CHAPTER 8

Resource Trade, Outsourcing, and Product Fragmentation

Most items traded among countries are not final consumer goods. Typically, they are raw materials, such as coal, oil, or bauxite; or producer goods; or processed materials, such as steel, textiles, or aluminum; or machinery. We estimate that goods passing into consumption without significant further processing account for only approximately a third of the value of world exports. The strong distinction made by David Ricardo between commodities that can be traded on world markets (final consumer goods) and productive inputs that cannot is at best an extremely qualified view of trade. As will become evident, the fundamental Ricardian concept of comparative advantage must increasingly be modified in a world where trade cuts ever more deeply into the production process.

The term *outsourcing* has entered the media's vocabulary. The term is used in a variety of ways, for example, to suggest that a commodity previously produced at home is now only produced abroad or that an item previously produced by a particular firm is now produced by a different firm. Here we apply it to a more focused event: Suppose it becomes possible to break up, or *fragment*, an originally vertically connected production process so that some parts of it (or fragments) can be produced in a different locale—perhaps by a different firm (but not necessarily), and perhaps nearby or, instead, in another country. If the latter, we refer to *international fragmentation* of the production process, for example, the transfer of an unskilled labor-intensive part of production to a developing country where the wage rate for unskilled labor is lower (relative to its productivity). As we discuss, the phenomenon of international fragmentation reveals a natural role for increasing returns (or decreasing costs) that differs from that encountered in Chapter 7's analysis of intra-industry trade and monopolistic competition. Indeed, a natural role is established for any of the competitive production and trade models discussed in Chapters 4 through 6. We discuss as well the consequences of outsourcing for the distribution of income within a country. Does outsourcing of a previously labor-intensive fragment of the production process at home to a developing country such as Malaysia or India necessarily endanger labor's local real wage rate? As we shall argue, the answer could well be in the negative. But first we turn to a discussion of international trade based on resources.

8.1 Given Resources and Footloose Production Processes

Most final goods reach consumers after passing through a series of intermediate stages of production. For example, bauxite ore becomes alumina, then aluminum, electrical wire, and finally a component of your house. Often these successive conversions are performed by different industries, which may be located in different countries. The country with a cost advantage in aluminum wire may be poorly equipped to produce aluminum (an activity that is drawn to low-cost sources of electric power), in which case the aluminum enters into international trade. Nations should be thought of as specializing in activities or processing stages, not products.

Natural Resource Endowments

One of the factors that governs the allocation of production processes among nations is the uneven distribution of natural resources. Saudi Arabia, richly endowed with petroleum, is apt to find most of its factors drawn into the production of crude petroleum. Saudi Arabia may have no comparative advantage in producing petrochemicals, not to mention undertaking activities that require little or no crude petroleum as an input. Less obviously, natural resource abundance can explain major changes in the long-run trade pattern of the United States. A century ago, the United States was, compared to its principal trading partners, rich in natural resources. Over the years some American natural resources, such as forests, metallic ores, petroleum, and natural gas, were partially depleted, and other nations were drawn into world trade to supply these primary products. Applying the models discussed in Chapters 5 and 6, we expect that land (natural resources in general), which was abundant, is now the scarce factor in the U.S. endowment and that American trade switched from predominantly exporting resource-intensive products to principally importing them.

Gavin Wright analyzed the long-run trend in natural resources' role in U.S. comparative advantage from 1879 to 1940.[1] The United States was long a net exporter of resource-intensive products, and the importance of natural-resource inputs in U.S. exports relative to U.S. goods competing with imports actually kept rising until 1914. The United States remained a net natural-resource exporter until 1940, although by 1955 the country had become a net importer. Wright argued that the importance of natural resources in U.S. comparative advantage was even greater than these figures suggest. First, resource-intensive production tends to be strongly capital intensive. For this reason, from 1879 to 1928, before the United States came to appear a capital-rich country, U.S. exports were more capital intensive than import replacements. Exports' resource intensity and capital intensity declined hand in hand after 1928. Second, Wright argued that the predominant role of natural resources in U.S. comparative advantage extended to the mass production industries (automobiles, machinery) that were the high-tech exports of their day and depended on low-cost sources of both energy and resource-intensive inputs (steel). Third, Wright thought the U.S. advantage

[1]Gavin Wright, "The Origins of American Industrial Success, 1879–1940," *American Economic Review,* 80 (September 1990): 651–668; Jaroslav Vanek, *The Natural Resource Content of United States Foreign Trade 1870–1955* (Cambridge, MA: MIT Press, 1963).

rested not so much on the endowment of resources as the efficiency with which they were exploited. Other trading nations had rich resource endowments but not the cheap transportation and internal free trade needed to exploit them effectively. Only later did those countries develop their resource endowments, setting the scene for the cheapened world prices of resource outputs that led to the displacement of U.S. domestic resources.

