the absence of trade by producing and consuming 50X and 60Y.

Now let us slide Nation 1's production block, or frontier, along indifference curve I so that the production block remains tangent to indifference curve I and the commodity axes are kept parallel at all times. As we do this, the origin of the production block will trace out curve TI (see Figure 4.7). Point A^* is derived from the tangency at A, point B^* from the tangency at B, point W^* from the tangency at W (not shown to keep the figure simple), and point Z^* from the tangency at Z.

Curve TI is Nation 1's trade indifference curve, corresponding to its indifference curve I. TI shows the various trade situations that would keep Nation 1 at the same level of welfare as in the initial no-trade situation. For example, Nation 1 is as well off at point A as at point B, since both points A and B are on the same community indifference curve I. However, at point A, Nation 1 produces and consumes 50X and 60Y without trade. At point B, Nation 1 would produce 130X and 20Y (with reference to the origin at B^*) and consume 30X and 70Y (with reference to the origin at O or A^*) by exporting 100X in exchange for 50Y (see the figure).

Thus, a **trade indifference curve** shows the various trade situations that provide a nation equal welfare. The level of welfare shown by a trade indifference curve is given by the community indifference curve, from which the trade indifference curve is derived. Also note that the slope of the trade indifference curve at any point is equal to the slope at the corresponding point on the community indifference curve from which the trade indifference curve is derived.

A4.2 Derivation of Nation 1's Trade Indifference Map

There is one trade indifference curve for each community indifference curve. Higher community indifference curves (reflecting greater national welfare) will give higher trade indifference curves. Thus, a nation's *trade* indifference map can be derived from its *community* indifference curve map.

Figure 4.8 shows the derivation of trade indifference curve TI from community indifference curve I (as in Figure 4.7) and the derivation of trade indifference curve $TIII$ from

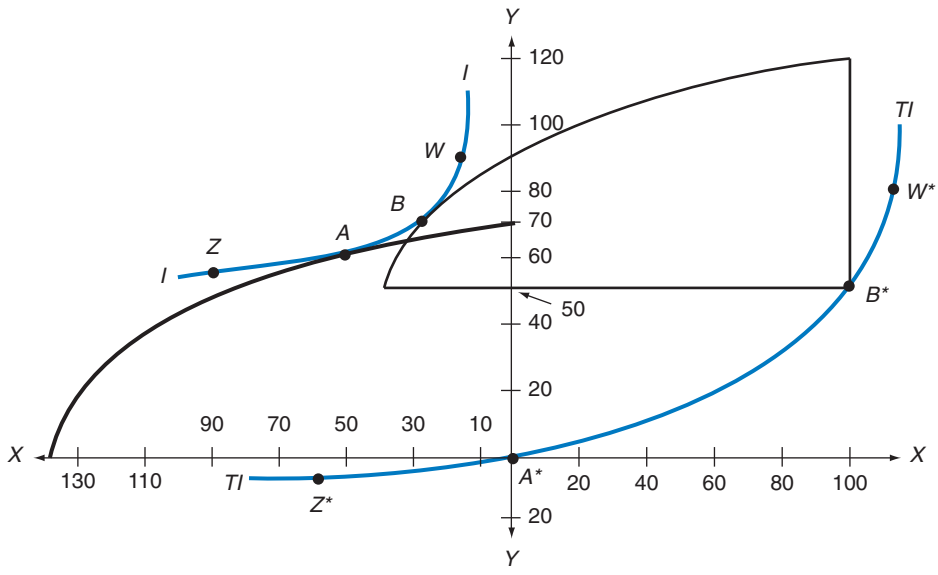

FIGURE 4.7. Derivation of a Trade Indifference Curve for Nation 1.
Trade indifference curve TI is derived by sliding Nation 1's production frontier, or block, along its indifference curve I so that the production block remains tangent to indifference curve I and the commodity axes are kept parallel at all times. As we do this, the *origin* of the production block will trace out TI. This shows the various *trade* situations that would keep Nation 1 at the same level of welfare as in the initial no-trade situation (given by point *A* on indifference curve I).

community indifference curve *III* for Nation 1. Note that community indifference *curve III* is the one shown in Figure 3.2. To reach community indifference curve *III* in Figure 4.8, the production block must be shifted up parallel to the axes until it is tangent to that community indifference curve. Thus, the tangency point J gives J^* on *TIII*. Tangency point E would give E^* on *TIII*, and so on.

