

# Trade Model Extensions and Applications

Our analysis so far has stressed the importance of relative price differentials among nations as the immediate basis for trade. Because relative prices are underlain by supply and demand conditions, an account should be made of factors such as resource endowments, technology, tastes and preferences, and income levels. In this chapter, we first consider the leading theories that attempt to explain what underlies relative price differentials. We then turn our attention to the role of transportation costs and their impact on trade flows.

## **F**ACTOR-ENDOWMENT THEORY

As discussed in Chapter 2, the Ricardian principle of comparative advantage explains why specialization and trade lead to gains for producers and consumers. It does not, however, in itself explain why the production possibilities schedules of different nations have different shapes, and thus why a nation's comparative advantage is in one product rather than another.

Ricardo thought that comparative advantage depended on comparative differences in labor productivity—that is, differences in technology. However, he did not explain the basis for these differences. Ricardo essentially assumed the existence of comparative advantage in his theoretical model. Moreover, Ricardo's assumption of a single factor of production (labor) ruled out an explanation of how trade affects the distribution of income within a nation and why certain groups favor free trade, whereas other groups oppose it.

## *chapter 2*

### KEY CONCEPTS AND TERMS

- Business services
- Distribution of income
- Dynamic comparative advantage
- Economies of scale
- Environmental regulation
- Factor-endowment theory
- Factor-price equalization
- Heckscher–Ohlin theory
- Industrial policy
- Interindustry specialization
- Interindustry trade
- Intraindustry specialization
- Intraindustry trade
- Leontief paradox
- Polluter-pays principle
- Product life cycle theory
- Specific-factors theory
- Theory of overlapping demands
- Transportation costs

In the 1920s and 1930s, the Swedish economists Eli Heckscher and Bertil Ohlin formulated a theory addressing two questions left largely unexplained by Ricardo: (1) What determines comparative advantage? (2) What effect does international trade have on the earnings of various factors of production (distribution of income) in trading nations? Because Heckscher and Ohlin maintained that factor (resource) endowments underlie a nation's comparative advantage, their theory became known as the **factor-endowment theory**. It is also known as the **Heckscher–Ohlin theory**,<sup>1</sup> and Ohlin was awarded the 1977 Nobel prize in economics for his contribution to the theory of international trade.

The factor-endowment theory states that comparative advantage is explained exclusively by differences in relative national *supply conditions*. In particular, the theory highlights the role of nations' *resource endowments* (such as labor and capital) as the key determinant of comparative advantage. The theory implies that Brazil exports coffee because it has an abundance of the soil and climatic conditions required for coffee's production; the United States and Canada export wheat because they are endowed with an abundance of temperate-zone land, which is well suited for wheat production; and India and China are huge exporters of shoes and garments because they are heavily endowed with labor.

The factor-endowment theory relies on several simplifying assumptions: (1) nations have the same tastes and preferences (demand conditions); (2) they use factor inputs that are of uniform quality; and (3) they use the same technology. This last assumption is made explicitly to neutralize the possibility that trade is based on international technological variations in favor of the possibility that trade is based solely on differences in supplies of labor and capital.

According to the factor-endowment theory, relative price levels differ among nations because (1) the nations have different relative endowments of

factor inputs and (2) different commodities require that the factor inputs be used with differing intensities in their production. Given these circumstances, a nation will *export* that commodity for which a large amount of the relatively *abundant* (cheap) input is used. It will *import* that commodity in the production of which the relatively *scarce* (expensive) input is used. That is why land-abundant nations (such as Australia) export land-intensive goods, such as meat, while labor-abundant nations (such as South Korea) export labor-intensive goods, such as textiles.