Today most industrial countries share the U.S. position in drawing on other nations to supply many of their raw materials. They still differ a great deal, however, in the prevalence of final and intermediate goods in their international trade. Some, such as Norway and Canada, still export a lot of processed materials and intermediate goods as well as goods for final use. Japan, a crowded island devoid of most natural resources, exports mostly finished goods to pay for its mostly resource-based imports, and Germany's situation is similar, if less extreme. For several countries we calculated the share of primary and intermediate goods in their exports and imports:

	Exports	Imports
Japan	5.0%	66.2%
Germany	7.2	43.0
United States	10.7	32.4
Canada	27.0	31.1
Norway	66.8	41.7

Primary and intermediate goods are defined here as products of the agriculture, fishing, forestry, and mining sectors, plus wood products and basic metals. Economists have debated inconclusively whether Japan's position simply reflects that nation's lack of indigenous raw materials or some abnormal disinclination to purchase manufactured imports from other countries.[2]

Scarce Natural Resources and the Terms of Trade

For countries such as Japan that live by turning imported intermediates into final goods, the terms of trade vitally affect their welfare. Rising prices of primary materials squeeze their "processor's margins" and impoverish their factors of production. Countries such as Kuwait that obtain most of their final goods by exporting raw materials are in the opposite situation. Every so often in the history of international commerce, a controversy arises over how long-term trends affect terms of trade and relative incomes in countries that mainly export intermediate goods compared to those that mainly import and process them. This concern is no surprise given the short-run variability of the prices of many primary products. For example, in 1999 the world price of crude petroleum rose 42 percent while that of tropical beverages fell 21 percent and vegetable oilseeds and oils declined 23 percent.

This controversy has surfaced over and over in the industrial countries; it arose at the end of World War II and again in the 1970s following the major increase in the

[2]See Edward J. Lincoln, *Japan's Unequal Trade* (Washington, DC: Brookings Institution, 1990), especially Chapter 2.

price of crude petroleum. Another episode occurred in 2005, when the world price of crude petroleum rose 50 percent during the year. The world's stock of nonrenewable natural resources—metals, energy sources, and so on—is a factor that ultimately limits the real incomes of those who consume them. The most readily available resources—those that require the application of the fewest other inputs—are utilized first. As these resources are exhausted, the margin of extraction moves to resources that are lower in quality, farther away, deeper in the earth, or otherwise more costly in terms of the additional inputs needed to convert them into useful intermediate goods. In the 1970s episode, projections of the Club of Rome[3] focused on the limit that would be reached as fossil energy sources grow scarcer, to the point where securing another unit output of energy requires the input of just that much energy. Then no income would remain to allocate to other factors of production, resulting in the ultimate worsening of one's terms of trade. Most economists were not impressed by the Club of Rome's alarmist stance (and that of its earlier counterparts). It is not that nonrenewable resources lack this potential for shifting the terms of trade against other factors of production. Rather, the forecast neglects technological change, which has shown a remarkable ability over the course of history to cheapen the extraction of natural resources, make it easier to find previously undiscovered ones, and facilitate the substitution of other inputs for resources that have grown more expensive.[4]

Indeed, at other times spokespersons for the developing countries have argued that primary products face long-term deterioration in their terms of trade, presumably reflecting productivity gains in their production. During the period 1900 to 1986, the prices of primary commodities relative to manufactures did indeed decline at a rate of about 0.5 percent a year (a little faster, if fuels are left out of the primary commodities).

The decline in the terms of trade of nonfuel primary products continued at about the same rate for the period 1970 to 2000, although agricultural primary products showed diverse individual patterns but on average did not decline. The fates of the less developed countries are decreasingly tied to the terms of trade for the primary commodities in which they have traditionally specialized. The share of manufactures in exports of developing countries rose from 3.7 percent in 1899 to 21.1 percent in 1979, and many developing countries themselves are losers when energy prices rise.[5]

The Newly Industrializing Countries and Footloose Production Processes

If nations can import intermediate goods to feed their processing capabilities, the processing activities can themselves migrate from country to country. The nations that developed successfully in the last three decades took up processing activities suited to

[3]D. H. Meadows et al., *The Limits to Growth* (New York: Universe Books, 1972).

[4]In the nineteenth century when the horse was a principal source of motive power, concern arose over where enough land could be found to raise oats to feed all the horses required for transportation. The internal combustion engine, of course, spared us the need to raise oats in window boxes.

[5]Enzo R. Grilli and May Cheng Yang, "Primary Commodity Prices, Manufactured Goods Prices, and the Terms of Trade of Developing Countries: What the Long Run Shows," *World Bank Economic Review,* 2 (January 1988): 1–47.

their factor endowments—efficient if low-skilled labor, good infrastructure—importing intermediate goods or parts (textiles, electronic components) and exporting finished goods (apparel, consumer electronics). Because these activities demand no elaborate or highly specialized capital goods or labor skills, they are easily expanded in any country where they prove profitable. By the same token, they are quickly contracted in a location where they prove unprofitable. They are sometimes referred to as footloose. (The athletic-shoe industry is, happily, an example.)

Which industries are footloose and have gravitated to the developing countries can be explained by the Hecksher-Ohlin theorem. They are typically industries that generate low value-added per worker when carried out in the United States. Value-added is the sum of all payments to an industry's primary factors of production. It can be high (per worker) because the industry uses a lot of physical capital, pays rents for the use of natural resources, or employs workers with heavy investments in skills. Low value-added per worker thus is a good indicator of low capital intensity of each type. Furthermore, in the absence of factor-intensity reversals, an industry with low value-added per worker in the United States will have that status in the developing countries.[6] These industries have swarmed to the Asian newly industrializing countries (NICs) (Singapore, Hong Kong, Taiwan, Korea), the ASEAN group that followed them (Malaysia, Indonesia, Philippines, Thailand), and now China. These economies accounted for 5 percent of global exports and 5.2 percent of imports in 1965, 16.9 percent of each by 1994. Their share of global manufactured exports rose from 1.6 to 19.9 percent, and the Asian NICs shifted their processing activities from low to increasingly high-technology manufactures.[7]

8.2 Footloose Inputs: The Joint Role of Comparative and Absolute Advantage

The doctrine of comparative advantage points out that the absolute level of efficiency of inputs does not determine a nation's trade pattern. Poor climate and technology at home may make labor less efficient both in producing food and making clothing, but if such inefficiency is relatively less pronounced in the clothing sector, the home country exports clothing. This basic truth is thus strongly linked to the vision of trade offered in the classical paradigm: International markets are limited to final goods, and inputs are trapped within a nation's boundaries. Suppose, however, some productive inputs are footloose: They can be attracted to the country offering the highest return. In such a case, production and trade patterns internationally are determined by absolute advantage as well as comparative advantage.