Figure 4.8 shows only the derivation of *TI* and *TIII* (to keep the figure simple). However, for each indifference curve for Nation 1, we could derive the corresponding trade indifference curve and obtain the entire trade indifference map of Nation 1.

A4.3 Formal Derivation of Nation 1's Offer Curve

A nation's offer curve is the locus of tangencies of the relative commodity price lines at which trade could take place with the nation's trade indifference curves. The formal derivation of Nation 1's offer curve is shown in Figure 4.9.

In Figure 4.9, *TI* and *TII* are Nation 1's trade indifference curves, derived from its production block and community indifference curves, as illustrated in Figure 4.8. Lines P_A, P_F, P_B, P_F', and P_A' from the origin refer to relative prices of commodity X at which trade could take place (as in Figure 4.5).

Joining the origin with tangency points *H, E, R, S*, and *T* gives Nation 1's offer curve. This is the same offer curve that we derived with a simpler technique in Figure 4.3. The only

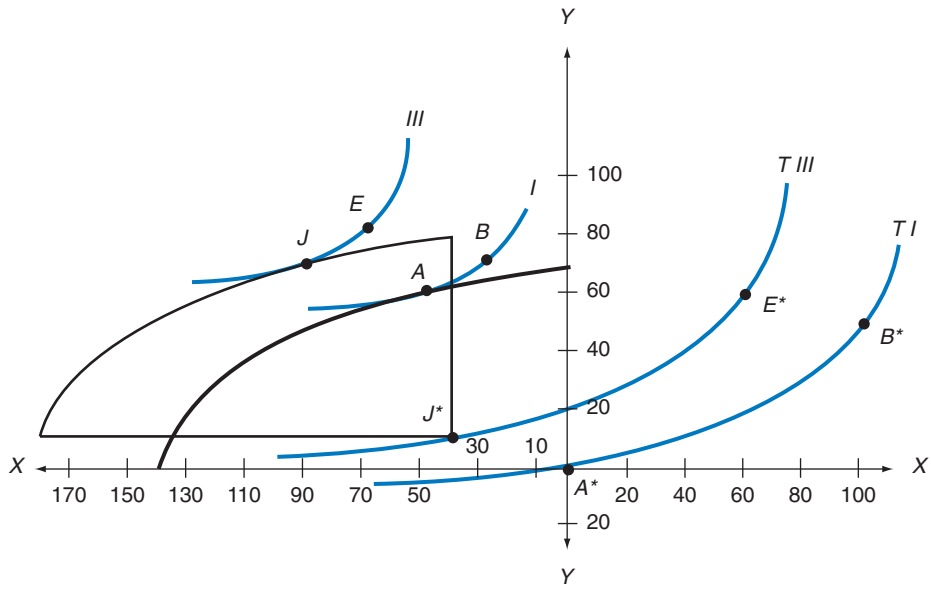

FIGURE 4.8. Derivation of Nation 1's Trade Indifference Map.
Trade indifference curve TI is derived from Nation 1's indifference curve I, as shown in Figure 4.7. Trade indifference curve TIII is similarly derived by sliding Nation 1's production block along its indifference curve III while keeping the axes always parallel. Higher community indifference curve III gives higher trade indifference curve TIII. For each indifference curve, we could derive the corresponding trade indifference curve and obtain the entire trade indifference map of Nation 1.

difference is that now we have derived the top and backward-bending portion of Nation 1's offer curve as well. As defined earlier, Nation 1's offer curve shows the amount of imports of commodity Y that Nation 1 demands to be willing to supply various amounts of commodity X for export. Note that the greater Nation 1's terms of trade are, the higher is the trade indifference curve reached and the greater is Nation 1's welfare.