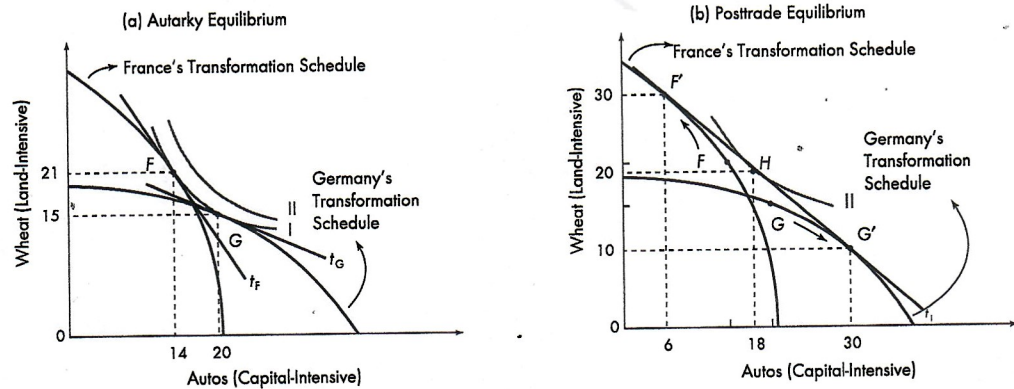
The factor-endowment theory is illustrated in Figure 4.1, which shows the production possibilities schedules of France and Germany. Assume that auto production is capital-intensive, requiring much capital and little land; wheat production is assumed to be land-intensive, requiring much land and little capital. Suppose that capital is relatively abundant in Germany and that land is relatively abundant in France. The abundance of capital in Germany causes its production possibilities schedule to be biased toward the auto axis; the abundance of land in France causes its production possibilities schedule to be biased toward the wheat axis.

According to the factor-endowment theory, demand conditions are assumed to be identical for each nation. This is illustrated in Figure 4.1 by the community indifference curves (curve I and curve II), which are common for both France and Germany. In Figure 4.1(a), the points where community indifference curve I is tangent to the production possibilities schedules of Germany and France indicate the equilibrium locations for the two countries. In the absence of trade, Germany locates at point G on its production possibilities schedule and France at point F on its schedule. The relative price ratios at these points suggest that Germany has the comparative advantage in producing autos and France has the comparative advantage in producing wheat.

Figure 4.1(a) depicts the following assertion of the Heckscher–Ohlin theory: Given identical demand conditions and input productivities, differences in the relative abundance of resources determine relative price levels and the pattern of trade. Capital is relatively cheaper in the capital-abundant country, and land is relatively cheaper in

<sup>1</sup> Eli Heckscher's explanation of the factor-endowment theory is outlined in his article "The Effects of Foreign Trade on the Distribution of Income," *Economisk Tidskrift* 21 (1919), pp. 497–512. Bertil Ohlin's account is summarized in his *Interregional and International Trade* (Cambridge, MA: Harvard University Press, 1933).

**Figure 4.1** Comparative Advantage According to the Factor-Endowment Model



The factor-endowment model asserts that the pattern of trade is explained by differentials in resource endowments. A capital-abundant nation will have a comparative advantage in a capital-intensive product, while a labor-abundant nation will have a comparative advantage in a labor-intensive product.

the land-abundant country. *The capital-abundant country thus exports the capital-intensive product, and the land-abundant country exports the land-intensive product.*

Refer now to Figure 4.1(b). With trade, each nation continues to specialize in the production of the commodity of its comparative advantage until its commodity price equalizes with that of the other nation. Specialization in production continues until France reaches  $F'$  and Germany reaches  $G'$ , the points at which each nation's production possibilities schedule is tangent to the common relative price line  $t_1$ .

With trade, France maximizes its welfare by exchanging 10 bushels of wheat for 12 autos and achieves posttrade consumption at point  $H$  along community indifference curve II. Similarly, Germany exchanges 12 autos for 10 bushels of wheat and achieves posttrade consumption at point  $H$ . With trade, both nations achieve a higher level of satisfaction (community indifference curve II) than that which occurs in the absence of trade (community indifference curve I).

### Factor-Price Equalization

In Chapter 2, we learned that free trade tends to equalize commodity prices among trading partners. Can the same be said for factor prices?<sup>2</sup> A nation with trade finds output expanding in its comparative-advantage industry, which uses a lot of the cheap, abundant factor. As a result of the rise in demand for the abundant factor, its price increases. At the same time, the expensive, scarce factor is being released from the comparative-disadvantage industry; producers will not be induced to employ this factor unless its price falls. Because this process occurs at the same time in both nations, each nation experiences a *rise in the price of the abundant factor and a fall in the price of the scarce factor*. Trade therefore leads toward an equalization of the relative factor prices in the two trading partners.

