FOURTH EDITION

INTERNATIONAL TRADE

ROBERT C. FEENSTRA ■ ALAN M. TAYLOR

2 Ricardian Model

In developing the Ricardian model of trade, we will work with an example similar to that used by Ricardo; instead of wine and cloth, however, the two goods will be wheat and cloth. Wheat and other grains (including barley, rice, and so on) are major exports of the United States and Europe, while many types of cloth are imported into these countries. In our example, the home country (we will call it just "Home") will end up with this trade pattern, exporting wheat and importing cloth.

The Home Country

To simplify our example, we will ignore the role of land and capital and suppose that both goods are produced with labor alone. In Home, one worker can produce 4 bushels of wheat or 2 yards of cloth. This production can be expressed in terms of the marginal product of labor (MPL) for each good. Recall from your study of microeconomics that the marginal product of labor is the extra output obtained by using one more unit of labor.[2] In Home, one worker produces 4 bushels of wheat, so $MPL_W = 4$. Alternatively, one worker can produce 2 yards of cloth, so $MPL_C = 2$.

Home Production Possibilities Frontier

Using the marginal products for producing wheat and cloth, we can graph Home's production possibilities frontier (PPF). Suppose there are $\bar{L} = 25$ workers in Home (the bar over the letter L indicates our assumption that the amount of labor in Home stays constant). If all these workers were employed in wheat, they could produce $Q_W = MPL_W \cdot \bar{L} = 4 \cdot 25 = 100$ bushels. Alternatively, if they were all employed in cloth, they could produce $Q_C = MPL_C \cdot \bar{L} = 2 \cdot 25 = 50$ yards. The production possibilities frontier is a straight line between these two points at the corners, as shown in Figure 2-1. The straight-line PPF, a special feature of the Ricardian model, follows from the assumption that the marginal products of labor are *constant*. That is, regardless of how much wheat or cloth is already being produced, one extra hour of labor yields an additional 4 bushels of wheat or 2 yards of cloth. There are *no diminishing returns* in the Ricardian model because it ignores the role of land and capital.

Given this property, the slope of the PPF in Figure 2-1 can be calculated as the ratio of the quantity of cloth produced to the quantity of wheat produced at the corners, as follows:

$$\text{Slope of PPF} = -\frac{50}{100} = -\frac{MPLC \cdot \bar{L}}{MPLW \cdot \bar{L}} = -\frac{MPLC}{MPLW} = -\frac{1}{2}$$

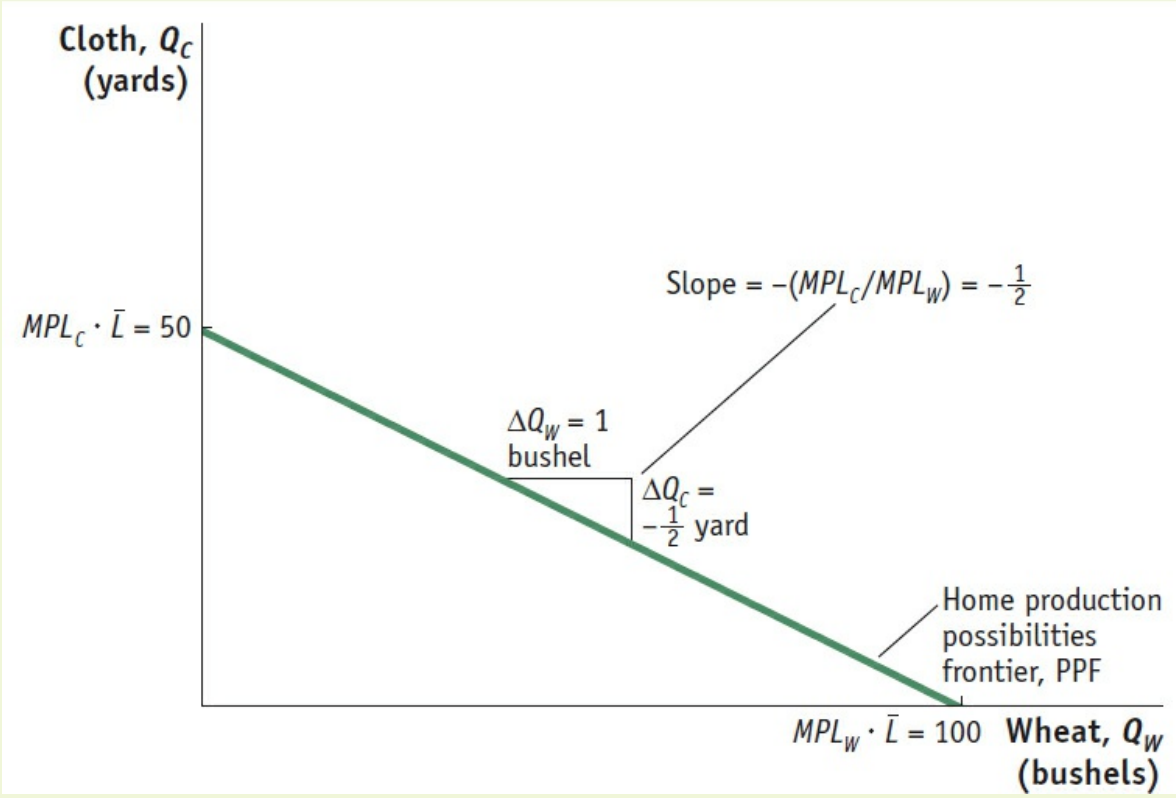


FIGURE 2-1

Home Production Possibilities Frontier The Home PPF is a straight line between 50 yards of cloth and 100 bushels of wheat. The slope of the PPF equals the negative of the opportunity cost of wheat; that is, the amount of cloth that must be given up (12 yard) to obtain 1 more bushel of wheat. Equivalently, the magnitude of the slope can be expressed as the ratio of the marginal products of labor for the two goods.

Ignoring the minus sign, the slope equals the ratio of marginal products of the two goods. The slope is also the opportunity cost of wheat, the amount of cloth that must be given up to obtain one more unit of wheat.[3] To see this, suppose that Q_W is increased by 1 bushel. It takes one worker to produce 4 bushels of wheat, so increasing Q_W by 1 bushel means that one-quarter of a worker's time must be withdrawn from the cloth industry and shifted into wheat production. This shift would reduce cloth output by 12 yard, the amount of cloth that could have been produced by one-quarter of a worker's time. Thus, 12 yard of cloth is the opportunity cost of obtaining 1 more bushel of wheat and is the slope of the PPF.

Home Indifference Curve

With this production possibilities frontier, what combination of wheat and cloth will Home actually produce? The answer depends on the country's demand for each of the two goods. There are several ways to represent demand in the Home economy, but we will start

by using indifference curves. Each indifference curve shows the combinations of two goods, such as wheat and cloth, that a person or economy can consume and be equally satisfied.

In Figure 2-2, the consumer is indifferent between points *A* and *B,* for example. Both of these points lie on an indifference curve U_1 associated with a given level of satisfaction, or utility. Point *C* lies on a higher indifference curve U_2, indicating that it gives a higher level of utility, whereas point *D* lies on a lower indifference curve U_0, indicating that it gives a lower level of utility. It is common to use indifference curves to reflect the utility that an individual consumer receives from various consumption points. In Figure 2-2, we go a step further, however, and apply this idea to an entire country. That is, the indifference curves in Figure 2-2 show the preferences of an entire country. The combinations of wheat and cloth on U_0 give consumers in the country lower utility than the combinations on indifference curve U_1, which in turn gives lower utility than the combinations of wheat and cloth on U_2.

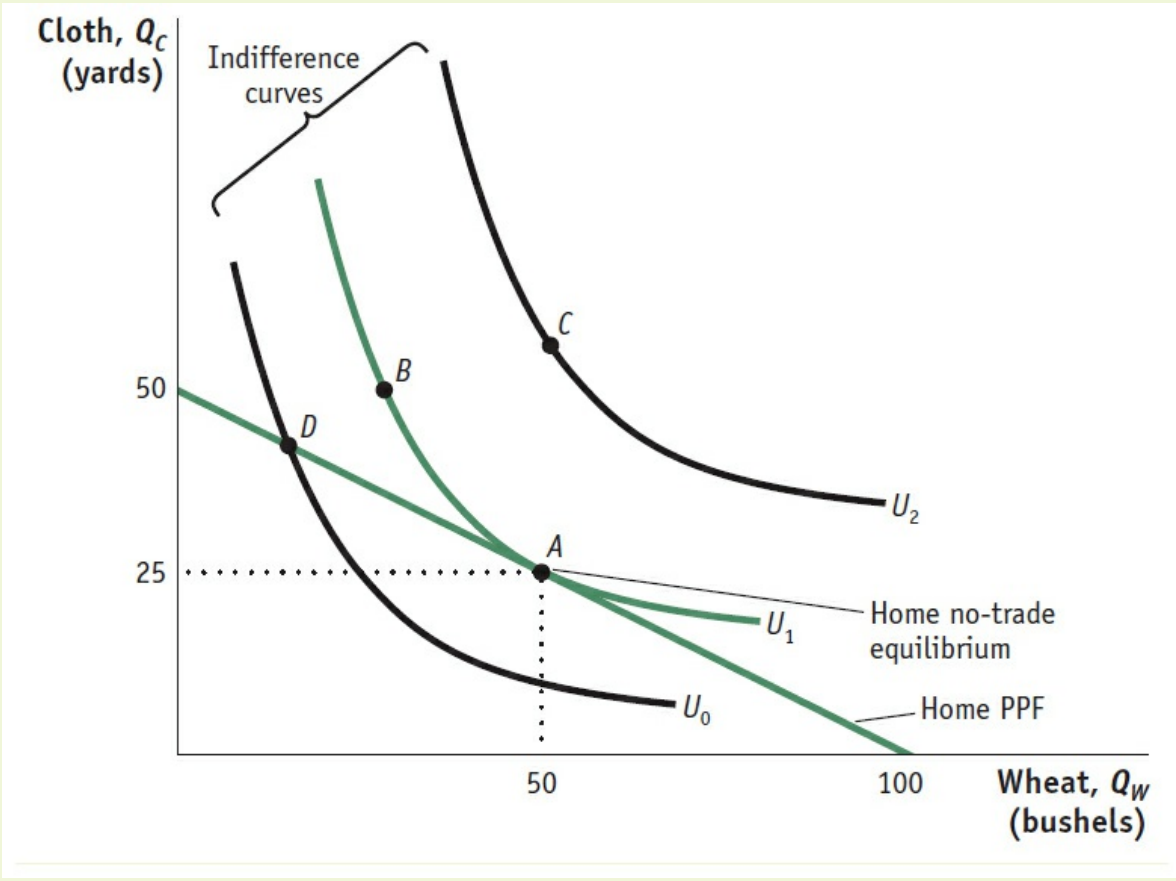


FIGURE 2-2

Home Equilibrium with No Trade Points *A* and *B* lie on the same indifference curve and give the Home consumers the level of utility, U_1. The highest level of Home utility on the PPF is obtained at point *A,* which is the no-trade equilibrium. Point *D* is also on the PPF but would give lower utility. Point *C* represents a higher utility level but is off of the PPF, so it is not attainable in the absence of international trade.

Home Equilibrium

In the absence of international trade, the production possibilities frontier acts like a budget constraint for the country, and with perfectly competitive markets, the economy will produce at the point of highest utility subject to the limits imposed by its PPF. The point of highest utility is at point *A* in Figure 2-2, where Home consumes 25 yards of cloth and 50 bushels of wheat. This bundle of goods gives Home the highest level of utility possible (indifference curve U_1) given the limits of its PPF. Notice that Home could produce at other points such as point *D,* but this point would give a lower level of utility than point *A* (i.e., point *D* would offer lower utility because U_0 is lower than U_1). Other consumption points, such as *C,* would give higher levels of utility than point *A* but cannot be obtained in the absence of international trade because they lie outside of Home's PPF.

We will refer to point *A* as the "no-trade" or the "pre-trade" equilibrium for Home.[4] What we really mean by this phrase is "no *international* trade." Home is able to reach point *A* by having its own firms produce wheat and cloth and sell these goods to its own consumers. We are assuming that there are many firms in each of the wheat and cloth industries, so the firms act under perfect competition and take the market prices for wheat and cloth as given. The idea that perfectly competitive markets lead to the highest level of well-being for consumers—as illustrated by the highest level of utility at point *A*—is an example of the "invisible hand" that Adam Smith (1723–1790) wrote about in his famous book *The Wealth of Nations*. Like an invisible hand, competitive markets lead firms to produce the amount of goods that results in the highest level of well-being for consumers.

Opportunity Cost and Prices

Whereas the slope of the PPF reflects the opportunity cost of producing one more bushel of wheat, under perfect competition the opportunity cost of wheat should also equal the relative price of wheat, as follows from the economic principle that price reflects the opportunity cost of a good. We can now check that this equality between the opportunity cost and the relative price of wheat holds at point *A*.

Wages

We solve for the prices of wheat and cloth using an indirect approach, by first reviewing how wages are determined. In competitive labor markets, firms hire workers up to the point at which the cost of one more hour of labor (the wage) equals the value of one more hour of production. In turn, the value of one more hour of labor equals the amount of goods produced in that hour (the marginal product of labor) times the price of the good (P_W for the price of wheat and P_C for the price of cloth). That is to say, in the wheat industry, labor will be hired up to the point at which the wage equals $P_W \cdot MPL_W$, and in the cloth industry labor will be hired up to the point at which the wage equals $P_C \cdot MPL_C$.