From Figure 4.9, we can see that as its terms of trade rise from $P_A = \frac{1}{4}$ to $P_M = 1\frac{1}{2}$, Nation 1 offers more and more exports of commodity X in exchange for more and more imports of commodity Y. At point R, Nation 1 offers the maximum amount of 70X for export. Past point R, Nation 1 will only export less and less of commodity X in exchange for more and more imports of commodity Y. The reason for the backward bend in Nation 1's offer curve past point R is generally the same as the reason (discussed in Section 4.3B) that gives the offer curve its shape and curvature before the bend. Past point R, the opportunity cost of X has risen so much and the marginal rate of substitution of X for Y has fallen so much that Nation 1 is only willing to offer less and less of X for more and more of Y.

The shape of Nation 1's offer curve can also be explained in terms of the substitution and income effects on Nation 1's *home demand* for commodity X. As P_X/P_Y rises, Nation 1 tends to produce more of commodity X and demand less of it. As a result, Nation 1 has more of commodity X available for export. At the same time, as P_X/P_Y rises, the income of Nation 1 tends to rise (because it exports commodity X), and when income rises, more of every normal good is demanded in Nation 1, including commodity X. Thus, by itself, the income effect tends to reduce the amount of commodity X available to Nation 1 for export,

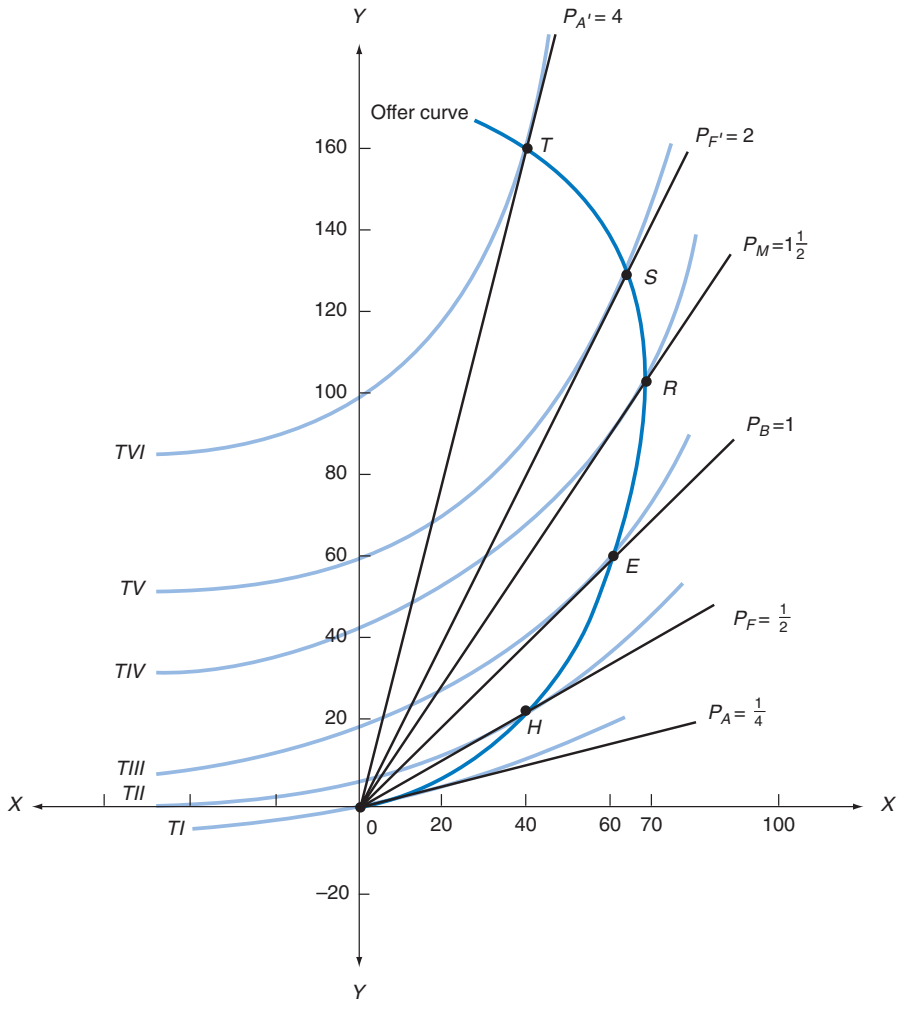

FIGURE 4.9. Formal Derivation of Nation 1's Offer Curve.
Curves TI to TIII are Nation 1's trade indifference curves, derived from its production block and community indifference curves, as illustrated in Figure 4.8. Lines P_A, P_F, P_B, P_M', P_F', and P_A' from the origin refer to relative prices of commodity X at which trade could take place. Joining the origin with tangency points of price lines with trade indifference curves gives Nation 1's offer curve. This is elastic up to point *R*, unitary elastic at point *R*, and inelastic over its backward-bending portion.