<sup>2</sup> See Paul A. Samuelson, "International Trade and Equalization of Factor Prices," *Economic Journal*, June 1948, pp. 163-184, and "International Factor-Price Equalization Once Again," *Economic Journal*, June 1949, pp. 181-197.

In the preceding example, the French demand for inexpensive German autos results in an increased German demand for its abundant factor, capital; the price of capital thus rises in Germany. As France produces fewer autos, its demand for capital decreases, and the price of capital falls. The effect of trade is thus to equalize the price of capital in the two nations. Similarly, the German demand for cheap French wheat leads to France's demanding more land, its abundant factor; the price of land thus rises in France. With Germany producing less wheat, its demand for land decreases, and the price of land falls. With trade, the price of land tends to equalize in the two trading partners. We conclude that by redirecting demand away from the scarce factor and toward the abundant factor in each nation, trade leads toward **factor-price equalization**. In each nation, the cheap factor becomes more expensive, and the expensive factor becomes cheaper.

In the real world, differences in factor prices do exist. For example, the average salary of unskilled labor in the United States is higher than in Korea. That resource prices may not fully equalize between trading partners can be explained in part by the fact that the assumptions underlying the factor-endowment theory are not completely borne out in the real world. For example, to the extent that different countries use different technologies or that markets are not perfectly competitive, factor prices may only partially equalize. Transportation costs and trade barriers may prevent product prices from becoming equal. Such market imperfections reduce the volume of trade, limiting the extent to which commodity prices and factor prices can become equal.

An example of the tendency toward factor-price equalization is provided by the U.S. auto industry. By the early 1980s, the compensation of the U.S. autoworker was roughly double that of the Japanese autoworker. In 1981, the average General Motors worker earned hourly wages and benefits of \$19.65, compared to the \$10.70 earned by the average Japanese autoworker. Owing to the domestic (U.S.) recession, high gasoline prices, and other factors, the demand for U.S.-produced autos deteriorated. However, the U.S. consumer continued to purchase Japanese

vehicles up to the limit permissible under the prevailing quota system. To save its members' jobs with struggling U.S. auto companies, the United Auto Workers (UAW) union reluctantly accepted wage cuts so that the companies could remain in business. It is no wonder that the UAW pushed for trade legislation to further restrict foreign autos entering the United States, thereby insulating the wages of domestic autoworkers from the market pressure created by foreign competition.

## Trade and the Distribution of Income

We have seen how free trade can increase the level of output and income for trading nations. Not only does trade affect a nation's aggregate income level, however; it also affects the internal **distribution of income** among the owners of resources.

The factor-endowment theory states that the export of commodities embodying large amounts of the relatively cheap, abundant factors makes those factors less abundant in the domestic market. The increased demand for the *abundant* factor leads to an *increase* in its return. At the same time, returns to the factor used intensively in the import-competing product (the *scarce factor*) *decrease* as its demand falls. The increase in the returns to each country's abundant factor thus comes at the expense of the scarce factor's returns.

In theory, increased trade could worsen inequalities in wages even while increasing national income. The U.S. economy, for example, has a relative abundance of skilled labor, and so its comparative advantage is in producing skill-intensive goods. The factor-endowment model suggests that the United States will tend to export goods requiring relatively large amounts of skilled labor and import goods requiring relatively large amounts of unskilled labor. International trade in effect increases the supply of unskilled labor to the U.S. economy, lowering the wages of unskilled American workers relative to those of skilled workers. Skilled workers—who are already at the upper end of the income distribution—find their incomes increasing as exports expand, while