If we assume that labor is perfectly free to move between these two industries and that

workers will choose to work in the industry for which the wage is highest, then wages must be equalized across the two industries. If the wages were not the same in the two industries, laborers in the low-wage industry would have an incentive to move to the high-wage industry; this would, in turn, lead to an abundance of workers and a decrease in the wage in the high-wage industry, and a scarcity of workers and an increase in the wage in the low-wage industry. This movement of labor would continue until wages are equalized between the two industries.

We can use the equality of the wage across industries to obtain the following equation:

$$P_W \cdot MPL_W = P_C \cdot MPL_C$$

By rearranging terms, we see that

$$P_W/P_C = MPL_C/MPL_W$$

The right-hand side of this equation is the slope of the production possibilities frontier (the opportunity cost of obtaining one more bushel of wheat) and the left-hand side of the equation is the relative price of wheat, as we will explain in the next paragraph. This equation says that the relative price of wheat (on the left) and opportunity cost of wheat (on the right) must be equal in the no-trade equilibrium at point *A*.

To understand why we measure the relative price of wheat as the ratio P_W/P_C, suppose that a bushel of wheat costs \$3 and a yard of cloth costs \$6. Then \$3/\$6 = 12, which shows that the relative price of wheat is 12, that is, 12 of a yard of cloth (or half of \$6) must be given up to obtain 1 bushel of wheat (the price of which is \$3). A price ratio like P_W/P_C always denotes the relative price of the good in the numerator (wheat, in this case), measured in terms of how much of the good in the denominator (cloth) must be given up. In Figure 2-2, the slope of the PPF equals the relative price of wheat, the good on the *horizontal axis.*

The Foreign Country

Now let's introduce another country, Foreign, into the model. We will assume that Foreign's technology is inferior to Home's so that it has an absolute *disadvantage* in producing both wheat and cloth as compared with Home. Nevertheless, once we introduce international trade, we will still find that Foreign will trade with Home.

Foreign Production Possibilities Frontier

Suppose that one worker in Foreign can produce 1 bushel of wheat ($MPL^*_W = 1$), or 1 yard of cloth ($MPL^*_C = 1$), whereas recall that a worker in Home can produce 4 bushels of wheat or 2 yards of cloth. Suppose that there are $L^* = 100$ workers available in Foreign. If all these workers were employed in wheat, they could produce $MPL^*_W \cdot L^* = 100$ bushels, and if they were all employed in cloth, they could produce $MPL^*_C \cdot L^* = 100$ yards. Foreign's production possibilities frontier is thus a straight line between these two points, with a slope of –1, as shown in Figure 2-3.

You might find it helpful to think of Home in our example as the United States or Europe and Foreign as the "rest of the world." Empirical evidence supports the idea that the United States and Europe have the leading technologies in many goods and an absolute advantage in the production of both wheat and cloth. Nevertheless, they import much of their clothing and textiles from abroad, especially from Asia and Latin America. Why does the United States or Europe import these goods from abroad when they have superior technology at home? To answer this question, we want to focus on the *comparative advantage* of Home and Foreign in producing the two goods.

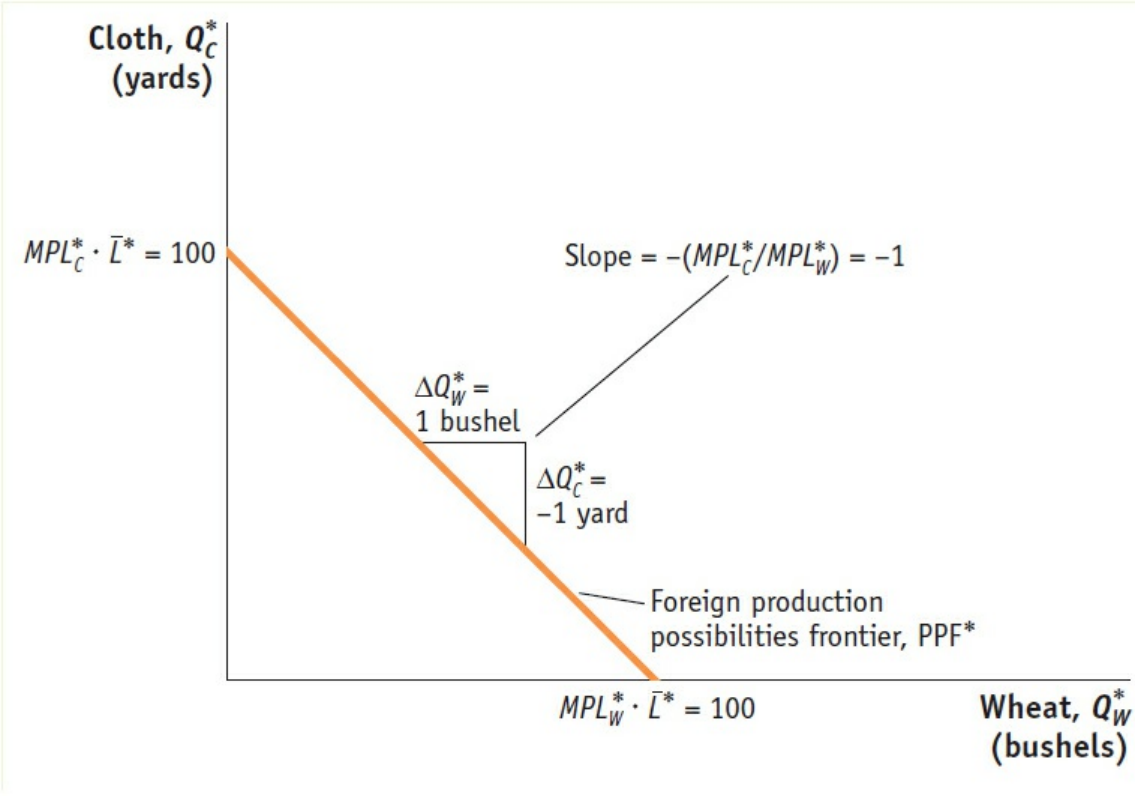


FIGURE 2-3

Foreign Production Possibilities Frontier The Foreign PPF is a straight line between 100 yards of cloth and 100 bushels of wheat. The slope of the PPF equals the negative of the opportunity cost of wheat; that is, the amount of cloth that must be given up (1 yard) to obtain 1 more bushel of wheat.

Comparative Advantage

In Foreign, it takes one worker to produce 1 bushel of wheat or 1 yard of cloth. Therefore, the opportunity cost of producing 1 yard of cloth is 1 bushel of wheat. In Home, one worker produces 2 yards of cloth or 4 bushels of wheat. Therefore, Home's opportunity cost of a bushel of wheat is 12 a yard of cloth, and its opportunity cost of a yard of cloth is 2 bushels of wheat. Based on this comparison, Foreign has a *comparative advantage in*

producing cloth because its opportunity cost of cloth (which is 1 bushel of wheat) is *lower* than Home's opportunity cost of cloth (which is 2 bushels of wheat). Conversely, Home has a *comparative advantage in producing wheat* because Home's opportunity cost of wheat (which is 12 yard of cloth) is lower than Foreign's (1 yard of cloth). In general, a country has a comparative advantage in a good when it has a lower opportunity cost of producing it than does the other country. Notice that Foreign has a comparative advantage in cloth even though it has an absolute disadvantage in both goods.

As before, we can represent Foreign's preferences for wheat and cloth with indifference curves like those shown in Figure 2-4. With competitive markets, the economy will produce at the point of highest utility for the country, point A^*, which is the no-trade equilibrium in Foreign. The slope of the PPF, which equals the opportunity cost of wheat, also equals the relative price of wheat.[5] Therefore, in Figure 2-4, Foreign's no-trade relative price of wheat is $P^*_W/P^*_C = 1$. Notice that this relative price *exceeds* Home's no-trade relative price of wheat, which is $P_W/P_C = 12$. This difference in these relative prices reflects the comparative advantage that Home has in the production of wheat.[6]

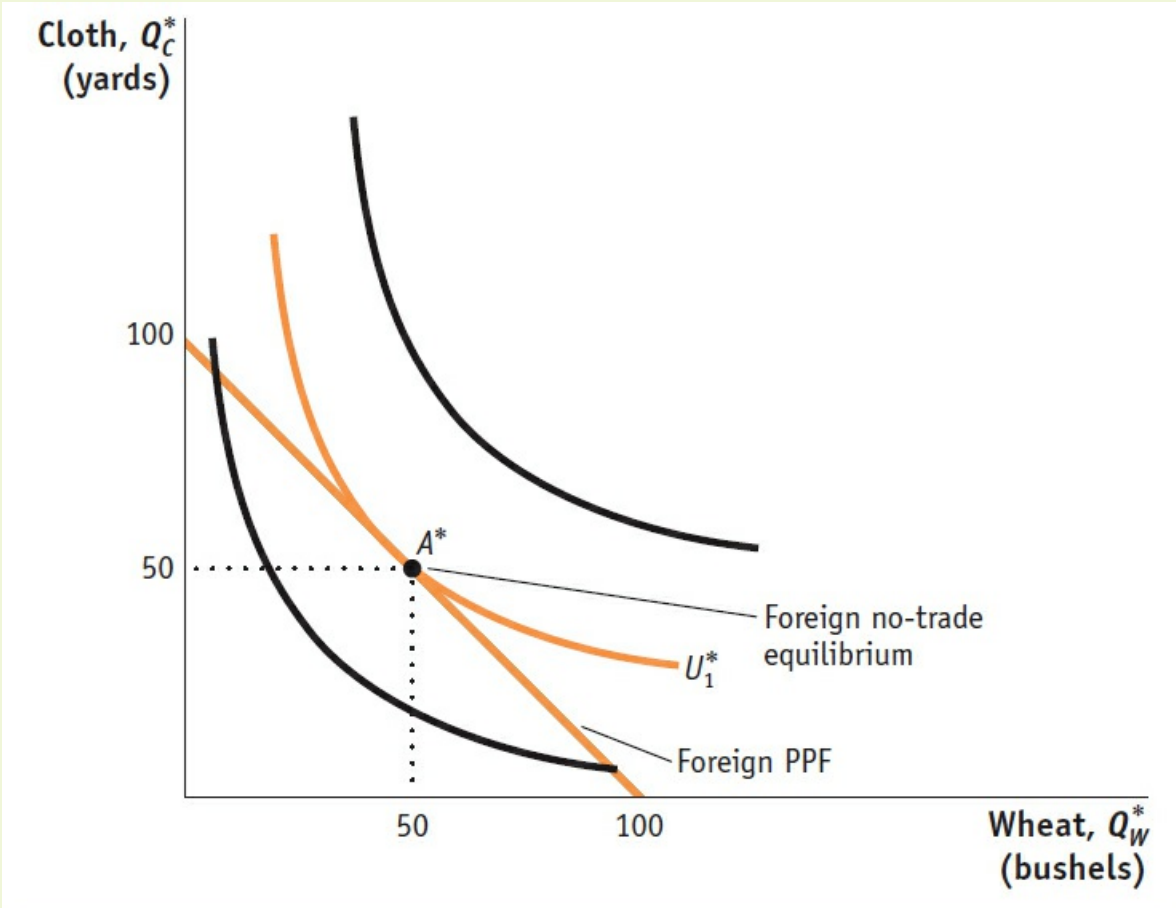


FIGURE 2-4

Foreign Equilibrium with No Trade The highest level of Foreign utility on the PPF is obtained at point A^*,

which is the no-trade equilibrium.

APPLICATION

Comparative Advantage in Apparel, Textiles, and Wheat

The U.S. textile and apparel industries face intense import competition, especially from Asia and Latin America. Employment in this industry in the United States fell by more than 80%, from about 1.7 million people in 1990 to about 280,000 in 2014. An example of this import competition can be seen in one U.S. fabric manufacturer, Burlington Industries, which announced in January 1999 that it would reduce its production capacity by 25% because of increased imports from Asia. Burlington closed seven plants and laid off 2,900 people, approximately 17% of its domestic force. After the layoffs, Burlington Industries employed 17,400 people in the United States. Despite these reductions in employment, textiles and apparel remain an important industry in some cities: Los Angeles had about 2,500 business establishments in the apparel industry in 2010, and New York had about 800.[7]

The average sales total per employee for all U.S. apparel producers was $70,000 in 2014, as shown in Table 2-2. The textile industry, producing the fabric and material inputs for apparel, is even more productive, with annual sales per employee of $232,000 in the United States. In comparison, the average employee in China produces $27,000 of sales per year in the apparel industry and $20,000 in the textile industry. Thus, an employee in the United States produces $70,000/$27,000 = 2.6 times more apparel sales than an employee in China and $232,000/$20,000 = 12 times more textile sales. This ratio is shown in Table 2-2 in the column labeled "Absolute Advantage." It illustrates how much more productive U.S. labor is in these industries relative to Chinese labor. The United States clearly has an absolute advantage in both these industries, so why does it import so much of its textiles and apparel from Asia, including China?