while the substitution effect tends to increase it. These effects operate simultaneously. Up to $P_X/P_Y = 1\frac{1}{2}$ (i.e., up to point *R*), the substitution effect overwhelms the opposite income effect, and Nation 1 supplies more of commodity X for export. At $P_X/P_Y > 1\frac{1}{2}$, the income effect overwhelms the opposite substitution effect, and Nation 1 supplies less of commodity X for export (i.e., Nation 1's offer curve bends backward).

Note that Nation 1's offer curve also represents its demand for imports of commodity Y, *not in terms of the price of imports (as along a usual demand curve), but in terms of total expenditures in terms of the nation's exports of commodity X*. As Nation 1's terms of trade

rise (and P_Y/P_X falls) so that it demands more imported Y, its expenditures in terms of commodity X rise up to point R, reach the maximum at point R, and fall past R. Thus, the nation's offer curve is elastic up to point R, unitary elastic at point R, and inelastic past point R.

We can now understand (at least intuitively) why the nation with the weaker or less intense demand for the other nation's export commodity has an offer curve with a greater curvature (i.e., less elasticity) and gains more from trade than the nation with the stronger or more intense demand (refer to Problem 5).

This is sometimes referred to as the **law of reciprocal demand**, first expounded numerically by *John Stuart Mill* (another British classical economist) and subsequently generalized and visualized with offer curves, or reciprocal demand curves.

Problem Starting with Nation 1's offer curve, the more advanced student should attempt to sketch (a) Nation 1's demand curve for imports of commodity Y (with P_Y/P_X along the vertical axis) and (b) Nation 1's supply curve for exports of commodity X (with P_X/P_Y along the vertical axis).

A4.4 Outline of the Formal Derivation of Nation 2's Offer Curve

Nation 2's offer curve can be formally derived in a completely analogous way from its trade indifference map and the various relative commodity prices at which trade could take place. This is outlined in Figure 4.10 without repeating the entire process.

Quadrant 2 of Figure 4.10 shows Nation 1's production frontier, or block, and indifference curves I and III, while quadrant 4 shows the same things for Nation 2. Nation 2's production frontier and indifference curves are placed in quadrant 4 so that its offer curve will be derived in the proper relationship to Nation 1's offer curve in quadrant 1.

Nation 1's offer curve in quadrant 1 of Figure 4.10 was derived from its trade indifference map in Figure 4.9. Note that Nation 1's offer curve bends in the same direction as its community indifference curves. In a completely analogous way, Nation 2's offer curve in quadrant 1 of Figure 4.10 can be derived from its trade indifference map and bends in the same direction as its community indifference curves in quadrant 4.

The offer curves of Nation 1 and Nation 2 in quadrant 1 of Figure 4.10 are the offer curves of Figure 4.5 and define the equilibrium-relative commodity price of $P_B = 1$ at their intersection. As will be seen in the next section, only at point E does general equilibrium exist.

Problem Draw a figure showing Nation 2's trade indifference curves that would give its offer curve, including its backward-bending portion.

A4.5 General Equilibrium of Production, Consumption, and Trade

Figure 4.11 brings together in one diagram all the information about production, consumption, and trade for the two nations in equilibrium. The production blocks of Nation 1 and Nation 2 are joined at point E^* (the same as point E in Figure 4.10), where the offer curves of the two nations cross.