To construct a model that can handle the importance of absolute advantage jointly with comparative advantage, we adapt the Ricardian model of Chapter 4. Stick to the two-commodity food and clothing scenario, but now introduce an asymmetry in the

[6]This was first shown by Hal B. Lary, *Imports of Manufactures from Less-Developed Countries* (New York: National Bureau of Economic Research, 1968).
[7]Sylvia Ostry, *The Post-Cold War Trading System* (Chicago: University of Chicago Press, 1997), Chapter 5.

way these two commodities are produced. As before, let food require labor only, with a_{LF} and a^*_{LF} denoting fixed unit requirements in the two countries. By contrast, clothing requires not only labor (a_{LC} and a^*_{LC}) but also the services of some internationally footloose factor, which we simply call A. To keep matters simple, suppose the pair of input coefficients (a_{LC} and a_{AC} at home; a^*_{LC} and a^*_{AC} abroad) is constant but allows for intercountry differences not only in labor skills but also in the technology whereby A is used in clothing production. Input A is footloose in the sense it is attracted to the country that can offer it the higher return (denoted by R_A if at home, or R^*_A abroad).

Some of the lessons of the simple competitive Ricardian model are applicable here as well. Each country must produce something in a free-trade equilibrium—food, clothing, or both. Competition ensures that unit cost equals price for any activity actually undertaken and does not fall below price (suggesting profitable opportunities that would be bid away in a competitive equilibrium) for activities not undertaken. Suppose world prices of food and clothing are determined in a large world market. Which of these two countries is in a better position to attract the services of footloose factor A? Here we restrict our attention only to these two countries as potential employers of A; later we ask whether A would be attracted to either of these countries if a larger world market exists. Technology for producing food in each country puts a floor on the wage rate. Thus, at home, Equation 8.1 reveals the minimum value for the home wage rate, w:

$$a_{LF}w = p_F \tag{8.1}$$

If the wage rate were higher, the home food sector would prove noncompetitive in world markets. For the home clothing sector, the prevailing world price of clothing, home technology, and this minimal level for home wages help determine the maximum amount, R_A, that the home country could bid to obtain the services of footloose factor A. These are formally related by Equation 8.2:

$$a_{LC}w + a_{AC}R_A = p_C \tag{8.2}$$

Now divide Equation 8.1 into Equation 8.2 to obtain:

$$(a_{LC}/a_{LF}) + a_{AC}\,(R_A/p_F) = p_C/p_F \tag{8.3}$$

This expression reveals, with given world commodity prices of food and clothing, the maximum amount that the home clothing industry could pay to obtain footloose input A. Of course, if the wage rate were even lower than the breakeven point for food production shown by Equation 8.1, more could be paid to attract input A, but the existence of profitable activity in the food sector would bid up wages again.

Technology differs abroad, so that although foreign producers face the same prices for traded food and clothing, the maximum amount their clothing sector could pay to obtain A without incurring losses is R^*_A, shown in Equation 8.4:

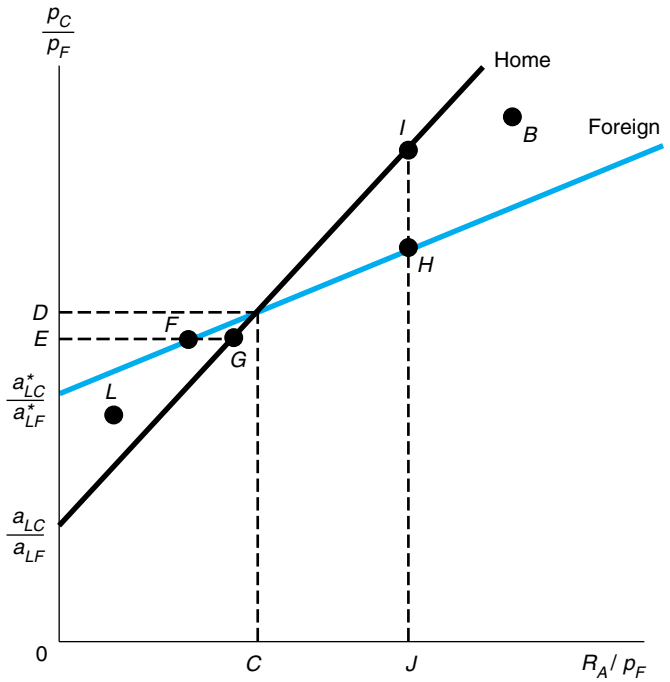
$$(a^*_{LC}/a^*_{LF}) + a^*_{AC}(R^*_A/p_F) = p_C/p_F \tag{8.4}$$

A comparison of Equations 8.3 and 8.4 clearly reveals that the ability to attract the footloose input required to produce clothing depends both on potential *comparative* advantage in labor costs (a_{LC}/a_{LF} vs. a^*_{LC}/a^*_{LF}) as well as on *absolute* superiority in the productivity of footloose input A (literally the inverses of a_{AC} and a^*_{AC}). We follow our earlier assumption in letting the home country possess a comparative labor cost advan-

FIGURE 8.1

Comparative and Absolute Advantage

For relatively high world prices of clothing (above 0*D*), the foreign country could outbid the home country to attract the internationally footloose input used to produce clothing. Below 0*D*, relative labor costs become more important and production patterns switch, so that the home country produces clothing.



tage in producing clothing, but now suppose that the foreign country has an absolute advantage in employing the footloose factor in clothing (a^*_{AC} is smaller than a_{AC}). In Figure 8.1 relative world prices of clothing and food are shown on the vertical axis, and the maximum amount each country could pay to attract footloose input A is shown on the horizontal axis. The vertical intercepts of each line reveal comparative labor costs; the slopes of the lines reflect absolute costs of the footloose input A in clothing production; the formal expressions for these lines are given in Equations 8.3 and 8.4.