The answer can be seen by also comparing the productivities in the wheat industry. The typical wheat farm in the United States grows 10,000 bushels of wheat per worker (by which we mean either the farmer or an employee). In comparison, the typical wheat farm in China produces only 300 bushels of wheat per worker, so the U.S. farm is 10,000/300 = 33 times more productive! The United States clearly has an *absolute advantage* in the textile and apparel and wheat industries.

But China has the *comparative advantage* in both apparel and textiles, as illustrated by the columns labeled "Comparative Advantage." Dividing the marginal product of labor in wheat by the marginal product of labor in apparel give us the *opportunity cost of apparel*. In the United States, for example, this ratio is 10,000/$70,000 = 0.14 bushels/$, indicating that 0.14 bushels of wheat must be foregone to obtain an extra dollar of sales in apparel. In textiles, the U.S. ratio is 10,000/$232,000 = 0.04 bushels/$,

so that 0.04 bushels of wheat must be foregone to obtain an extra dollar in textile sales. These ratios are much smaller in China: only 300/$27,000 or 300/$20,000 ≈ 0.01 bushels of wheat must be foregone to obtain $1 of extra sales in either textiles or apparel. As a result, China has a lower opportunity cost of both textiles and apparel than the United States, which explains why it exports those goods, while the United States exports wheat, just as predicted by the Ricardian model.

TABLE 2-2

Apparel, Textiles, and Wheat in the United States and China This table shows sales per employee for the apparel and textile industries in the United States and China, as well as bushels per worker in producing wheat. The United States has an absolute advantage in all these products (as shown by the numbers in the right-hand column of the table), but it has a comparative advantage in producing wheat (as shown by the numbers in the bottom rows of the table).

	United States	China	Absolute Advantage
	Sales/Employee	*Sales/Employee*	*U.S./China Ratio*
Apparel	$70,000	$27,000	2.6
Textiles	$232,000	$20,000	12
	Bushels/Worker	*Bushels/Worker*	*U.S./China Ratio*
Wheat	10,000	300	33
	Comparative Advantage		
Wheat/apparel ratio	0.14	0.01	
Wheat/textile ratio	0.04	0.01	

Note: Data are for 2013 or 2014.

Data from: U.S. apparel and textile data from U.S. Bureau of Labor Statistics, 2014. U.S. wheat data from USDA Wheat Yearbook 2014. All China data from China Statistical Yearbook 2013.

3 Determining the Pattern of International Trade

Now that we have examined each country in the absence of trade, we can start to analyze what happens when goods are traded between them. We will see that a country's no-trade relative price determines which product it will export and which it will import when trade is opened. Earlier, we saw that the no-trade relative price in each country equals its opportunity cost of producing that good. Therefore, the pattern of exports and imports is determined by the opportunity costs of production in each country, or by each country's pattern of comparative advantage. This section examines why this is the case and details each country's choice of how much to produce, consume, and trade of each good.

International Trade Equilibrium

The differences in no-trade prices across the countries create an opportunity for international trade between them. In particular, producers of cloth in Foreign, where the relative price of cloth is $P^*_C/P^*_W = 1$, would want to export cloth to Home, where the relative price, $P_C/P_W = 2$, is higher. Conversely, producers of wheat in Home, where the relative price of wheat is $P_W/P_C = 12$, would want to export wheat to Foreign, where the relative price of $P^*_W/P^*_C = 1$ is higher. The trade pattern that we expect to arise, then, is that *Home will export wheat,* and *Foreign will export cloth.* Notice that both countries export the good in which they have a comparative advantage, which is what the Ricardian model predicts.

To solidify our understanding of this trade pattern, let's be more careful about explaining where the two countries would produce on their PPFs under international trade and where they would consume. As Home exports wheat, the quantity of wheat sold in Home falls, and this condition bids up the price of wheat in the Home market. As the exported wheat arrives in Foreign's wheat market, more wheat is sold there, and the price of wheat in Foreign's market falls. Likewise, as Foreign exports cloth, the price of cloth in Foreign will be bid up and the price of cloth in Home will fall. The two countries are in an international trade equilibrium, or just "trade equilibrium," for short, when the relative price of wheat is the same in the two countries, which means that the relative price of cloth is also the same in both countries.[8]

To fully understand the international trade equilibrium, we are interested in two issues: (1) determining the relative price of wheat (or cloth) in the trade equilibrium, and (2) seeing how the shift from the no-trade equilibrium to the trade equilibrium affects production and consumption in both Home and Foreign. Addressing the first issue requires some additional graphs, so let's delay this discussion for a moment and suppose for now that the relative price of wheat in the trade equilibrium is established at a level between the pre-trade prices in the two countries. This assumption is consistent with the bidding up of export prices and bidding down of import prices, as discussed previously. Since the no-trade prices were $P_W/P_C = 12$ in Home and $P^*_W/P^*_C = 1$ in Foreign, let's suppose that the world relative price of wheat is between these two values, say, at 23. Given the change in relative prices from their pre-trade level to the international trade equilibrium, what

happens to production and consumption in each of the two countries?

Change in Production and Consumption

The world relative price of wheat that we have chosen for this example is higher than Home's pre-trade price (23 > 12). This relationship between the pre-trade and world relative prices means that Home producers of wheat can earn more than the opportunity cost of wheat (which is 12) by selling their wheat to Foreign. For this reason, Home will shift its labor resources toward the production of wheat and produce more wheat than it did in the pre-trade equilibrium (point *A* in Figure 2-5). To check that this intuition is correct, let us explore the incentives for labor to work in each of Home's industries.

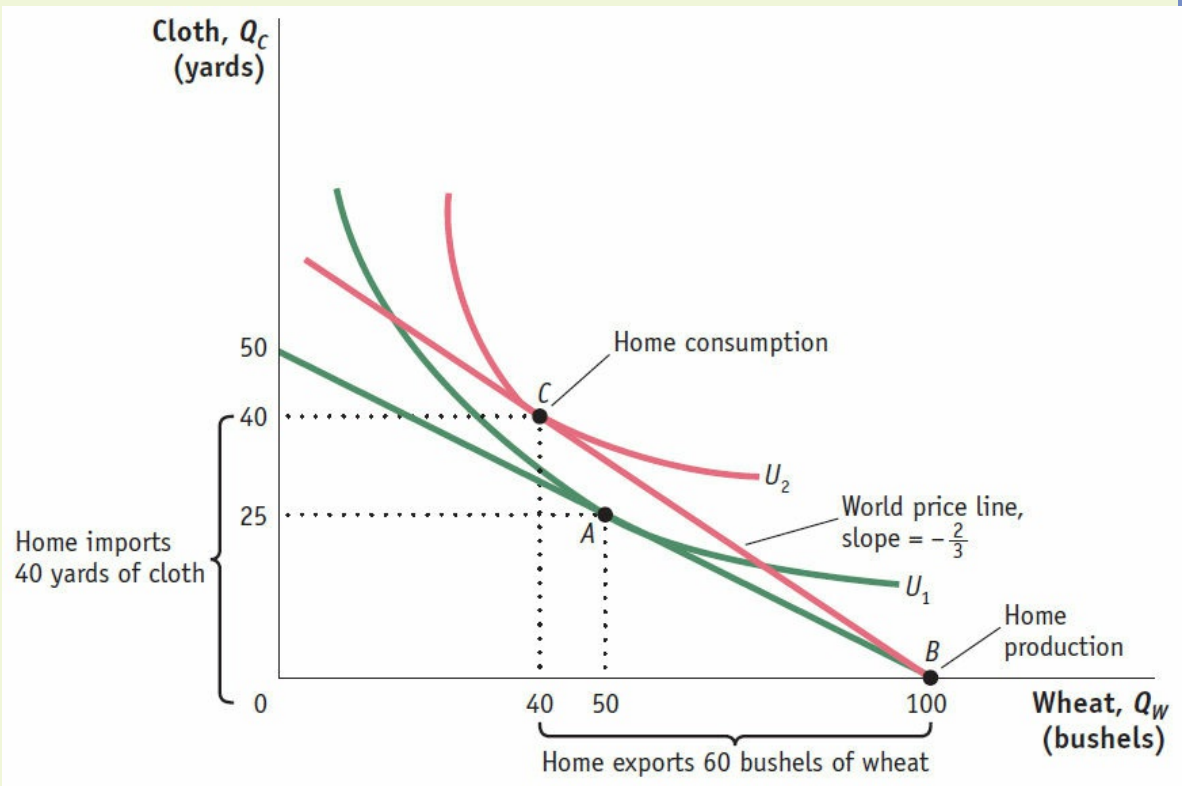


FIGURE 2-5

Home Equilibrium with Trade With a world relative price of wheat of 23, Home production will occur at point *B*. Through international trade, Home is able to export each bushel of wheat it produces in exchange for 23 yard of cloth. As wheat is exported, Home moves up the world price line, *BC*. Home consumption occurs at point *C*, at the tangent intersection with indifference curve, U_2, since this is the highest possible utility curve on the world price line. Given these levels of production and consumption, we can see that total exports are 60 bushels of wheat in exchange for imports of 40 yards of cloth and also that Home consumes 10 fewer bushels of wheat and 15 more yards of cloth relative to its pre-trade levels.

Recall that Home wages paid in the wheat industry equal $P_W \cdot MPL_W$, and wages paid in the cloth industry equal $P_C \cdot MPL_C$. We know that the relative price of wheat in the trade equilibrium is $P_W/P_C = 23$, that the marginal product of labor in the Home wheat industry is $MPL_W = 4$, and that the marginal product of labor in the Home cloth industry is $MPL_C = 2$. We can plug these numbers into the formulas for wages to compute the *ratio* of wages in the two industries as

$$PW \cdot MPLW PC \cdot MPLC = (23)(42) = 86 > 1, \text{ so that } PW \cdot MPLW > PC \cdot MPLC$$

This formula tells us that with the world relative price of wheat, wages paid in Home's wheat industry ($P_W \cdot MPL_W$) are greater than those paid in its cloth industry ($P_C \cdot MPL_C$). Accordingly, all of Home's workers will want to work in the wheat industry, and no cloth will be produced. With trade, the Home economy will be fully specialized in wheat production, as occurs at production point *B* in Figure 2-5.[9]

International Trade

Starting at the production point *B,* Home can export wheat at a relative price of 23. This means that for 1 bushel of wheat exported to Foreign, it receives 23 yard of cloth in exchange. In Figure 2-5, we can trace out its international trades by starting at point *B* and then exchanging 1 bushel of wheat for 23 yard of cloth, another bushel of wheat for 23 yard of cloth, and so on. From point *B,* this traces out the line toward point *C,* with slope −23. We will call the line starting at point *B* (the production point) and with a slope equal to the negative of the world relative price of wheat, the world price line, as shown by *BC.* The world price line shows the range of *consumption possibilities* that a country can achieve by specializing in one good (wheat, in Home's case) and engaging in international trade (exporting wheat and importing cloth). We can think of the world price line as a new budget constraint for the country under international trade.

Notice that this budget constraint (the line *BC*) lies *above* Home's original PPF. The ability to engage in international trade creates consumption possibilities for Home that were not available in the absence of trade when the consumption point had to be on Home's PPF. Now, Home can choose to consume at any point on the world price line, and utility is maximized at the point corresponding to the intersection with highest indifference curve, labeled *C* with a utility of U_2. Home obtains a higher utility with international trade than in the absence of international trade (U_2 is higher than U_1); the finding that Home's utility increases with trade is our first demonstration of the gains from trade, by which we mean the ability of a country to obtain higher utility for its citizens under free trade than with no trade.

Pattern of Trade and Gains from Trade

Comparing production point *B* with consumption point *C,* we see that Home is exporting 100 – 40 = 60 bushels of wheat, in exchange for 40 yards of cloth imported from Foreign. If we value the wheat at its international price of 23, then the value of the exported wheat is

$23 \cdot 60 = 40$ yards of cloth, and the value of the imported cloth is also 40 yards of cloth. Because Home's exports equal its imports, this outcome shows that Home's trade is balanced.

What happens in Foreign when trade occurs? Foreign's production and consumption points are shown in Figure 2-6. The world relative price of wheat (23) is less than Foreign's pre-trade relative price of wheat (which is 1). This difference in relative prices causes workers to leave wheat production and move into the cloth industry. Foreign specializes in cloth production at point B^*, and from there, trades along the world price line with a slope of (negative) 23, which is the relative price of wheat. That is, Foreign exchanges 23 yard of cloth for 1 bushel of wheat, then 23 yard of cloth for another 1 bushel of wheat, and so on repeatedly, as it moves down the world price line B^*C^*. The consumption point that maximizes Foreign's utility is C^*, at which point 60 units of each good are consumed and utility is U^*_2. Foreign's utility is greater than it was in the absence of international trade (U^*_2 is a higher indifference curve than U^*_1), as is true for Home. Therefore, both countries gain from trade.

Foreign produces 100 yards of cloth at point B^*: it consumes 60 yards itself and exports $100 - 60 = 40$ yards of cloth in exchange for 60 bushels of wheat imported from Home. This trade pattern is exactly the opposite of Home's, as must be the case. In our two-country world, everything leaving one country must arrive in the other. We see that Home is exporting wheat, in which it has a comparative advantage (Home's opportunity cost of wheat production is 12 yard of cloth compared with 1 yard in Foreign). Furthermore, Foreign is exporting cloth, in which it has a comparative advantage (Foreign's opportunity cost of cloth production is 1 bushel of wheat compared with 2 bushels in Home). This outcome confirms that *the pattern of trade is determined by comparative advantage,* which is the first lesson of the Ricardian model. We have also established that there are *gains from trade for both countries,* which is the second lesson.