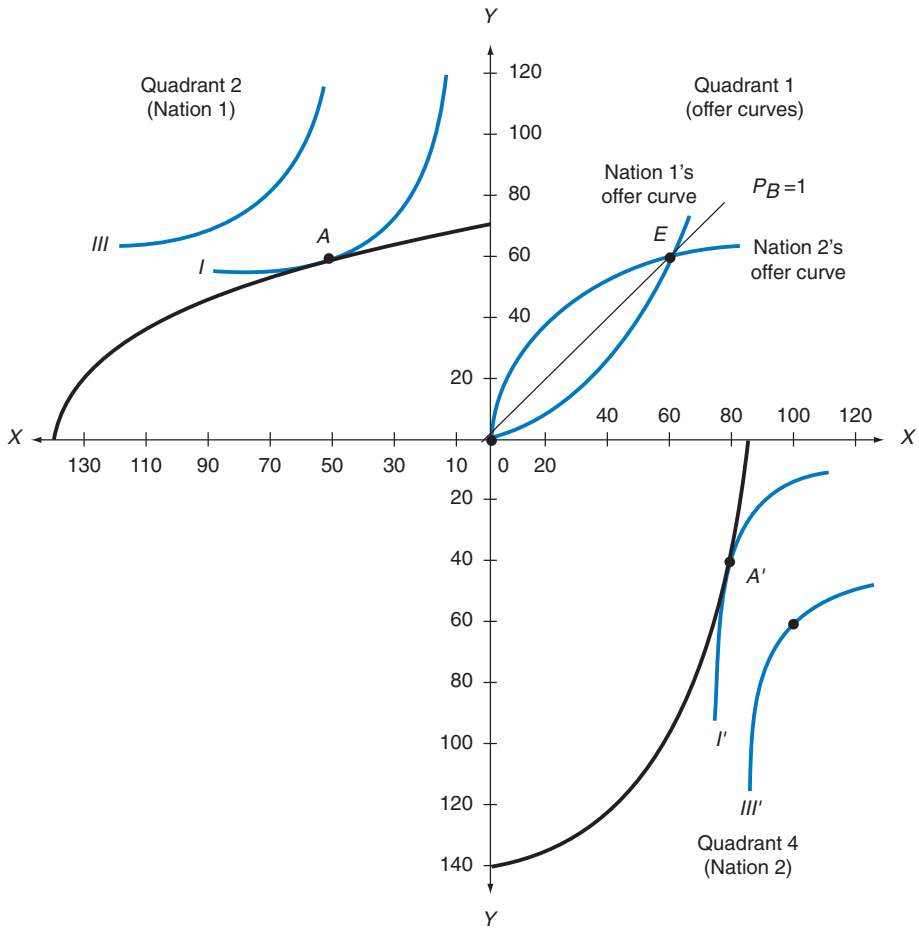

FIGURE 4.10. Outline of the Formal Derivation of Nation 2's Offer Curve.
Nation 2's offer curve can be formally derived from its trade indifference map and the various relative commodity prices at which trade could take place, as was done for Nation 1. This is simply outlined here without repeating the entire process. Thus, Nation 1's offer curve in quadrant 1 is derived from its production block and indifference curves in quadrant 2 and bends in the same direction as its indifference curves. Nation 2's offer curve in quadrant 1 could similarly be derived from its production block and indifference curves in quadrant 4 and bends in the same direction as its indifference curves.

With trade, Nation 1 produces 130X and 20Y (point E with reference to point E^*) and consumes 70X and 80Y (the same point E but with reference to the origin, O) by exchanging 60X and 60Y with Nation 2. On the other hand, Nation 2 produces 40X and 120Y (point E' with reference to point E^*) and consumes 100X and 60Y (the same point E' but with reference to the origin) by exchanging 60Y for 60X with Nation 1.

International trade is in equilibrium with 60X exchanged for 60Y at $P_B = 1$. This is shown by the intersection of offer curves 1 and 2 at point E^*. $P_B = 1$ is also the relative commodity price of X prevailing *domestically* in Nations 1 and 2 (see the relative price line tangent to each nation's production blocks at points E and E', respectively). Thus, producers,

consumers, and traders in both nations all respond to the same set of equilibrium-relative commodity prices.