Armed with this apparatus, it is now possible to discuss issues concerning trade and production patterns that arise when not all inputs have strictly national markets.

Who Produces What?

The answer to the question, "Which country is better able to attract footloose factor, A, and thus actively produce clothing?" is, "It depends." In particular, it depends on whether clothing's price is relatively high, in which case the return to footloose factor A is also high. With such payments looming as important in the cost picture, the high-bidding country for A is the country with the superior technology for using A. In Figure 8.1, for any p_C/p_F exceeding $0D$, the foreign country can outbid the home county in attracting A. Conversely, low relative prices for clothing imply a low return for A, in which case relative labor costs loom as more important, just as in standard Ricardian theory. For example, at a clothing relative price given by $0E$, the home country can offer EG for the use of A and still break even producing clothing; the foreign

country, with a comparative disadvantage in labor costs, could offer only EF for A. The vertical comparisons for any given value of R_A/p_F are also instructive. If, in world markets, the payment required for footloose factor A is $0J$, the home country's relative cost of producing clothing, JI, exceeds that in the foreign country, JH, and the foreign country would be the producer of clothing.

It is perhaps more instructive to imagine both home and foreign countries embedded in a multicountry trading nexus in which the commodity prices *and* the rate of return to footloose input A are determined by world market forces. That is, these prices are shown by some point in Figure 8.1. Suppose this is point B. The home country cannot compete in the clothing sector. By contrast, the foreign country can successfully pay the going rate for input A and establish a competitive clothing industry. But point B lies above the foreign relative cost curve in Figure 8.1. This reveals that the foreign wage rate would be bid above the level that would allow foreign food production. In sum, at point B the foreign country is specialized in clothing and the home country in food. Should clothing and the return to footloose A become cheaper with the passage of time, moving, say, to point L, clothing production would shift to the home country as relative labor costs become more important.[8]

National Tax Treatments and Absolute Advantage

The doctrine of comparative advantage recognizes that differences between countries that affect some industries differentially have an impact on trade patterns. This doctrine, however, denies the role of countries' characteristics that affect all local sectors uniformly. Once international trade invades the markets for inputs into the production process, such a neglect of national characteristics is no longer appropriate.

For example, suppose tax rates on earned incomes are uniformly higher in one country than in another. If inputs are *not* internationally mobile, such a difference in national tax treatments does not affect production patterns. But if some inputs are footloose, their location will be influenced by taxes. Other things being equal, footloose inputs will be attracted to countries with low tax rates on earnings. Similarly, differences between governments in attitudes toward expropriation of firms or differences in overall levels of social overhead capital can steer footloose inputs toward some countries and away from others. Pollution controls provide another example. South Korea and Hong Kong have recently been under pressure to tighten up their controls on dirty industry. As a consequence, some of these processes have been shifted to countries like Thailand.[9]

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[8]In the past half century, the location of the American textile industry has shifted from the North to the South. Southern climate (especially high humidity and temperature) does not naturally favor textiles, but this disadvantage can be overcome by air-conditioning if electricity is cheap enough. In Figure 8.1 associate footloose input A with energy (or electricity) and associate the South, where higher energy inputs are required, with the home country. Of course in recent years much of the South's textile industry has been bid away to countries such as China.

[9]The *Economist* of November 16, 1991, cites an increase from 25 to 55 percent of total applications for foreign investment "whose activities would produce significant amounts of hazardous wastes" in Thailand in the two-year period from 1987 to 1989.

Suppose, in Figure 8.1, that the home country is uniformly a "better" place in which to work than the foreign country, in a sense that can be translated into an absolute lowering of all input requirements in all sectors. The vertical intercept of the home curve is unaffected because it reflects only *comparative* labor costs. The home schedule becomes flatter, however, and, if world commodity prices initially did not allow home production of clothing (e.g., at B), such a change in home national characteristics could alter its production pattern. That is, uniform tax reduction could serve to attract the footloose input to the clothing sector as the home country becomes a relatively more attractive locale.

Comparative Advantage and the Dutch Disease

Finally, the enduring role of comparative advantage can be revealed in the following example. Suppose that the home country initially produces both goods and that a new innovation that lowers labor requirement, a_{LF}, is introduced into the national food industry. The home country's schedule in Figure 8.1 then shifts upward, possibly wiping out its clothing sector. Despite the fact that no change has taken place in the production techniques for clothing or in the world prices of clothing and food, the country has developed a stronger *comparative* advantage in producing food. The wage rate rises, and footloose input A leaves the country for other parts of the world where wages have not risen. This is the Dutch Disease once again, with some inputs (A) now escaping the penalty of a shift in comparative advantage through international mobility.