## The Heckscher–Ohlin Theory: U.S.–China Trade

### Skill Groups of U.S.–China Trade

Skill Group (Key Industries)		Percent of Chinese Exports to the United States	Percent of U.S. Exports to China
Higher Skill ↑ ↓ Lower Skill	1. Periodicals, office and computing machines	4.8	7.7
	2. Aircraft and parts, industrial inorganic chemicals	2.6	48.8
	3. Engines and turbines, fats and oils	3.9	21.3
	4. Concrete, nonelectric plumbing and heating	11.5	4.3
	5. Watches, clocks, toys, sporting goods	18.9	6.3
	6. Wood buildings, blast furnaces, basic steel	8.2	1.3
	7. Ship building and repair, furniture and fixtures	4.1	2.8
	8. Cigarettes, motor vehicles, iron and steel foundries	5.2	1.8
	9. Weaving, wool, leather tanning and finishing	17.2	0.4
	10. Children's outerwear, nonrubber footwear	23.5	5.2

Source: Jeffrey Sachs and Howard Shatz, "Trade and Jobs in U.S. Manufacturing," *Brookings Papers on Economic Activity* I (1994), pp. 18, 53.

According to the Heckscher–Ohlin theory, factor endowments are the source of comparative advantage among nations. As we have learned, human capital (skills) is abundant in the United States, but unskilled labor is scarce. Conversely, China is rich in unskilled labor. Thus, the Heckscher–Ohlin theory predicts that the United States will export to China goods embodying large amounts of skilled labor; China will export to the United States goods for which a large amount of unskilled labor is used.

The table shows the results of a study that tested the predictions of Heckscher–Ohlin for U.S.–China trade in 1990. The researchers

divided a sample of 131 industries into 10 groups according to their skill intensity. The industries of group 1 embodied the highest amount of worker skill, and the industries of group 10 were the least skill-intensive.

The pattern of U.S.–China trade corresponds well to the predictions of Heckscher–Ohlin. U.S. exports to China were concentrated in the higher skilled industries; skill groups 1 through 3 included about 78 percent of U.S. exports to China. Conversely, Chinese exports to the United States fell into the lower skill industries; 41 percent of China's exports to the United States were located in skill groups 9 and 10.

unskilled workers are forced into accepting even lower wages in order to compete with imports. According to the factor-endowment theory, then, international trade can aggravate income inequality, at least in a country such as the United States where skilled labor is relatively abundant.

From the perspective of an unskilled U.S. worker, it makes little difference whether his wages are driven down directly via relaxed immigration laws that let in more people from low-wage nations, or indirectly via the importation of products that make heavy use of unskilled labor.

To the extent that free trade and import competition impose hardship on suppliers of the scarce factor, those suppliers may desire tariffs or quotas on imports. This may explain why segments of the U.S. labor force (such as steelworkers or autoworkers) favor protection against import competition; labor is scarce relative to capital in the United States, compared with the rest of the world.

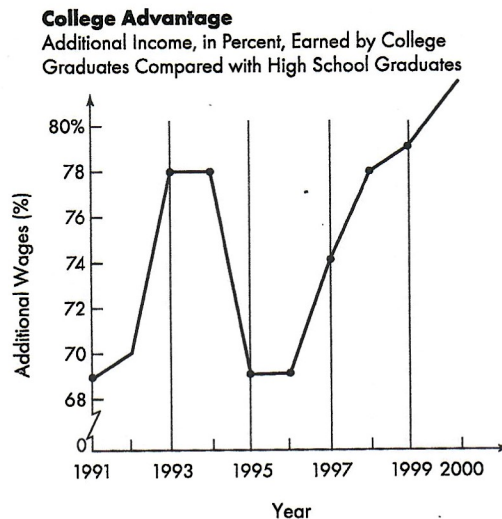
The notion that the abundant factor gains from free trade and that the relatively scarce factor loses is founded on the assumption that resources are completely mobile among industries within a country and completely immobile among countries. In the short run, however, the mobility of factors may be imperfect and the results quite different. Exploring Further 4.1 at the end of this chapter discusses the effects of opening trade when resources are immobile in the short run.

## DOES TRADE MAKE THE POOR EVEN POORER?

Are your wages set in Mexico or China? That question has underlined many Americans' fears about their economic future. They worry that the growth of trade with low-wage developing nations could reduce the demand for low-skilled workers in the United States and cause unemployment and wage decreases for U.S. workers.