Note that point E on Nation 1's indifference curve III measures consumption in relation to the origin, O, while the same point E on Nation 1's production block measures production from point E^*. Finding Nation 1's indifference curve III tangent to its production block at point E seems different but is in fact entirely consistent and confirms the results of Figure 3.4 for Nation 1. The same is true for Nation 2.

Figure 4.11 summarizes and confirms all of our previous results and the conclusions of our trade model (compare, for example, Figure 4.11 with Figure 3.4). Thus, Figure 4.11 is a complete general equilibrium model (except for the fact that it deals with only two nations and two commodities). The figure is admittedly complicated. But this is because it summarizes in a single graph a tremendous amount of very useful information. Figure 4.11 is the pinnacle of the neoclassical trade model. The rewards of mastering it are great indeed in terms of future deeper understanding.

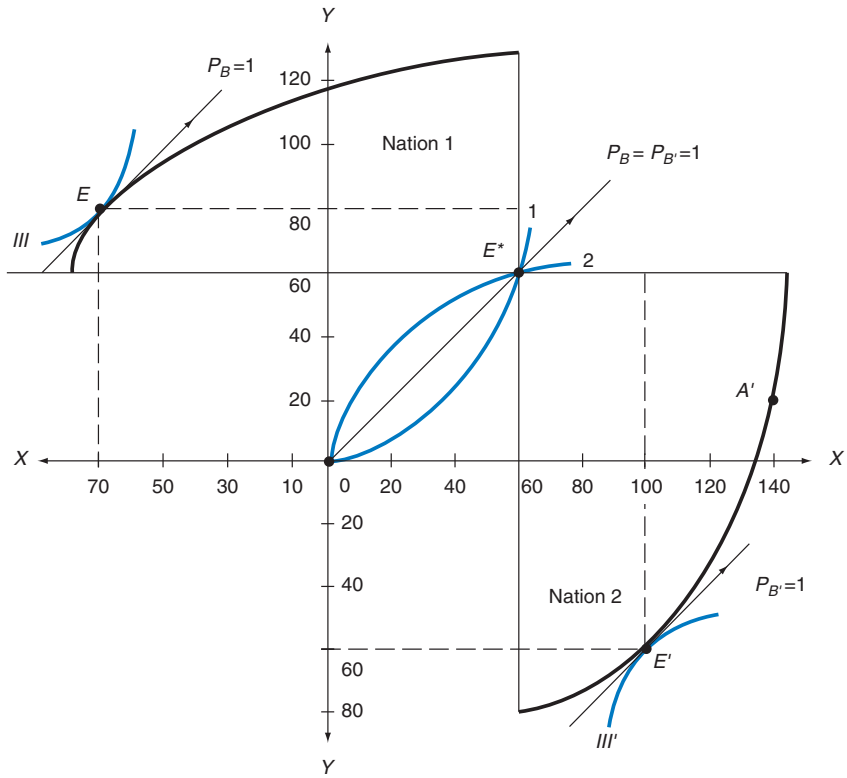

FIGURE 4.11. Meade's General Equilibrium Trade Model.
The production blocks of Nations 1 and 2 are joined at point E^* (the same as point E in Figure 4.10), where the offer curves of the two nations cross. With trade, Nation 1 produces 130X and 20Y (point E with reference to point E^*) and consumes 70X and 80Y (the same point E but with reference to the origin) by exchanging 60X and 60Y with Nation 2. On the other hand, Nation 2 produces 40X and 120Y and consumes 100X and 60Y by exchanging 60Y for 60X with Nation 1. International trade is in equilibrium at point E^*. $P_B = 1$ is the equilibrium-relative commodity price prevailing in international trade and domestically in each nation.

A4.6 Multiple and Unstable Equilibria

In Figure 4.12, offer curve 1 and offer curve 2 intersect at three points (A, B, and C) where at least one of the offer curves is inelastic. Equilibrium points B and C are stable, while equilibrium point A is unstable. The reason is that a small displacement from point A will give rise to economic forces that will automatically shift the equilibrium point farther away from A and toward either B or C.