8.3 Outsourcing and the International Fragmentation of Production

Even before David Ricardo (1817) explained the advantages of international trade—advantages based on each nation having a certain range of commodities in which it has a comparative advantage—Adam Smith expounded on the benefits that arise from an enlarged scale of operations and the division of labor. That is, as scale expands, resources (especially labor) can increasingly be focused on a narrower class of activities in a manner that improves productivity. The economist Allyn Young was prescient in remarking as early as 1928 that "over a large part of the field of industry an increasingly intricate nexus of specialized undertakings has inserted itself between the producer of raw materials and the consumer of the final product."[10]

This is even more true now. One of the defining characteristics of the growth in international trade and incomes in the past few decades has been the steady rise in trade in intermediate goods and goods in process, indicative of a phenomenon we call *fragmentation* of production. As the scale of activity in an originally vertically integrated production process expands, costs get reduced by outsourcing some parts of the process, perhaps to other firms, perhaps to different locales, including, as suggested

[10]Allyn Young, "Increasing Returns and Economic Progress," *Economic Journal*, 38 (1928): 527–542.

earlier, to foreign countries where different productivities relative to factor prices could lower the costs of producing the outsourced parts. The Swedish furniture firm Ikea has for years outsourced the actual manufacture of items to Poland, retaining the design work in Sweden. In the United States the firm Nike does its design work and advertising at home but outsources its manufacturing of footwear to many developing Asian countries. Many other industries are characterized by production processes featuring international outsourcing of parts of production (e.g., automobiles, cameras, and pharmaceuticals).

A simple model setting in which to discuss this issue is that laid out in Jones and Kierzkowski.[11] Consider, first, a small-scale process whereby local resources are combined in a simple *production block* to produce an output in a manner such as described in Chapters 4, 5, or 6, with, perhaps, technology exhibiting constant returns to scale. More extensive ways of production can also be considered, whereby the process is split up into more production blocks, with their locale being outsourced to other regions of the country or, perhaps, to another country. The attraction would be the possibility of a better fit of the factor proportions required in each block to relative wages and rents found in different areas. Perhaps, instead, outsourcing is encouraged because labor is relatively more productive in some countries than in others, à la the Ricardian model set out in Chapter 4. However, such outsourcing requires additional costs, of what we call *service links*, and these encompass the costs of coordinating the production of separate production blocks, which involves costs of transportation, communication, insurance, and so on. These are areas in which strong increasing returns are to be found. For example, the costs of communication in arranging a shipment of 1000 units of a product are about the same as arranging a shipment of 10,000 units. The extent of outsourcing that will be selected depends on the nature of these costs as well as the scale of total output.

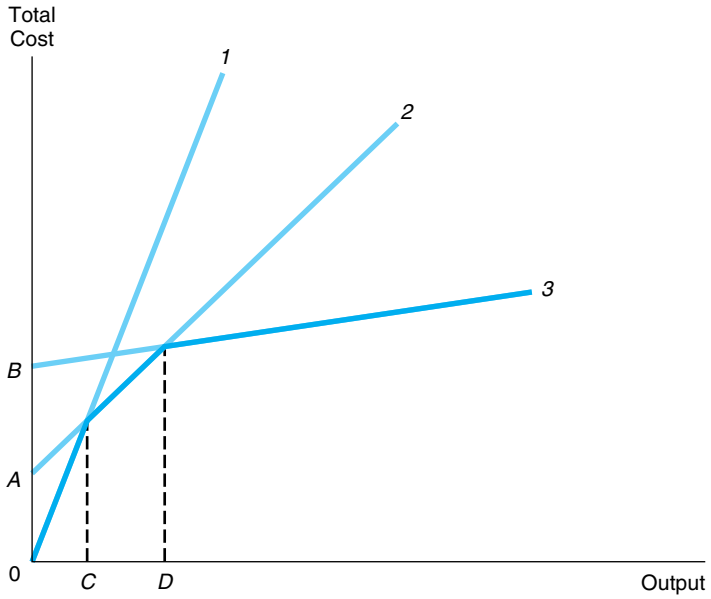
Figure 8.2 illustrates how minimal total costs of producing final output increase with the scale of output but at a diminishing rate. If there is a vertically integrated single production block, costs are shown by ray *1*. An alternative of two blocks, both located within the country, is illustrated by line *2*. This line illustrates the trade-off between lower marginal costs of production achieved by the better fit of locating each block in a locale in which factor prices and productivities match the particular factor intensities required in each block, on the one hand, and the extra service link costs required to coordinate the two blocks, on the other. For simplicity we adopt here the extreme assumption that these costs are constant, level 0*A*. Line segment *3* illustrates an alternative, one in which one of the production blocks is moved overseas, thus achieving even lower marginal costs but at the expense of greater costs of coordinating service links, 0*B*. As output grows, note the switch to greater and greater degrees of fragmentation and outsourcing: None takes place until output level 0*C* is reached. In the range *CD*, it pays to outsource locally, but if output expands beyond level 0*D*, inter-

[11]Ronald W. Jones and Henryk Kierzkowski, "The Role of Services in Production and International Trade: A Theoretical Framework," ch. 3 in R. Jones and A. Krueger, eds., *The Political Economy of International Trade* (Oxford: Blackwell, 1990). See also Ronald W. Jones, "Immigration vs. Outsourcing: Effects on Labor Markets," *International Review of Economics and Finance*, 14 (2005): 105–114.