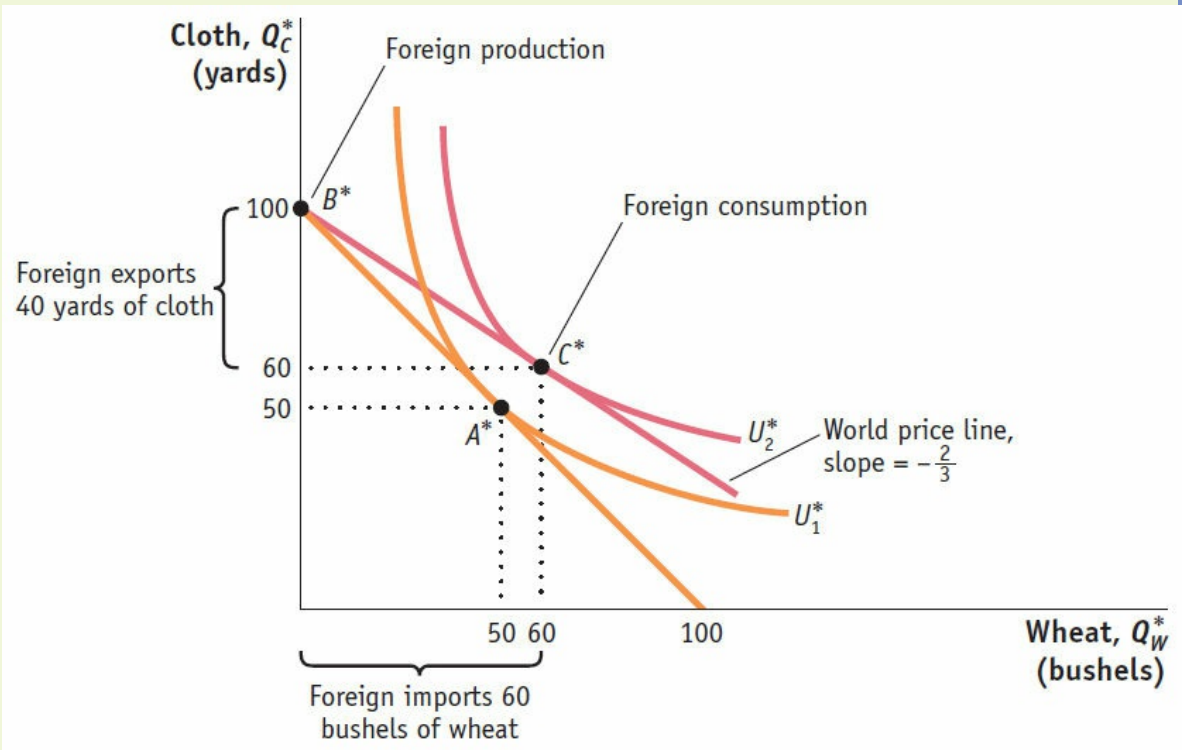


FIGURE 2-6

Foreign Equilibrium with Trade With a world relative price of wheat of 23, Foreign production will occur at point B^*. Through international trade, Foreign is able to export 23 yard of cloth in exchange for 1 bushel of wheat, moving down the world price line, B^*C^*. Foreign consumption occurs at point C^*, and total exports are 40 yards of cloth in exchange for imports of 60 bushels of wheat. Relative to its pre-trade wheat and cloth consumption (point A^*), Foreign consumes 10 more bushels of wheat and 10 more yards of cloth.

These two conclusions are often where the Ricardian model stops in its analysis of trade between countries, but the story is incomplete because we have not yet determined the level of wages across countries. We have seen that with trade, the relative price of each good converges to a single equilibrium price in both countries. Does the same occur with wages? As we now show, this is not the case. Wage levels differ across countries with trade, and wages are determined by *absolute* advantage, not *comparative* advantage. This is a third, less emphasized lesson from the Ricardian model, which we explore next.

Solving for Wages Across Countries

To understand how wages are determined, we go back to microeconomics. In competitive labor markets, firms will pay workers the value of their marginal product. Home produces and exports wheat, so we can think of Home workers being paid in terms of that good: their real wage is $MPL_W = 4$ bushels of wheat. We refer to this payment as a "real" wage because it is measured in terms of a good that workers consume and not in terms of money. The workers can then sell the wheat they earn on the world market at the relative price of

$P_W/P_C = 23$. Thus, their real wage in terms of units of cloth is $(P_W/P_C) \cdot MPL_W = 23 \cdot 4 =$ 83 yard. Summing up, the Home wage is[10]

Home wage=
{MPLW=4 bushels of wheat or (PW/PC) · MI

What happens to Foreign wages? Foreign produces and exports cloth, and the real wage is $MPL^*_C = 1$ yard of cloth. Because cloth workers can sell the cloth they earn for wheat on the world market at the price of 32, their real wage in terms of units of wheat is $(P^*_C/P^*_W) \cdot MPL^*_C = (32) \cdot 1 = 32$ bushels. Thus, the Foreign wage is[11]

Foreign wage={
(PC*/PW*) · MPLC*=32 bushels of wheat or

Foreign workers earn less than Home workers as measured by their ability to purchase either good. This fact reflects Home's absolute advantage in the production of both goods.

Absolute Advantage

As our example shows, wages are determined by absolute advantage: Home is paying higher wages because it has better technology in both goods. In contrast, the pattern of trade in the Ricardian model is determined by comparative advantage. Indeed, these two results go hand in hand—the only way that a country with poor technology can export at a price others are willing to pay is by having low wages.

This statement might sound like a pessimistic assessment of the ability of less-developed countries to pay reasonable wages, but it carries with it a silver lining: as a country develops its technology, its wages will correspondingly rise. In the Ricardian model, a logical consequence of technological progress is that workers will become better off through receiving higher wages. In addition, as countries engage in international trade, the Ricardian model predicts that their real wages will rise.[12] We do not have to look very hard to see examples of this outcome in the world. Per capita income in China in 1978, just as that nation began to open up to international trade, is estimated to have been $1,600, whereas 36 years later in 2014, per capita income in China had risen by nearly eight times to $12,400. These estimates mean that the real income that Chinese consumers had available to spend doubled every 12 years. For India, per capita income increased by more than four times from $1,300 in 1978 to $5,600 in 2014, so that real income doubled every 18 years.[13] Many people believe that the opportunity for these countries to engage in international trade has been crucial in raising their standard of living. As our study of international trade proceeds, we will try to identify the conditions that have allowed China, India, and many other developing countries to improve their standards of living through trade.

APPLICATION

Labor Productivity and Wages

The close connection between wages and labor productivity is evident by looking at data across countries. Labor productivity can be measured by the *value-added per hour* in manufacturing. Value-added is the difference between sales revenue in an industry and the costs of intermediate inputs (e.g., the difference between the value of a car and the cost of all the parts used to build it). Value-added then equals the payments to labor and capital in an industry. In the Ricardian model, we ignore capital, so we can measure labor productivity as value-added divided by the number of hours worked, or value-added per hour.

In Figure 2-7, we show the value-added per hour in manufacturing in 2011 for several different countries. The United States has the highest level of productivity and Taiwan has the lowest of the countries shown. Figure 2-7 also shows the wages per hour paid in each country. These are somewhat less than value-added per hour because value-added is also used to pay capital. We see that the highest productivity countries shown —the United States and Japan—have higher wages than the lowest productivity countries shown—South Korea and Taiwan. But the middle countries—Italy, France, and Sweden—have wages at or above the U.S. level, despite having lower productivity. That is because the wage being used includes the *benefits* received by workers, in the form of medical benefits, Social Security, and so on. Many European countries have higher social benefits than the United States. Although including benefits distorts the comparison between wages and productivity, we still see from Figure 2-7 that higher productivity countries tend to have higher wages, broadly speaking, as the Ricardian model predicts. The connection between productivity and wages is also evident if we look at countries over time. Figure 2-8 shows that the general upward movement in labor productivity is matched by upward movement in wages, also as the Ricardian model predicts.

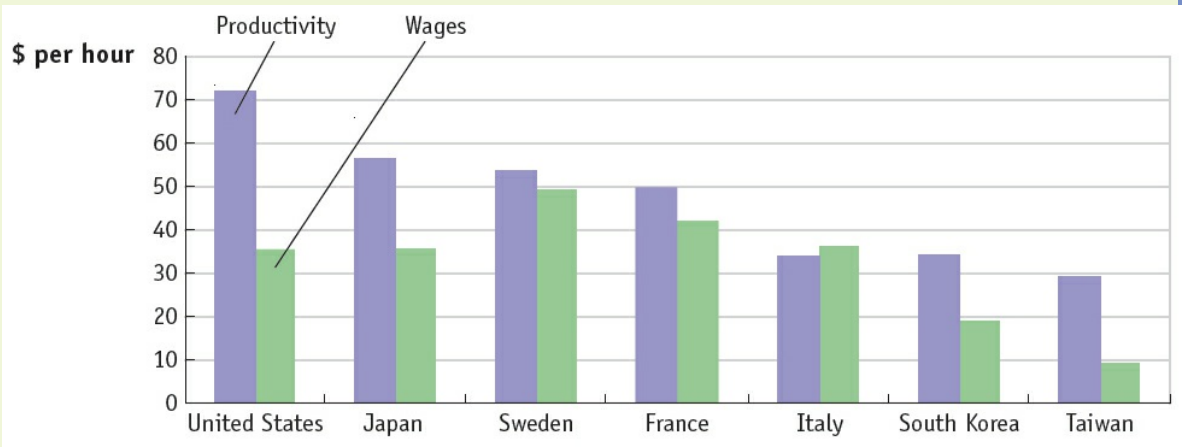


FIGURE 2-7

Labor Productivity and Wages, 2011 Labor productivity is measured by value-added per hour of work and can be compared with the wages paid in manufacturing in various countries. The general ranking of countries in terms of labor productivity—from highest to lowest—is the same as the ranking in terms of wages: countries with higher labor productivity generally pay higher wages, just as the Ricardian model predicts.

Data from: U.S. Department of Labor, Bureau of Labor Statistics.

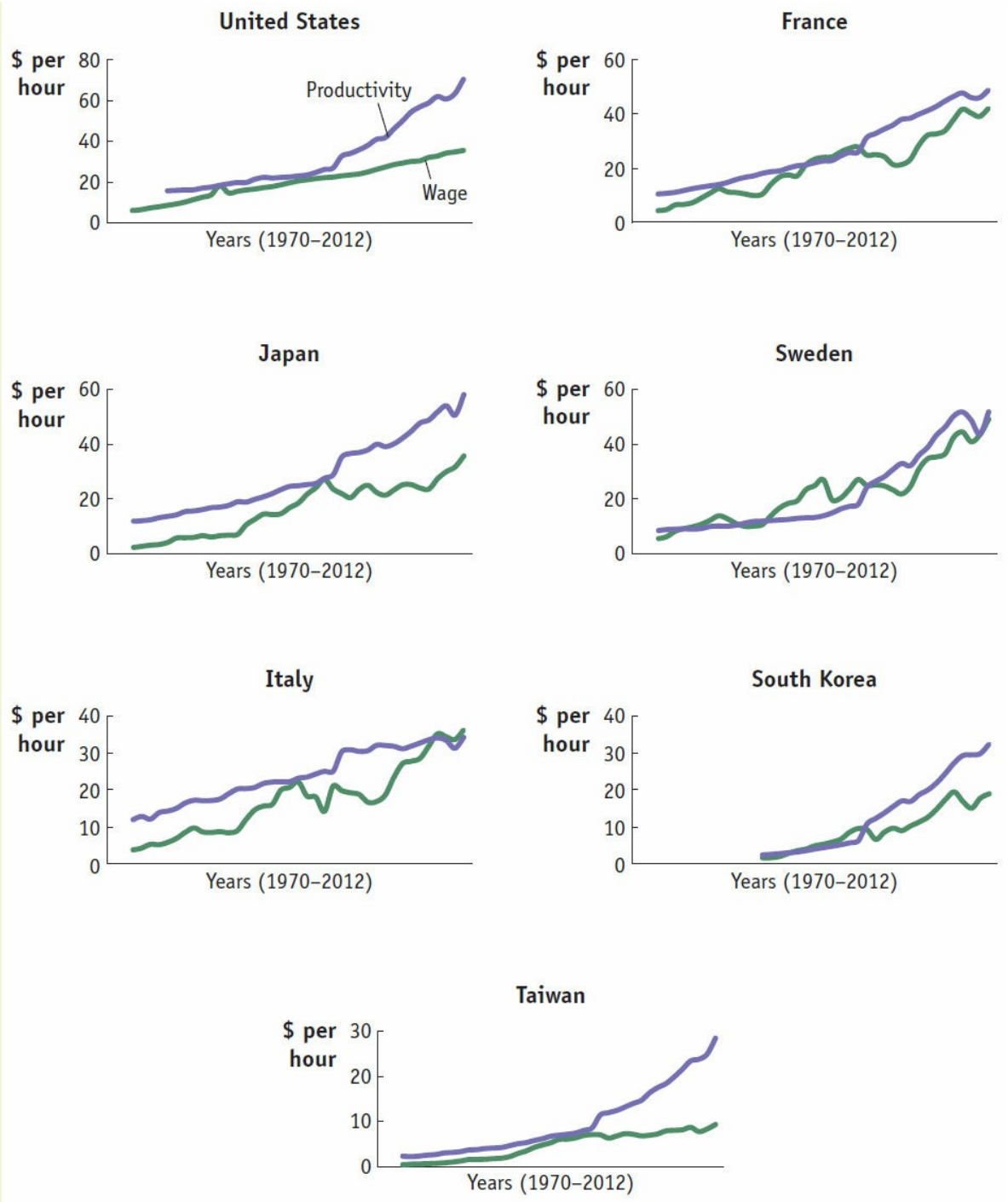


FIGURE 2-8

Labor Productivity and Wages over Time The trends in labor productivity and wages can also be graphed over time. The general upward movement in labor productivity is matched by upward movements in wages, as predicted by the Ricardian model.