For example, at P_F, Nation 2 will demand GH more of commodity X than Nation 1 is willing to export at that price. At the same time, Nation 1 will demand FH less of commodity Y than Nation 2 wants to export at P_F. For both reasons, P_X/P_Y will rise until point B is reached. Past point B, Nation 1 will demand more of commodity Y than Nation 2 is willing to offer, and Nation 2 will demand less of commodity X than Nation 1 wants to export, so that P_X/P_Y will fall until the nations have moved back to point B. Thus, point B is a point of stable equilibrium.

On the other hand, if for whatever reason P_X/P_Y falls below P_A (see Figure 4.12), automatic forces will come into play that will push the nations to equilibrium point C, which is also a point of stable equilibrium.

Problem Draw two relative commodity price lines on Figure 4.12, one between point A and point C and one intersecting both offer curves to the right of point C. Starting from each of the two price lines that you have drawn, explain the forces that will automatically push the nations toward equilibrium point C.

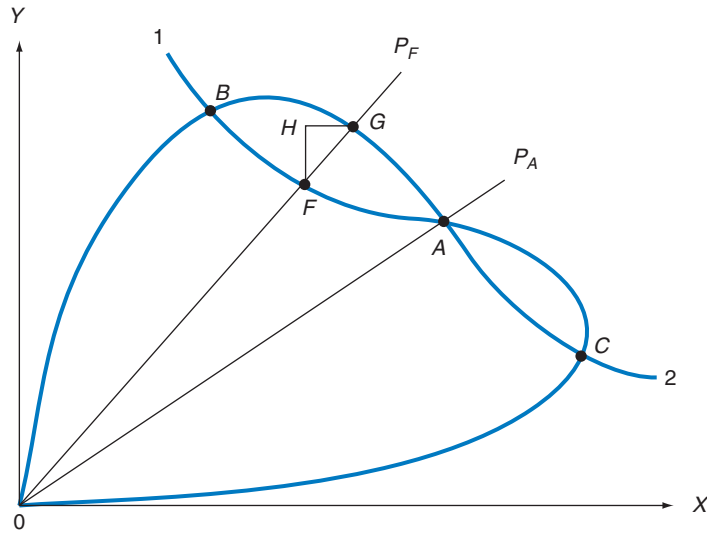

FIGURE 4.12. Stable and Unstable Equilibria.
Equilibrium point A is unstable because any displacement from it will give rise to economic forces that will automatically move the nations even farther away from it and toward either point B or point C. For example, at P_F, Nation 2 demands GH more of commodity X than Nation 1 is willing to export at that price. At the same time, Nation 1 demands FH less of commodity Y than Nation 2 wants to export at P_F. For both reasons, P_X/P_Y will rise until point B is reached. Any small displacement away from point B will push the nations back to point B. On the other hand, if P_X/P_Y falls below P_A, the nations will be pushed toward stable equilibrium point C.

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For a problem-solving approach to the material covered in this chapter, see:

- D. Salvatore, *Theory and Problems of International Economics*, 4th ed. (New York: McGraw-Hill, 1996), ch. 3 (sects. 3.3 to 3.6).

An excellent discussion of offer curves is found in:

- A. P. Lerner, "The Diagrammatic Representation of Demand Conditions in International Trade," *Economica*, 1934, pp. 319–334.
- G. Haberler, *The Theory of International Trade* (London: W. Hodge & Co., 1936), ch. 11.
- J. Viner, *Studies in the Theory of International Trade* (New York: Harper & Brothers, 1937), ch. 9.

For the law of reciprocal demand, see:

- J. S. Mill, *Principles of Political Economy* (New York: Kelly, 1965, a reprint of Mill's 1848 treatise), ch. 18.

For the formal derivation of offer curves perfected by Meade and presented in the appendix to this chapter, see:

- J. E. Meade, *A Geometry of International Trade* (London: George Allen & Unwin, 1952), chs. 1–4.

INTERNet

Online current and historical data on energy prices in general and petroleum prices in particular are available from the Energy Information Administration at:

http://www.eia.doe.gov

Historical series on export and import unit values, which are used to determine the terms of trade of 45 countries, as well as other specific commodity prices, are found in *International Financial Statistics*, published monthly and yearly by the International Monetary Fund (IMF). See:

http://www.imf.org