FIGURE 8.2

Costs and Fragmentation

At low levels of output, production might take place in a single production block exhibiting total costs rising proportionally with output, as in ray *1*. An alternative technique fragments the production process into a pair of blocks by placing one of them in a locale more suited to its factor requirements, but this involves service link costs of coordinating the blocks (line *2*). Line *3* illustrates fragmentation that outsources one production block overseas to obtain even lower marginal costs, although the costs of service links become larger (0*B*). The heavy broken lines show how fragmentation leads to a lowering of average costs as output expands.



national outsourcing is required to minimize costs. Note that along the lower locus (heavy broken lines) average costs diminish with scale of output, and this happens despite the presumed absence of increasing returns to scale for any given production block. The necessity of service link activities for achieving lower costs with outsourcing is responsible for the overall pattern of increasing returns to scale.

Three major changes in the past few decades help explain why international trade in parts and components has increased more rapidly than world incomes or than overall world trade. First, with incomes rising there is a natural tendency for larger scales of output to result in greater degrees of international fragmentation. This is illustrated in Figure 8.2. Second, one of the most striking changes in technology in recent years has been the great reduction in the costs of service link activities. This is especially the case for the costs of communication, which have been driven down almost to the vanishing point. As well, costs of transportation have been reduced. Greater information about operating abroad, coupled with a larger range of possible suppliers of components abroad, have lowered the costs of outsourcing to arm's-length firms with reduced risk that such supplies will not meet timing schedules. This means that for any given level of output, a greater degree of fragmentation and outsourcing can be expected. Finally, there has been a steady postwar reduction in tariffs and other barriers to international trade as well as a freeing up of domestic restrictions and regulations on service activities.

Although getting good data on the extent of fragmentation and outsourcing is difficult, Francis Ng and Alexander Yeats at the World Bank provided estimates.[12] For the

[12]Francis Ng and Alexander Yeats, "Major Trade Trends in Asia—What Are the Implications for Regional Cooperation and Growth?", World Bank Policy Research Working Paper 3084, June 2003.

period 1990 to 2000, they calculate a yearly expansion in world GDP of 3.7 percent. Not surprisingly, overall levels of world trade have been expanding more rapidly, at a 6.5 percent yearly rate. However, the subsector of trade in parts and components (indicative of the degree of international fragmentation) has been expanding at a 9.1 percent rate, even greater than the rate for intra-industry trade.

8.4 Outsourcing and Advanced Country Wage Rates

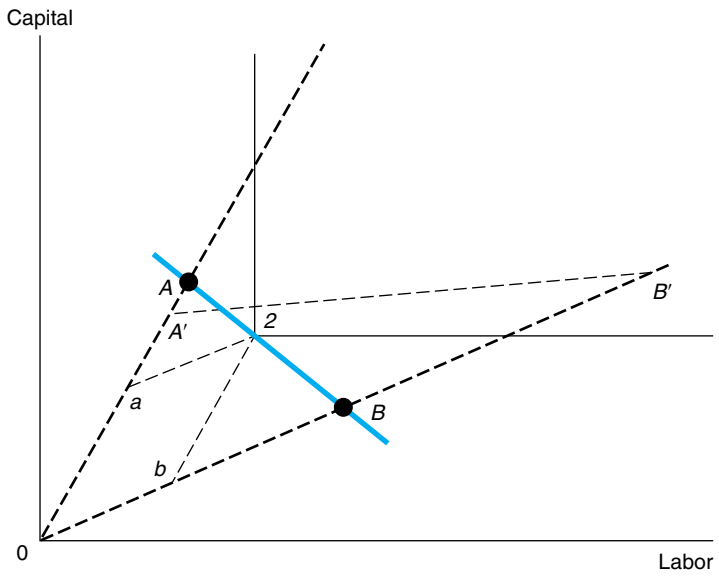
The recent outsourcing phenomenon has stirred considerable attention in the United States and European countries because of its supposed strong adverse effect on local wage rates and employment, especially of the unskilled.

To investigate the possibilities, we make use of the unit-value isoquant map introduced in Chapter 6. In Figure 8.3 we focus on the possibilities of fragmentation in some commodity, say commodity *2*, assumed to be produced in the home country. Production for the second commodity is assumed not to allow substitutability between capital (physical or human) and labor (interpreted as relatively unskilled labor if "human" capital is used to represent skilled labor), and therefore has the right-angled shape of the unit-value isoquant for commodity *2*. Its production is made up of two fragments: The one indicated by point *a* is the more capital-intensive one, and the other is indicated by point *b*. The slope of line *AB* is presumed to represent the ratio of the wage rate to the rental on capital. Before international trade in separate fragments is made possible by a reduction (not shown) in service link costs, the capital and labor bundles indicated by *A* and *B* would indicate, respectively, $1 worth of factors that are required initially to produce the capital-intensive and labor-intensive fragments when these are valued at initial home wages and rents.

FIGURE 8.3

Fragmentation in Industry *2*

The unit-value isoquant for the second industry shows that a $1 value of output can be produced by a combination of capital-intensive fragment, *a*, and labor-intensive fragment, *b*. Line *AB*'s slope indicates the factor-price ratio before the fragments can be traded. A reduction in service link costs allows such world trade, and the world price of the labor-intensive fragment falls so that point *B′* shows the new input bundle required to earn $1, and *A′* reveals that the price of the capital-intensive bundle has risen compared to initial costs.