Data from: U.S. Department of Labor, Bureau of Labor Statistics.

4 Solving for International Prices

In Figures 2-5 and 2-6, we assumed that the world relative price of wheat was and that at this level Home's exports of wheat just equaled Foreign's imports of wheat (and vice versa for cloth). Now let's dig a little deeper to show how the world price is determined.

To determine the world relative price of wheat, we will use supply and demand curves. Home exports wheat, so we will derive a Home export supply curve, which shows the amount it wants to export at various relative prices. Foreign imports wheat, so we will derive a Foreign import demand curve, which shows the amount of wheat that it will import at various relative prices. The international trade equilibrium is the quantity and relative price at which Home's exports equal Foreign's imports of wheat. This equality occurs where the Home export supply curve intersects the Foreign import demand curve.

Home Export Supply Curve

In panel (a) of Figure 2-9, we repeat Figure 2-5, which shows the trade equilibrium for Home with production at point *B* and consumption at point *C*. At the world relative price of P_W/P_C = 23, Home exports 60 bushels of wheat (the difference between wheat production of 100 and consumption of 40). We can use these numbers to construct a new graph, the Home export supply curve of wheat, shown in panel (b). The vertical axis in panel (b) measures the relative price of wheat and the horizontal axis measures the exports of wheat. The points *B* and *C* in panel (a), with the relative price of P_W/P_C = 23 and Home exports of 60 bushels of wheat, now appear as point C' in panel (b), with P_W/P_C = 23 on the vertical axis and Home wheat exports of 60 bushels on the horizontal axis. This is our first point on the Home export supply curve.

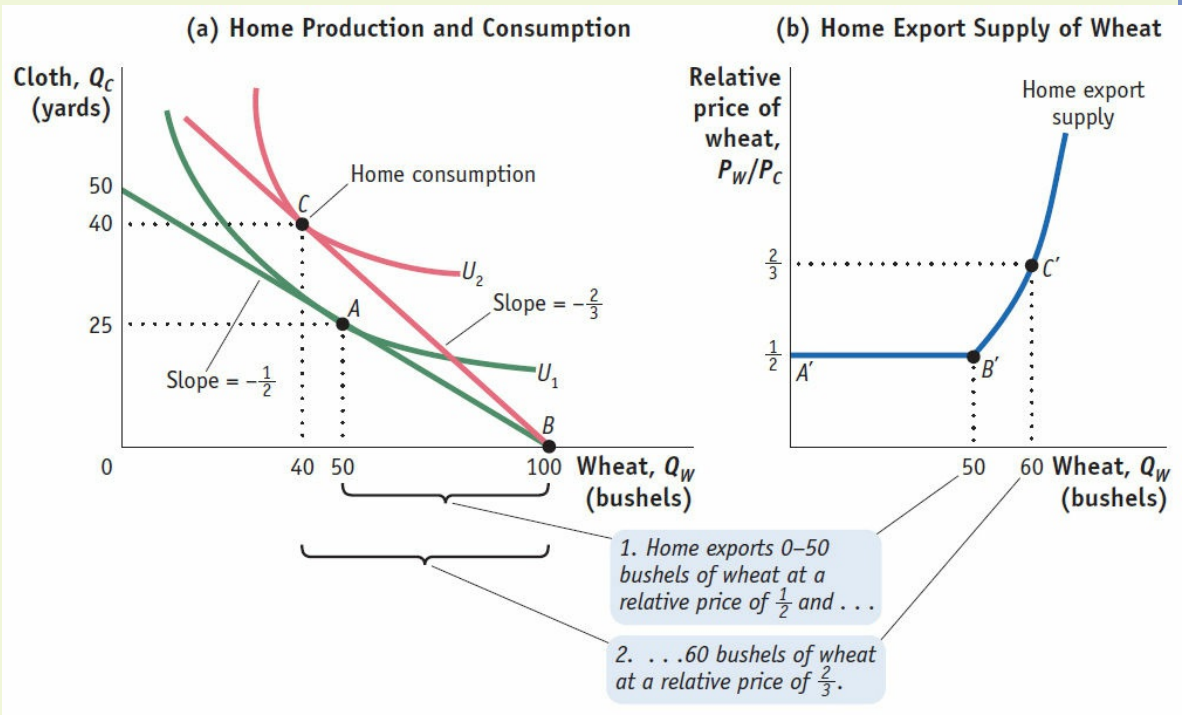


FIGURE 2-9

Home Export Supply Panel (a) repeats Figure 2-5 showing the trade equilibrium for Home with production at point *B* and consumption at point *C*. Panel (b) shows Home's export supply of wheat. When the relative price of wheat is 12, Home will export any amount of wheat between 0 and 50 bushels, along the segment *A′B′* of the Home export supply curve. For relative prices above 12, Home exports more than 50 bushels, along the segment *B′C′*. For example, at the relative price of 23, Home exports 60 bushels of wheat.

To derive other points on the export supply curve, consider the no-trade equilibrium in panel (a), which is shown by production and consumption at point *A*. The no-trade relative price of wheat is 12 (the slope of Home's PPF), and Home exports of wheat are zero because there is no international trade. So the point *A* in panel (a) can be graphed at point *A′* in panel (b), with a relative price of $P_W/P_C = 12$ and zero Home exports of wheat. This gives us a second point on the Home export supply curve.

To get a third point, let us keep the relative price of wheat at $P_W/P_C = 12$, as in the no-trade equilibrium, but now allow Home to export some wheat in exchange for cloth at this price. Home consumption remains at point *A* in panel (a), but production can shift from that point. The reason that production can shift to another point on the PPF is that, with the relative price $P_W/P_C = 12$, the wages of workers are equal in wheat and cloth. This result was shown in our earlier discussion. With wages equal in the two industries, workers are willing to shift between them, so any point on the PPF is a possible production point. Consider, for example, production at point *B* in panel (a), where all workers have shifted into wheat and no cloth is produced. With the relative price $P_W/P_C = 12$, consumption is still at point *A*, so the difference between points *A* and *B* is the amount of wheat that Home is exporting and the amount of cloth Home is importing. That is, Home exports 50 bushels

of wheat (the difference between production of 100 and consumption of 50) and imports 25 yards of cloth (the difference between production of 0 and consumption of 25). Therefore, the relative price of $P_W/P_C = 12$, with wheat exports of 50, is another point on the Home export supply curve, shown by B' in panel (b).

Joining up points A', B', and C', we get a Home export supply curve that is flat between A' and B', and then rises between B' and C' and beyond. The flat portion of the export supply curve is a special feature of the Ricardian model that occurs because the PPF is a straight line. That is, with the relative price of $P_W/P_C = 12$, production can occur anywhere along the PPF as workers shift between industries; meanwhile, consumption is fixed at point A, leading to all the export levels between A' and B' in panel (b). As the relative price of wheat rises above 12, production remains fixed at point B in panel (a), but the consumption point changes, rising above point A. With the relative price $P_W/P_C = 23$, for example, consumption is at point C. Then Home exports of wheat are calculated as the difference between production at B and consumption at C. Graphing the various relative prices above and the bushels of wheat exported at each price, we get the upward-sloping Home export supply curve between B' and C' in panel (b).

Foreign Import Demand Curve

In Foreign we will again focus on the wheat market and construct an import demand curve for wheat. In panel (a) of Figure 2-10, we repeat Figure 2-6, which shows the Foreign trade equilibrium with production at point B^* and consumption at point C^*. At the world relative price of $P_W/P_C = 23$, Foreign imports 60 bushels of wheat (the difference between wheat consumption of 60 and production of 0). These numbers are graphed as point $C^{*\prime}$ in panel (b), where we have the relative price of wheat on the vertical axis and the Foreign imports of wheat on the horizontal axis.

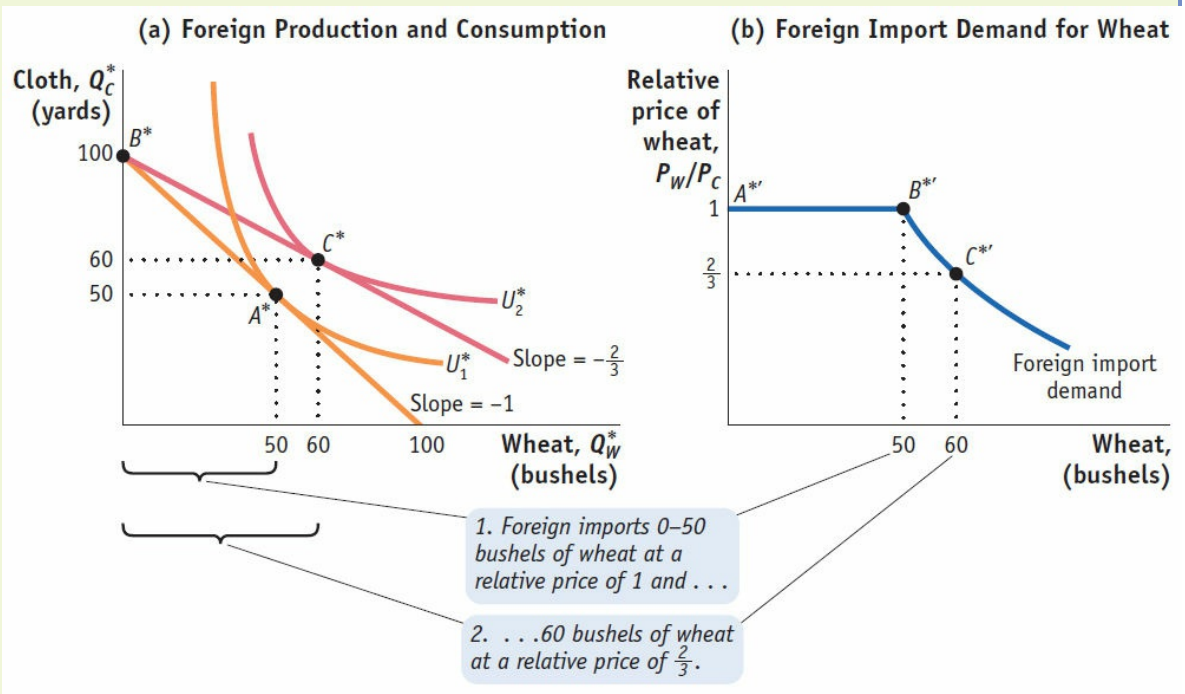


FIGURE 2-10

Foreign Import Demand Panel (a) repeats Figure 2-6, showing the Foreign trade equilibrium with production at point B^* and consumption at point C^*. Panel (b) shows Foreign's import demand for wheat. When the relative price of wheat is 1, Foreign will import any amount of wheat between 0 and 50 bushels, along the segment $A^{*\prime}B^{*\prime}$ of Foreign's import demand curve. For relative prices below 1, Foreign imports more than 50 bushels, along the segment $B^{*\prime}C^{*\prime}$. For example, at the relative price of 23, Foreign imports 60 bushels of wheat.

Other points on Foreign's import demand curve can be obtained in much the same way as we did for Home. For example, the no-trade equilibrium in Foreign is shown by production and consumption at point A^* in panel (a), with the relative price of wheat equal to 1 (the slope of Foreign's PPF) and zero imports (since there is no international trade). This no-trade equilibrium is graphed as point $A^{*\prime}$ in panel (b). Keeping the relative price of wheat fixed at 1 in Foreign, production can shift away from point A^* in panel (a). This can occur because, as we argued for Home, wages are the same in Foreign's wheat and cloth industries when the relative price is at its no-trade level, so workers are willing to move between industries. Keeping Foreign consumption fixed at point A^* in panel (a), suppose that all workers shift into the cloth industry, so that production is at point B^*. Then Foreign imports of wheat are 50 bushels (the difference between Foreign consumption of 50 and production of zero), as shown by point $B^{*\prime}$ in panel (b).

Joining up points $A^{*\prime}$, $B^{*\prime}$, and $C^{*\prime}$, we get an import demand curve that is flat between $A^{*\prime}$ and $B^{*\prime}$ and then falls between $B^{*\prime}$ and $C^{*\prime}$ and beyond. The flat portion of the Foreign import demand curve is once again a special feature of the Ricardian model that occurs because the PPF is a straight line. As we investigate other trade models in the following

chapters, in which the production possibilities frontiers are curved rather than straight lines, the export supply and import demand curves will no longer have the flat portions. A general feature of these export supply and import demand curves is that they begin at the no-trade relative price for each country and then slope up (for export supply) or down (for import demand).