The wage gap between skilled and unskilled workers widened in the United States during the past 40 years. This wider gap has destroyed the confidence of many Americans that the economic system works for them. As seen in Figure 4.2, for every dollar that a high school graduate earned in 1973, a college graduate would have made \$1.48. By 2000, the college graduate was making about

**Figure 4.2** The Widening of the Wage Gap: The Advantages of a College Education\*



\*Based on average incomes, in 2000 dollars.

Source: U.S. Census Bureau, *Historical Income Tables: Households*, at <http://www.census.gov/hhes/income/histinc/h13.html>.

\$1.85 for every dollar earned by the high school graduate. Over the same period, imports increased as a percentage of gross domestic product. These facts raise the question, is trade harming unskilled workers? If so, is this an argument for an increase in trade barriers?<sup>3</sup>

### Explaining Wage Inequality

As we have learned, economic theory suggests that free trade tends to undermine the real wages of those toward the bottom of the income distribution. According to the Heckscher–Ohlin theory, the United States would export goods that are intensive in the use of its abundant factor (skilled labor) and import goods that intensively use its scarce factor (unskilled labor). Moreover, trade liberalization would reduce the wages of the scarce factor and increase those of the abundant factor. In other words, additional export opportunities would bid up wages of those primarily producing export goods while increased competition from imports would tend to bid down wages of workers producing import-competing goods.

Economists agree that some combination of trade, technology, education, immigration, and union weakness has held down wages for unskilled American workers; but apportioning the blame is tough, partly because income inequality is so pervasive. During the 1990s, economists attempted to disentangle the relative contributions of trade and other influences on the wage discrepancy between skilled workers and unskilled workers. Their approaches shared the analytical framework shown by Figure 4.3. This framework views wages of skilled workers “relative” to those of unskilled workers as the outcome of the interaction between supply and demand in the labor market.

The vertical axis of Figure 4.3 shows the wage ratio, which equals the wage of skilled workers divided by the wage of unskilled workers. The

figure’s horizontal axis shows the labor ratio, which equals the quantity of skilled workers available divided by the quantity of unskilled workers. Initially, we assume that the supply curve of skilled workers relative to unskilled workers is fixed and is denoted by  $S_0$ . The demand curve for skilled workers relative to unskilled workers is denoted by  $D_0$ . The equilibrium wage ratio is 2.0, found at the intersection at the supply and demand curves: It suggests that the wages of skilled workers are twice as much as the wages of unskilled workers.

In the figure, a shift in either the supply curve or demand curve of skilled workers available relative to unskilled workers will induce a change in the equilibrium wage ratio. Let us consider factors that can affect wage inequality for the United States.

- *International trade and technological change.* Trade liberalization and falling transportation and communication costs result in an increase in the demand curve of skilled workers relative to unskilled workers, say, to  $D_1$  in the figure. Assuming a constant supply curve, the equilibrium wage ratio rises to 2.5, suggesting that the wages of skilled workers are 2½ times as much as the wages of unskilled workers. Similarly, skill-biased technological improvements lead to an increase in the demand for skilled workers relative to unskilled workers, thus promoting higher degrees of wage inequality.
- *Immigration.* Immigration of unskilled workers results in a decrease in the supply of skilled workers relative to unskilled workers. Assuming that the demand curve is constant, as the supply curve shifts from  $S_0$  to  $S_2$ , the equilibrium wage ratio rises to 2.5, thus intensifying wage inequality.
- *Education and training.* As the availability of education and training increases, so does the ratio of skilled workers to unskilled workers, as seen by the increase in the supply curve from  $S_0$  to  $S_1$ . If the demand curve remains constant, then the equilibrium wage ratio will fall from 2.0 to 1.5. Additional opportunities for education and training thus serve to reduce the wage inequality between skilled and unskilled workers.

<sup>3</sup> Robert Lawrence and Matthew Slaughter, “International Trade and American Wages in the 1980s,” *Brookings Papers on Economic Activity*, 1993.