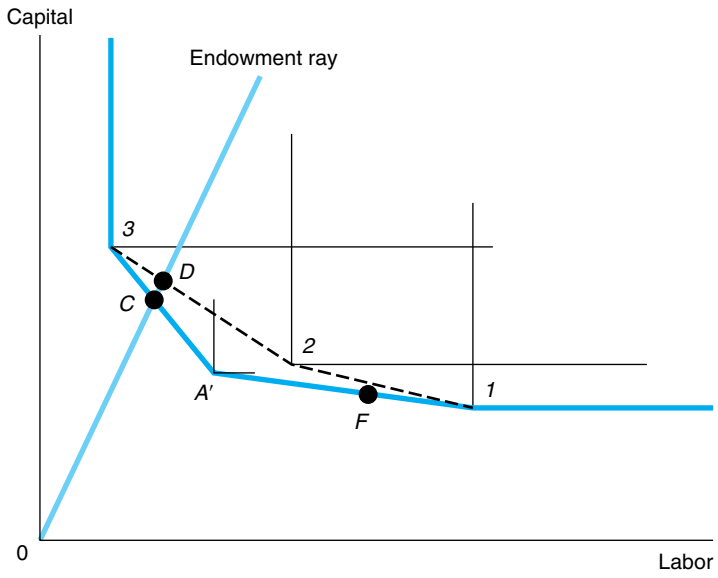
Once fragmentation leads to the possibility of international trade in the two separate fragments, the finer degree of association of factor intensities to various countries' factor prices leads for the first time to world prices for the separate fragments. In Figure 8.3 we have assumed that the world price of the labor-intensive fragment has gone down from its initial home cost (represented by point *B*), suggesting that although this country could initially meet world competition in producing the second commodity, it was not very good at producing the labor-intensive fragment. Once international fragmentation takes place and world prices for the two fragments are established, the price for the labor-intensive fragment has been reduced from its initial cost in the home country. (Point *B′* relative to point *B* indicates a halving of world price relative to initial cost). By contrast, the home country is an efficient producer of the capital-intensive fragment relative to other countries, and its world price has been assumed to increase compared with initial local costs so it now takes only the bundle *A′* to produce a unit of the capital-intensive fragment at new world prices.

With these details in mind, turn to Figure 8.4, which adds to the initial unit-value isoquant for commodity *2* those for commodities *1* and *3*, whose prices are assumed not to be altered. Thus before international fragmentation in industry *2* became possible, the composite unit-value isoquant was given by the broken line *3D21*. After fragmentation the country can no longer compete in producing an integrated second commodity, but the more capital-intensive fragment shown by the isoquant whose corner is *A′* does emerge as a competitive tradable item at the new world prices. The new unit-value isoquant is the broken line *3CA′F1*. What has happened to the wage rate (or the wage/rental ratio)? That depends on the country's endowment proportions, which help determine its production pattern. If such a ratio were shown by a ray (not drawn) through point *F*, the home country would originally have produced commodities *1* and *2*, and after fragmentation the capital-intensive fragment of commodity *2* as well as

FIGURE 8.4

Fragmentation and a Higher Wage Rate

The prefragmentation unit-value isoquant is the broken line *3D21*; after fragmentation in industry *2* (as shown in Figure 8.3), only the capital-intensive fragment, shown by *A′*, survives, and the new unit-value isoquant is *3CA′F1*. If the economy is relatively capital abundant (as shown by the endowment ray), the wage rate has increased as a consequence of outsourcing the labor-intensive fragment used to produce commodity *2*.



commodity *1*. Its wage/rental ratio would have fallen. However, if the home country were more capital/abundant, say with endowment ratio shown by the ray through point *C*, its wage rate would actually *increase* as a consequence of international fragmentation. It would produce commodity *3* both initially and after fragmentation, but it substitutes the fragment shown by *A′* for the entire commodity *2* produced initially. For such a capital-abundant home country, commodity *2* was the labor-intensive item of the two goods produced initially, and international fragmentation (that substitutes *A′* for *2*) represents a technological improvement in the home country's labor intensive item produced. Such technological progress in the economy's labor-intensive item produced must raise the wage rate (just as a price increase would do).

Popular discussion of outsourcing often focuses on the factors (especially labor) thrown out of work when a labor-intensive fragment of production is sent to foreign shores. What to make of this argument? These trade models all assume that factor markets are flexible in the sense that excess supply in the home labor market would lead to a readjustment of the equilibrium wage rate. Thus in Figure 8.4 there is full employment before and after international fragmentation. But consider what happens to the labor employed in the surviving fragment in the second industry: More labor is employed in this fragment after the new trading pattern than was employed in the entire second industry in the initial situation! In Figure 8.4 point *C* (showing input allocation after fragmentation) is relatively closer to point *A′* than point *D* was initially close to point *2*. The labor-intensive fragment in producing the second commodity was dragging down the home country's competitive position in producing commodity *2*, and its disappearance after international fragmentation puts the remaining fragment in commodity *2* in a stronger position, and it increases its resource inputs.

This result, whereby outsourcing improves the real wage, is just a possibility. But it does serve to emphasize that outsourcing has a positive aspect—it works like an improvement in productivity. Note that in countries such as the United States there is *insourcing* as well. According to Walter Wriston, in the past few years more jobs have been created by foreigners' activities in the United States than have been lost by outsourcing.[13] To concentrate only on jobs outsourced by trade and to ignore insourcing would be like saying that imports generally cause a country to lose jobs (and ignoring jobs created in export sectors).