International Trade Equilibrium

Now that we have derived the Home export supply curve and the Foreign import demand curve, we can put them together in a single diagram, shown in Figure 2-11. The intersection of these two curves at point C' gives the international trade equilibrium, the equilibrium relative price of wheat at which the quantity of Home exports just equals Foreign imports. In Figure 2-11, the equilibrium relative price of wheat is $P_W/P_C = 23$. This graph looks just like the supply = demand equilibria that you have seen in other economics classes, except that Figure 2-11 now refers to the *world* market for wheat rather than the market in a single country. That is, Home's export supply of wheat is the *excess* of the total Home supply over the quantity demanded by Home consumers, whereas Foreign import demand is the excess of total Foreign demand over the quantity supplied by Foreign suppliers. The intersection of these excess supply and demand curves, or export supply and import demand curves in Figure 2-11, determines the relative price of wheat that clears the world market, that is, at which the desired sales of Home equal the desired purchases by Foreign.

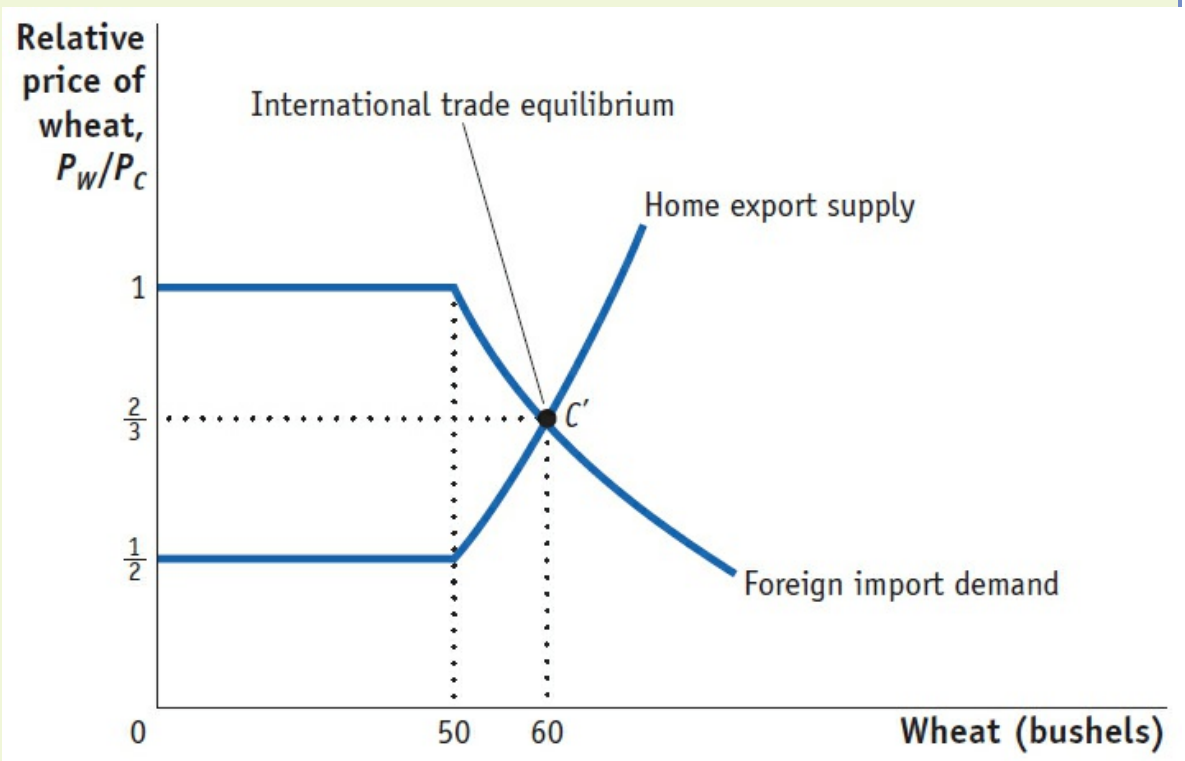


FIGURE 2-11

World Market for Wheat Putting together Home's export supply curve and Foreign's import demand curve for wheat, the world equilibrium is established at point C', where the relative price of wheat is 23. At this price, Home's export of 60 bushels equals Foreign's imports of wheat.

The Terms of Trade

The price of a country's exports divided by the price of its imports is called the terms of trade. Because Home exports wheat, (P_W/P_C) is its terms of trade. Notice that an increase in the price of wheat (Home's export) or a fall in the price of cloth (Home's import) would both *raise* its terms of trade. Generally, an increase in the terms of trade is good for a country because it is earning more for its exports or paying less for its imports, thus making it better off. Foreign exports cloth, so (P_C/P_W) is its terms of trade. In this case, having a higher price for cloth (Foreign's export) or a lower price for wheat (Foreign's import) would make Foreign better off.

APPLICATION

The Terms of Trade for Primary Commodities

What has happened over time to the terms of trade? Writing in the 1950s, the Latin American economist Raúl Prebisch and the British economist Hans Singer each put forward the hypothesis that the price of *primary commodities* (i.e., agricultural products and minerals) would decline over time relative to the price of manufactured goods. Because primary commodities are often exported by developing countries, this would mean that the terms of trade in developing countries would decline over time.

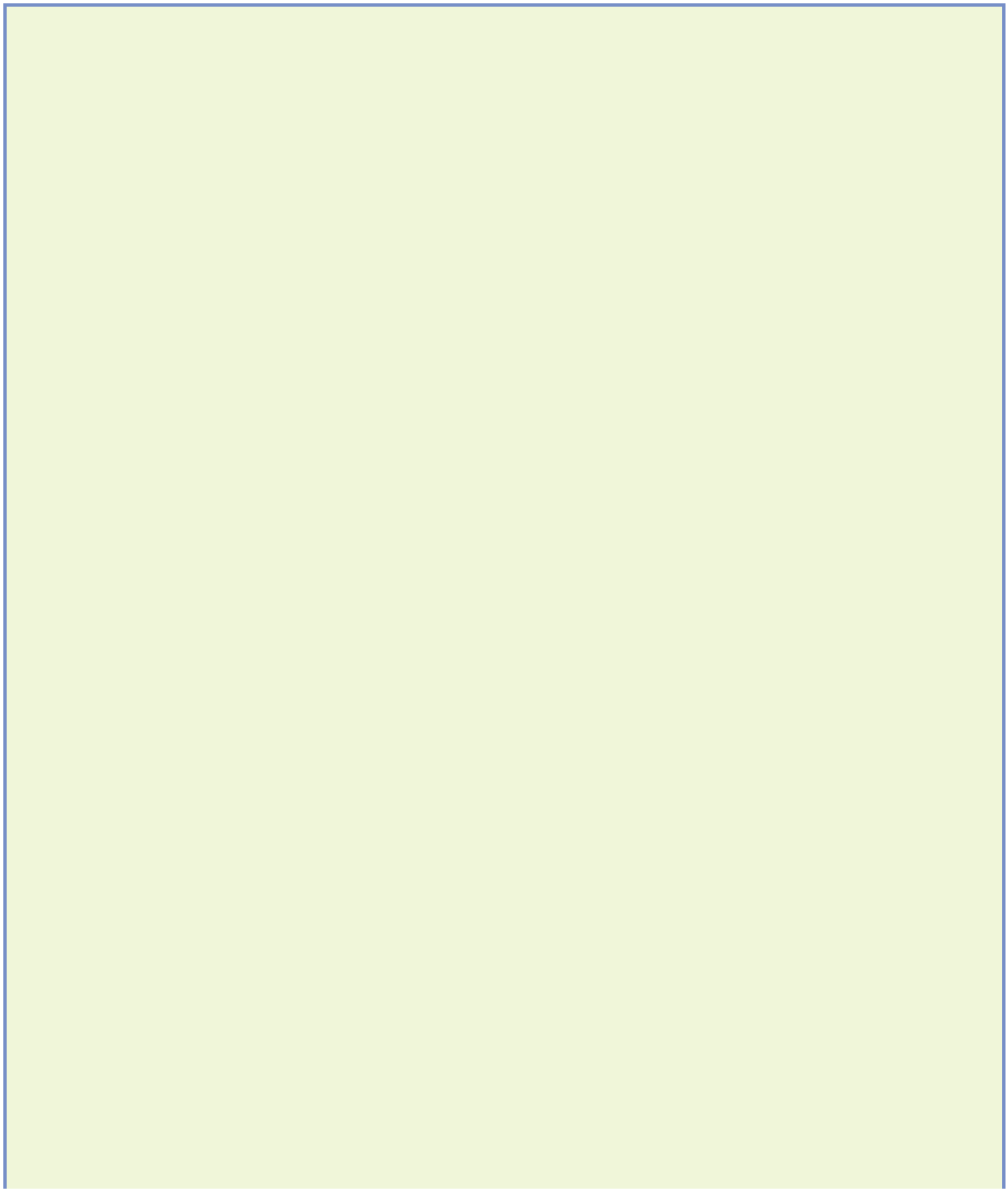
There are several reasons why the Prebisch–Singer hypothesis may be true. First, it is well-known that as people or countries become richer, they spend a smaller share of their income on food.[14] This means that as world income grows, the demand for food will decline relative to the demand for manufactured goods. Therefore, the price of agricultural products can also be expected to decline relative to manufactured goods. Second, for mineral products, it may be that industrialized countries continually find substitutes for the use of minerals in their production of manufactured products. For example, much less steel is used in cars today because automobile producers have shifted toward the use of plastic and aluminum in the body and frame. We can think of the substitution away from mineral products as a form of technological progress, and as it proceeds, it can lead to a fall in the price of raw minerals.

However, there are also several reasons why the Prebisch–Singer hypothesis may not be true. First, technological progress in manufactured goods can certainly lead to a fall in the price of these goods as they become easier to produce (e.g., think of the reduction in prices of many electronic goods, such as laptop computers). This is a fall in the terms of trade for industrialized countries rather than developing countries. Second, at least in the case of oil exports, the Organization of Petroleum Exporting Countries (OPEC) has managed to keep oil prices high by restricting supplies on the world market. This has resulted in an increase in the terms of trade for oil-exporting countries, which includes developing and industrialized nations.

Data on the relative price of primary commodities are shown in Figure 2-12.[15] This study considered 24 primary commodities from 1900 to 1998 and measured their world price relative to the overall price of manufactured goods. Of the 24 commodities, one-half of them showed a decline in their relative price for 50% or more of that period, including aluminum, cotton, hides, palm oil, rice, sugar, rubber, wheat, and wool. This evidence provides some support for the Prebisch–Singer hypothesis. Several examples of these commodities, with declining relative prices, are shown in panel (a) of Figure 2-12.

However, there are also a number of primary commodities that showed price increases for significant periods, or showed no consistent trend over the century.

Commodities that had increasing relative prices for 50% or more of that period include beef, lamb, timber, tin, and tobacco. Several of these commodities are shown in panel (b) of Figure 2-12. Finally, commodities that had no consistent trend in their relative prices between the beginning and end of the century include bananas, coffee, copper, and zinc. Several of these are shown in panel (c) of Figure 2-12. From these results for different commodities, we can conclude that there are some that follow the pattern predicted by Prebisch and Singer, with falling prices relative to manufacturing. This is not a general rule, however, and other primary commodities have had increasing or no consistent change in their prices.