The illustration just cited associates the outsourcing phenomenon with the loss of production blocks. Much has been made recently about call centers, a kind of service link activity, being outsourced to India. India obviously has a much lower wage rate, and widespread knowledge of English is a necessary characteristic. A partial answer to critics of such outsourcing from the United States is that in America these are not very high-paid jobs and would probably have been phased out anyway by automatic answering services, such as are common now in making airline reservations. As for production blocks, the main worry in advanced countries now is China. Its wage rate is less than 4 percent of the American wage rate. Some of this is related to an undervalued level of the Chinese yuan. Admittedly, its labor productivity is also lower (approximately 9 per-

[13]Walter B. Wriston, "Ever Heard of Insourcing?", *Wall Street Journal,* March 24, 2004.

cent of the American level), but this still leaves Chinese labor in a strong competitive position.[14] Indian labor is fairly comparable to that in China in terms of wages, but the infrastructure, such as roads and harbors that would allow India to be as competitive with China in terms of production blocks, is distinctly inferior. Call center activity can bypass such infrastructure.

8.5 Summary

The location of natural resources is spread rather unevenly around the globe, which has a large influence on trade patterns. A country such as Japan is highly dependent on foreign sources for its supplies of coal, steel, and oil and is a heavy exporter of high-quality finished consumer goods to obtain these resources. With such asymmetries, shifts in the terms of trade between resource-intensive primary products and final goods can greatly alter the relative income among countries. When some inputs become internationally mobile, the classical Ricardian concept of comparative advantage needs to be joined by the concept of absolute advantage in order to explain trading and production patterns. Comparative advantage is relevant for productive factors such as labor that are generally considered to be trapped behind national borders, but inputs such as some intermediate goods or capital have much more international mobility and will seek to be used in countries where their returns are maximized. All countries have a comparative advantage in some items, but high levels of taxation and low levels of productivity relative to factor prices make it difficult for some countries to attract internationally footloose inputs.

The recent striking improvements in technology such as in communication and, to a lesser degree, in transportation have encouraged an increase in fragmentation of the production process, whereby some production blocks are relocated to other areas, internationally as well as in the same country. For example, design activities or research and development could be located in advanced countries such as the United States, but more labor-intensive activities such as furniture or footwear production are nowadays often outsourced to locales in Eastern Europe or Asia. Higher levels of income and production, as well as deregulation internally or reductions of trade barriers internationally, also encourage greater degrees of international fragmentation. Although marginal costs of production can be lowered by the closer association of required factor intensities of production blocks with relative factor prices and productivities when outsourcing takes place, service link costs are generally greater when the production activity spreads over several countries. Service link costs tend to be characterized by increasing returns to scale, so that even if production blocks are not, increases in output leading to more fragmentation result in lower average costs of production.

Concerns about the effects of international outsourcing on the internal distribution of income, especially of wage rates in the more advanced countries, tend to stress

[14]These figures were supplied by Stephen Golub of Swarthmore College. In particular, see the paper by Janet Ceglowski and Stephen Golub, "Just How Low Are China's Labor Costs?" (2005), unpublished. The figures refer to the year 2002.

the downward pressure on wages and employment of losses of productive activities to developing countries. Some of these concerns may be justified, but often lost in the argument is that outsourcing is like an improvement in technology—it lowers the costs of the remaining productive sectors in a country and thus creates greater incomes for some. We provided an illustration of how this can work to the advantage of workers in advanced countries.

CHAPTER PROBLEMS

1. In Figure 8.1 suppose that labor becomes 10 percent more efficient in the foreign country in producing food. Compare the alteration necessary in the diagram with the case in which foreign labor becomes 10 percent more efficient in producing both food and clothing.
2. Suppose, in Figure 8.3, that this country has an advantage, relative to the rest of the world, in producing the labor-intensive fragment, B, instead of the capital-intensive fragment, A, so that after world prices adjust to separate fragments becoming tradable on world markets, it is fragment B that survives and not A. Show how a revision of Figure 8.4 could still result in showing an increase in real wages for a capital-abundant country.
3. With reference to the discussion of footloose factors in Section 8.2, suppose the fixed foreign labor costs for producing a unit of clothing and a unit of food are four hours and one hour, respectively, and comparable labor requirements in a home country are each one hour. Clothing production requires, as well, fixed units of some footloose productive input A. Suppose the foreign country has an absolute advantage in its use of A: Only one unit of A is required to produce a unit of clothing, whereas two units of A are required at home. Let the world price of food be \$1. What is the pattern of production and the wage rate in each country if:
   a. The world price of clothing is \$5.50 per unit and footloose factor A commands \$2?
   b. The world price of clothing rises to \$8 per unit and footloose factor A rises to \$4?
   In case (b) suppose that labor in the foreign country becomes more efficient in its production of food. Describe the impact on the production pattern abroad, and link the result to the phenomenon of the Dutch Disease.

SUGGESTIONS FOR FURTHER READING

Baumol, William J., Sue Ann Batey Blackman, and Edward N. Wolff. *Productivity and American Leadership: The Long View* (Cambridge, MA: MIT Press, 1989). Natural resources and technological diffusion in the U.S. international economic position.

Jones, Ronald W. *Globalization and the Theory of Input Trade* (Cambridge, MA: MIT Press, 2000). Chapter 2 contains a more complete discussion of the material in Section 8.2.

———. "Immigration vs. Outsourcing: Effects on Labor Markets," *International Review of Economics and Finance,* 14 (2005): 105–114. Discusses the possible effects of outsourcing on real wages.

Jones, Ronald W., and Henryk Kierzkowski. "The Role of Services in Production and International Trade: A Theoretical Framework" (1990), in R. Jones and A. Krueger, eds., *The Political Economy of International Trade* (Blackwells), Chapter 3, pp. 31–48. The original discussion of international fragmentation, including a discussion of Figure 8.2.

Wright, Gavin. "The Origins of American Industrial Success, 1879–1940," *American Economic Review,* 80 (September 1990): 651–668. Role of natural resources in long-run changes in U.S. comparative advantage.