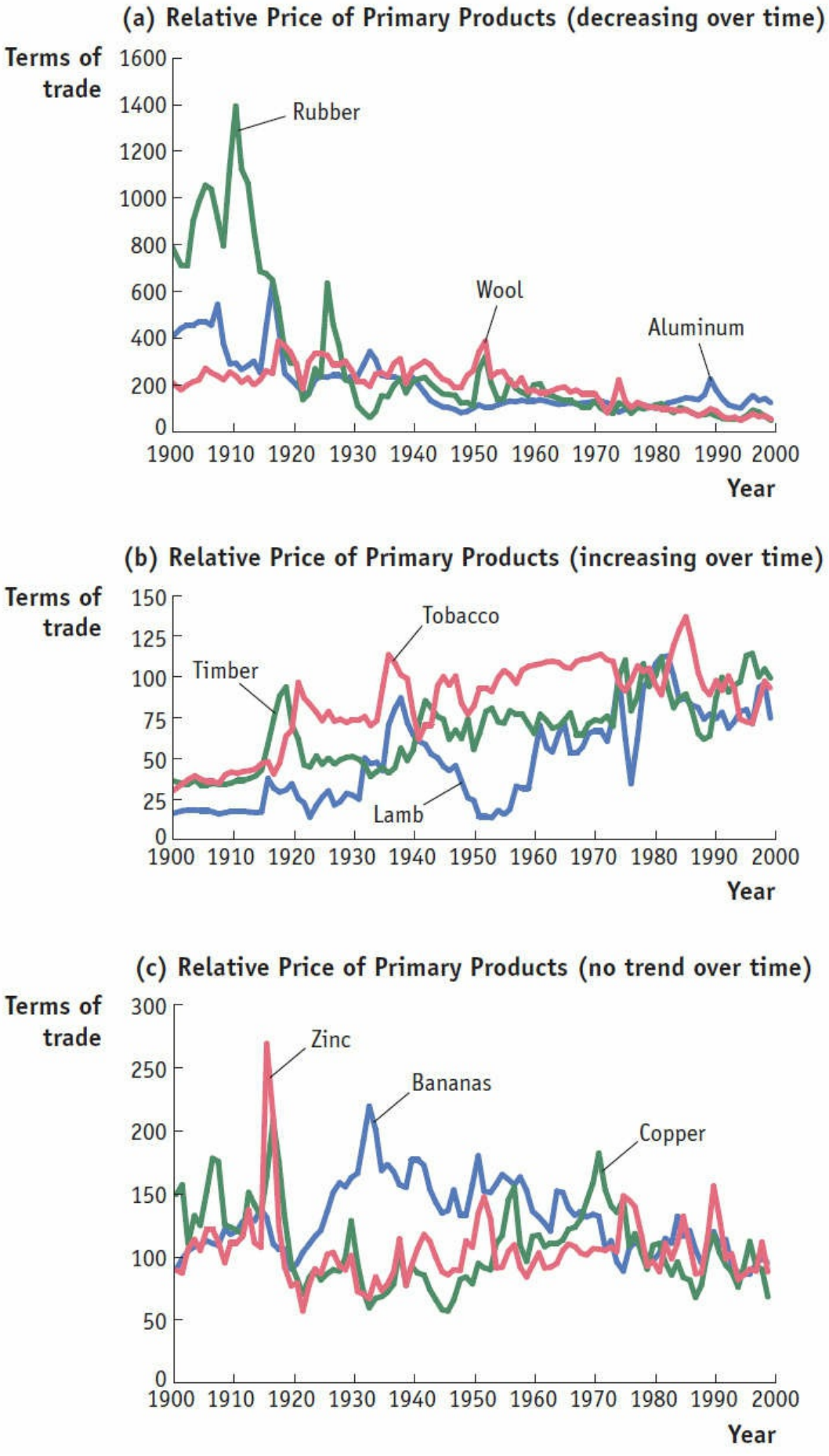

(a) Relative Price of Primary Products (decreasing over time)
Terms of trade
1600
1400
1200
1000
800
600
400
200
0
Rubber
Wool
Aluminum
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year
(b) Relative Price of Primary Products (increasing over time)
Terms of trade
150
125
100
75
50
25
0
Tobacco
Timber
Lamb
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year
(c) Relative Price of Primary Products (no trend over time)
Terms of trade
300
250
200
150
100
50
0
Zinc
Bananas
Copper
1900 1910 1920 1930 1940 1950 1960 1970 1980 1990 2000
Year

FIGURE 2-12

Relative Price of Primary Commodities Many developing countries export primary commodities (i.e., agricultural products and minerals), whereas industrial countries export manufactured products. Shown here are the prices of various primary commodities relative to an overall manufacturing price, from 1900 to 1998. The relative prices of some primary commodities have fallen over time (panel a), whereas other commodities have had rising relative prices (panel b). Other commodity prices show no consistent trend over time (panel c).

5 Conclusions

The Ricardian model was devised to respond to the mercantilist idea that exports are good and imports are bad. Not so, said David Ricardo, and to prove his point, he considered an example in which trade between two countries (England and Portugal) is balanced; that is, the value of imports equals the value of exports for each country. The reason that England and Portugal trade with each other in Ricardo's example is that their technologies for producing wine and cloth are different. Portugal has an absolute advantage in both goods, but England has a comparative advantage in cloth. That is, the opportunity cost of producing cloth in England (measured by how much wine would have to be given up) is lower than in Portugal. Based on this comparative advantage, the no-trade relative price of cloth is also lower in England than in Portugal. When trade is opened, merchants in England export cloth to Portugal where they can obtain a higher price, and vintners in Portugal export wine to England. Thus, the pattern of trade is determined by comparative advantage, and both countries gain from trade.

For simplicity, the Ricardian model is presented with just a single factor of production —labor. We have used a lesson from microeconomics to solve for wages as the marginal product of labor times the price of each good. It follows from this relationship that the ratio of wages across countries is determined by the marginal product of labor in the goods being produced and by the prices of those goods. Because wages depend on the marginal products of labor in each country, we conclude that wages are determined by absolute advantage—a country with better technology will be able to pay higher wages. In addition, wages depend on the prices prevailing on world markets for the goods exported by each country. We have defined the "terms of trade" as the price of a country's exports divided by the price of its imports. Generally, having higher terms of trade (because of high export prices or low import prices) will lead to higher real wages and therefore will benefit workers.

The fact that only labor is used in the Ricardian model, with a constant marginal product of labor, makes it special. Because of this assumption, the PPF in the Ricardian model is a straight line, and the export supply and import demand curves each have a flat segment. These special properties do not occur in other models we consider in the following chapters, where in addition to labor, industries will use capital and land. Once we allow for the more realistic assumption of several factors of production, the gains from trade become more complicated. Even when there are overall gains for a country, some factors of production will gain as other factors of production lose due to the opening up of trade. That is the topic we explore in the next chapter.

KEY POINTS

1. A country has comparative advantage in producing a good when the country's opportunity cost of producing the good is lower than the opportunity cost of producing the good in another country.
2. The pattern of trade between countries is determined by comparative advantage. This means that even countries with poor technologies can export the goods in which they

have comparative advantage.

3. All countries experience gains from trade. That is, the utility of an importing or exporting country is at least as high as it would be in the absence of international trade.
4. The level of wages in each country is determined by its absolute advantage; that is, by the amount the country can produce with its labor. This result explains why countries with poor technologies are still able to export: their low wages allow them to overcome their low productivity.
5. The equilibrium price of a good on the world market is determined at the point where the export supply of one country equals the import demand of the other country.
6. A country's terms of trade equal the price of its export good divided by the price of its import good. A rise in a country's terms of trade makes it better off because it is exporting at higher prices or importing at lower prices.

KEY TERMS

import

export

technology

resources

offshoring

proximity

Ricardian model

trade pattern

free-trade area

natural resources

labor resources

capital

factors of production

absolute advantage

comparative advantage

marginal product of labor (MPL)

production possibilities frontier (PPF)

opportunity cost

indifference curves

utility

relative price

international trade equilibrium

world price line

gains from trade

export supply curve

import demand curve

terms of trade

PROBLEMS

1. Discovering Data In this problem you will use the World Development Indicators (WDI) database from the World Bank to compute the comparative advantage of two countries in the major sectors of gross domestic product (GDP): agriculture, industry (which includes manufacturing, mining, construction, electricity, and gas), and services. Go to the WDI website at http://wdi.worldbank.org, and choose "Online tables," where you will be using the sections on "People" and on the "Economy."
   a. In the "People" section, start with the table "Labor force structure." Choose two countries that you would like to compare, and for a recent year write down their total labor force (in millions) and the percentage of the labor force that is female. Then calculate the number of the labor force (in millions) who are male and the number who are female.
   b. Again using the "People" section of the WDI, go to the "Employment by sector" table. For the same two countries that you chose in part (a) and for roughly the same year, write down the percent of male employment and the percent of female employment in each of the three sectors of GDP: agriculture, industry, and services. (If the data are missing in this table for the countries that you chose in part (a), choose different countries.)

      Use these percentages along with your answer to part (a) to calculate the number of male workers and the number of female workers in each sector. Add together the number of male and female workers to find the total labor force in each sector.
   c. In the "Economy" section, go to the table "Structure of output." There you will find GDP (in $ billions) and the % of GDP in each of the three sectors: agriculture, industry, and services. For the same two countries and the same year that you chose in part (a), write down their GDP (in $ billions) and the percentage of their GDP accounted for by agriculture, by industry, and by services. Multiply GDP by the percentages to obtain the dollar amount of GDP coming from each of these sectors, which is interpreted as the *value-added* in each sector, that is, the dollar amount that is sold in each sector minus the cost of materials (not including the cost of labor or capital) used in production.
   d. Using your results from parts (b) and (c), divide the GDP from each sector by the labor force in each sector to obtain the *value-added per worker in each sector*. Arrange these numbers in the same way as the "Sales/Employee" and "Bushels/Worker" shown in Table 2-2. Then compute the absolute advantage of one country relative to the other in each sector, as shown on the right-hand side of Table 2-2. Interpret your results. Also compute the comparative advantage of agriculture/industry and agriculture/services (as shown at the bottom of Table 2-2), and the comparative advantage of industry/services.

      Based on your results, what should be the trade pattern of these two countries if they were only trading with each other?
2. At the beginning of the chapter, there is a brief quotation from David Ricardo; here is a longer version of what Ricardo wrote:

England may be so circumstanced, that to produce the cloth may require the labour of 100 men for one year; and if she attempted to make the wine, it might require the labour of 120 men for the same time. . . . To produce the wine in Portugal, might require only the labour of 80 men for one year, and to produce the cloth in the same country, might require the labour of 90 men for the same time. It would therefore be advantageous for her to export wine in exchange for cloth. This exchange might even take place, notwithstanding that the commodity imported by Portugal could be produced there with less labour than in England.

Suppose that the amount of labor Ricardo describes can produce 1,000 yards of cloth or 2,000 bottles of wine in either country. Then answer the following:

a. What is England's marginal product of labor in cloth and in wine, and what is Portugal's marginal product of labor in cloth and in wine? Which country has absolute advantage in cloth, and in wine, and why?

b. Use the formula $P_W/P_C = MPL_C/MPL_W$ to compute the no-trade relative price of wine in each country. Which country has comparative advantage in wine, and why?

3. Suppose that each worker in Home can produce two cars or three TVs. Assume that Home has four workers.
   a. Graph the production possibilities frontier for Home.
   b. What is the no-trade relative price of cars in Home?
4. Suppose that each worker in Foreign can produce three cars or two TVs. Assume that Foreign also has four workers.
   a. Graph the production possibilities frontier for Foreign.
   b. What is the no-trade relative price of cars in Foreign?
   c. Using the information provided in Problem 3 regarding Home, in which good does Foreign have a comparative advantage, and why?
5. Suppose that in the absence of trade, Home consumes two cars and nine TVs, while Foreign consumes nine cars and two TVs. Add the indifference curve for each country to the figures in Problems 3 and 4. Label the production possibilities frontier (PPF), indifference curve (U_1), and the no-trade equilibrium consumption and production for each country.
6. Now suppose the world relative price of cars is $P_C/P_{TV} = 1$.
   a. In what good will each country specialize? Briefly explain why.
   b. Graph the new world price line for each country in the figures in Problem 5, and add a new indifference curve (U_2) for each country in the trade equilibrium.
   c. Label the exports and imports for each country. How does the amount of Home exports compare with Foreign imports?
   d. Does each country gain from trade? Briefly explain why or why not.

WORK IT OUT

Answer the following questions using the information given by the accompanying table:

	Home	Foreign	Absolute Advantage
Number of bicycles produced per hour	4	6	?
Number of snowboards produced per hour	6	8	?
Comparative advantage	?	?	

a. Complete the table for this problem in the same manner as Table 2-2.

b. Which country has an absolute advantage in the production of bicycles? Which country has an absolute advantage in the production of snowboards?

c. What is the opportunity cost of bicycles in terms of snowboards in Home? What is the opportunity cost of bicycles in terms of snowboards in Foreign?

d. Which product will Home export, and which product does Foreign export? Briefly explain why.

---

7. Assume that Home and Foreign produce two goods, TVs and cars, and use the information below to answer the following questions:

In the No-Trade Equilibrium

Home		Foreign	
$Wage_{TV} = 12$	$Wage_C = ?$	$Wage^*_{TV} = ?$	$Wage^*_C = 6$
$MPL_{TV} = 4$	$MPL_C = ?$	$MPL^*_{TV} = ?$	$MPL^*_C = 1$
$P_{TV} = ?$	$P_C = 4$	$P^*_{TV} = 8$	$P^*_C = ?$

a. What is the marginal product of labor for TVs and cars in Home? What is the no-trade relative price of TVs in Home?

b. What is the marginal product of labor for TVs and cars in Foreign? What is the no-trade relative price of TVs in Foreign?

c. Suppose the world relative price of TVs in the trade equilibrium is $P_{TV}/P_C = 1$. Which good will each country export? Briefly explain why.

d. In the trade equilibrium, what is the real wage in Home in terms of cars and in terms of TVs? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

e. In the trade equilibrium, what is the real wage in Foreign in terms of TVs and in terms of cars? How do these values compare with the real wage in terms of either good in the no-trade equilibrium?

f. In the trade equilibrium, do Foreign's workers earn more or less than Home's workers, measured in terms of their ability to purchase goods? Explain why.

8. Why do some low-wage countries, such as China, pose a threat to manufacturers in industrial countries, such as the United States, whereas other low-wage countries, such as Haiti, do not?

Answer Problems 9 to 11 using the chapter information for Home and Foreign.

9.

a. Suppose that the number of workers doubles in Home. What happens to the Home PPF and what happens to the no-trade relative price of wheat?

b. Suppose that there is technological progress in the wheat industry such that Home can produce more wheat with the same amount of labor. What happens to the Home PPF and what happens to the relative price of wheat? Describe what would happen if a similar change occurred in the cloth industry.

10.

a. Using Figure 2-5, show that an increase in the relative price of wheat from its world relative price of will raise Home's utility.

b. Using Figure 2-6, show that an increase in the relative price of wheat from its world relative price of will lower Foreign's utility. What is Foreign's utility when the world relative price reaches 1, and what happens in Foreign when the world relative price of wheat rises above that level?

11. *(This is a harder question.)* Suppose that Home is much larger than Foreign. For example, suppose we double the number of workers in Home from 25 to 50. Then,

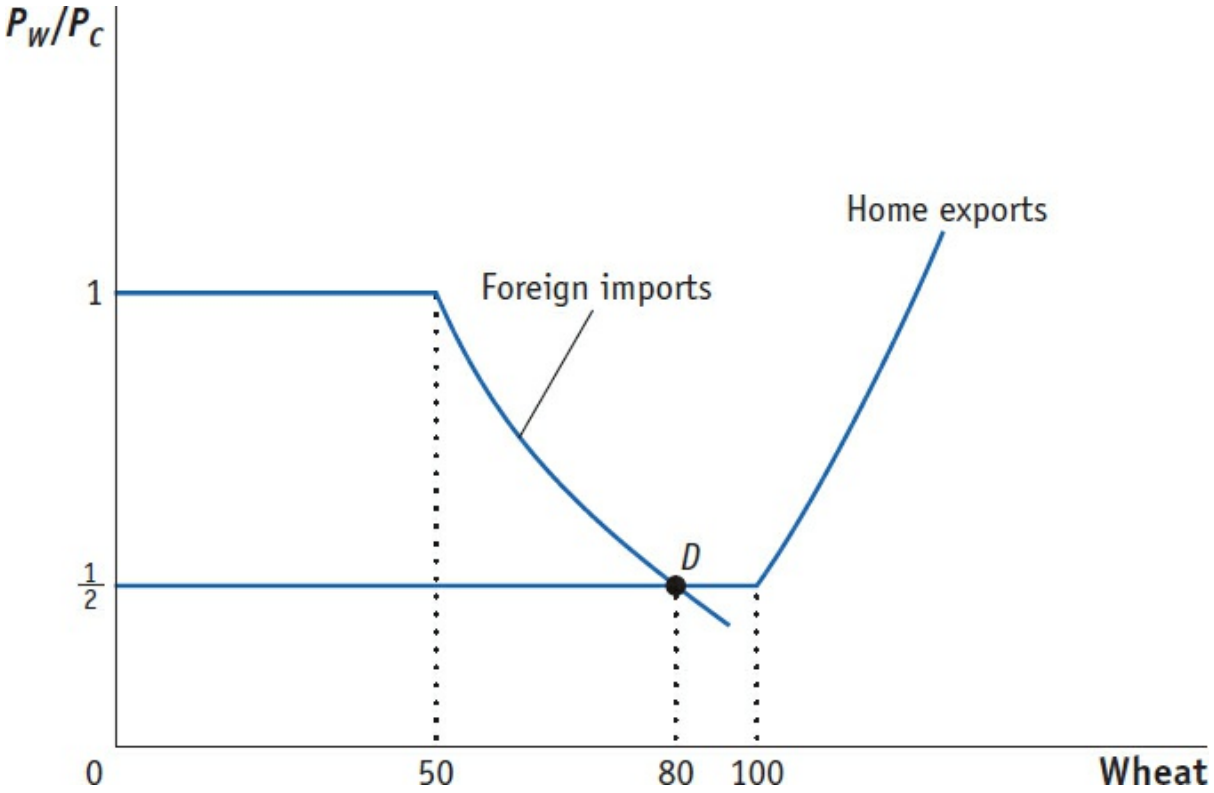
suppose that Home is willing to export up to 100 bushels of wheat at its no-trade price of $P_W/P_C = 12$ rather than the 50 bushels of wheat as shown in Figure 2-11. In the following figure, we draw a new version of Figure 2-11, with the larger Home.

a. From this figure, what is the new world relative price of wheat (at point *D*)?

b. Using this new world equilibrium price, draw a new version of the trade equilibrium in Home and in Foreign, and show the production point and consumption point in each country.

c. Are there gains from trade in both countries? Explain why or why not.

12. Using the results from Problem 11, explain why the Ricardian model predicts that Mexico would gain more than the United States when the two countries signed the North American Free Trade Agreement, establishing free trade between them.



[1] Samuelson, Paul A. 1969. "The Way of an Economist." In *International Economic Relations: Proceedings of the Third Congress of the International Economic Association,* edited by Paul A. Samuelson (London: Macmillan), pp. 1–11.

[2] A special assumption of the Ricardian model is that there are no diminishing returns to labor, so the marginal product of labor is constant. That assumption will no longer be made in the next chapter, when we introduce capital and land, along with labor, as factors of production.

[3] Notice that the slope of the PPF is the opportunity cost of the good on the *horizontal* axis—wheat, in this case.

[4] We also refer to point *A* as the "autarky equilibrium," because "autarky" means a situation in which the country does not engage in international trade.

[5] Remember that the slope of the PPF (ignoring the minus sign) equals the relative price of the good on the *horizontal* axis—wheat in Figure 2-4. Foreign has a steeper PPF than Home as shown in Figure 2-2, so Foreign's relative price of wheat is higher than Home's. The inverse of the relative price of wheat is the relative price of cloth, which is lower in Foreign.

[6] Taking the reciprocal of the relative price of wheat in each country, we also see that Foreign's no-trade relative price of

cloth is $P^*_C/P^*_W = 1$, which is less than Home's no-trade relative price of cloth, $P_C/P_W = 2$. Therefore, Foreign has a comparative advantage in cloth.

[7] These facts and many more about the apparel industry in the United States can be found at: http://www.bls.gov/spotlight/2012/fashion/ (accessed August 30, 2015).

[8] Notice that if the relative price of wheat P_W/P_C is the same in the two countries, then the relative price of cloth, which is just its inverse (P_C/P_W), is also the same.

[9] The fully specialized economy (producing only wheat) is a special feature of the Ricardian model because of its straight-line production possibilities frontier.

[10] Recall that without international trade, Home wages were $MPL_W = 4$ bushels of wheat or $MPL_C = 2$ yards of cloth. Home workers are clearly better off with trade because they can afford to buy the same amount of wheat as before (4 bushels) but more cloth (83 yards instead of 2 yards). This is another way of demonstrating the gains from trade.

[11] Without international trade, Foreign wages were $MPL^*_W = 1$ bushel of wheat or $MPL^*_C = 1$ yard of cloth. Foreign workers are also better off with trade because they can afford to buy the same amount of cloth (1 yard) but more wheat (32 bushels instead of 1 bushel).

[12] That result is shown by the comparison of real wages in the trade equilibrium as compared with the no-trade equilibrium in each country, as is done in the previous two footnotes.

[13] These values are expressed in 2011 dollars and are taken from the Penn World Table version 8.0, http://www.rug.nl/research/ggdc/data/pwt/pwt-8.0. For comparison, over the same period 1978–2014, real per-capita income in the United States nearly doubled from $28,700 to $52,300.

[14] This relationship is known as Engel's law after the nineteenth-century German statistician Ernst Engel. It is certainly true for purchases of food eaten at home but might not hold for dining out. As your income rises, you might spend a constant or even increasing share of your budget on restaurant food.

[15] These results are provided by Neil Kellard and Mark E. Wohar, 2006, "Trends and Persistence in Primary Commodity Prices," *Journal of Development Economics,* 79(1), February, 146–167.

8 Import Tariffs and Quotas Under Perfect Competition

Questions to Consider

1. Why do governments sometimes apply a tariff on imported goods?
2. Why does the World Trade Organization try to reduce the use of tariffs?
3. If the quantity of imports is restricted by a quota, how is that different from using a tariff?

I would tax China on products coming in. I would do a tariff, yes—and . . . the tax should be 45 percent.

Donald J. Trump, Republican candidate for president, January 5, 2016

Over a thousand Americans are working today because we stopped a surge in Chinese tires.

President Barack Obama, referring to a tariff on Chinese tires, January 24, 2012

I take this action to give our domestic steel industry an opportunity to adjust to surges in foreign imports, recognizing the harm from 50 years of foreign government intervention in the global steel market, which has resulted in bankruptcies, serious dislocation, and job loss.

President George W. Bush, announcing a tariff on imported steel, March 5, 2002

It was once proposed that the United States should apply a tariff against the imports from a certain Asian country. When that idea became public, the government of the Asian country cut back on its purchases of U.S. Treasury bills, which are a type of bond. That decrease in demand for U.S. Treasury bills—like a decrease in demand for any product—led to a fall in their price. Because U.S. Treasury bills always pay the same total amount when they mature, a fall in their price means that the effective interest rate being earned on the bond goes up. That rise in the interest rate on Treasury bills led to an increase in

interest rates in all other U.S. markets. So in this case, just the *proposal* of an import tariff had adverse macroeconomic effects in the United States.

Does this story sound familiar to you? Perhaps you remember that during the U.S. presidential campaign of 2016, the Republican candidate Donald Trump said that he would apply a 45% tariff against imports from China, as indicated in the first quote at the beginning of the chapter.[1] That announcement did not have any impact on the markets at the time, probably because it was not believed to be true. In fact, the story that we have described above *did happen* but it was much earlier, in 1995, when Bill Clinton was president. At that time the United States considered putting an import tariff—a tax on imported goods—on luxury cars imported from Japan. As a result, Japan reduced its purchases of U.S. Treasury bills and U.S. interest rates went up. Following that temporary rise in interest rates the American and the Japanese governments negotiated over the proposed tariff, and the tariff on luxury cars from Japan was never actually implemented.

This true story illustrates several important points. First, applying import tariffs against trading partners can lead to some form of retaliation by those partners. It is unusual for that retaliation to have a macroeconomic impact, as in the above example; typically, the retaliation takes the form of the trade partner applying a tariff of its own. This type of "tit for tat" tariff retaliation is often used when the first tariff applied was not actually legal according to international rules. We begin this chapter by discussing the international rules that govern the use of tariffs; the international body that governs these rules (the World Trade Organization, WTO); and the WTO's precursor, the General Agreement on Tariffs and Trade (GATT).

A second lesson of this chapter is that import tariffs on specific products are applied occasionally by many countries, including the United States, and sometimes for political reasons. For example, in 2009, President Barack Obama approved a 35% tariff on the import of tires from China, which was in place until 2012. That tariff was seen as a victory for the United Steelworkers, the union that represents American tire workers, but it was opposed by many economists as well as by a number of American tire-manufacturing companies that were already manufacturing tires in other countries. By approving this tariff in 2009, it is believed that President Obama won additional support from the labor movement for the Affordable Care Act that would be voted on in Congress later that year.

The tariff on Chinese-made tires announced by President Obama was not the first instance of a U.S. president—of either party—approving an import tariff soon after being elected. During the 2000 presidential campaign, George W. Bush promised that he would consider implementing a tariff on imports of steel. That promise was made for political purposes: It helped Bush secure votes in Pennsylvania, West Virginia, and Ohio, states that produce large amounts of steel. After he was elected, the U.S. tariffs on steel were increased in March 2002, though they were removed less than two years later, as we discuss later in this chapter.

At the time of writing, it is not known who the next U.S. president will be. But we can predict that he or she, just like Presidents Bill Clinton, George W. Bush, and Barack Obama, will face pressure to do something to help industries and workers that are especially hard hit by import competition. That "something" usually involves trade policy, a government action meant to influence the amount of international trade. Examples of trade policy include the use of import tariffs (taxes on imports), import quotas (quantity limits on imports), and export subsidies (meaning that the exporter of a good receives a higher

price than the buyer pays). In this chapter, we begin our investigation of trade policies by focusing on the effects of tariffs and quotas in a perfectly competitive industry. In the next chapter, we continue by discussing the use of import tariffs and quotas when the industry is imperfectly competitive.

This chapter examines first the most commonly used trade policy, the tariff. We explain the reasons why countries apply tariffs and the consequences of these tariffs on the producers and consumers in the importing and exporting countries. We show that import tariffs typically lead to welfare losses for "small" importing countries, by which we mean countries that are too small to affect world prices. Following that, we examine the situation for a "large" importing country, meaning a country that is a large enough buyer for its tariff to affect world prices. In that case, we find that the importing country can possibly gain by applying a tariff, but only at the expense of the exporting countries.

The chapter then examines the use of an import quota, which is a limit on the quantity of a good that can be imported from a foreign country. Past examples of import quotas in the United States include limits on the imports of agricultural goods, automobiles, and steel. More recently, the United States and Europe imposed temporary quotas on the import of textile and apparel products from China. We note that, like a tariff, an import quota often imposes a cost on the importing country. Furthermore, we argue that the cost of quotas can sometimes be even greater than the cost of tariffs. For that reason, the use of quotas has been greatly reduced under the WTO, though they are still used in some cases.

Throughout this chapter, we assume that firms are perfectly competitive. That is, each firm produces a homogeneous good and is small compared with the market, which comprises many firms. Under perfect competition, each firm is a price taker in its market. In the next chapter, we learn that tariffs and quotas have different effects in imperfectly competitive markets.

1 A Brief History of the World Trade Organization

As we discussed in Chapter 1, during the period between World War I and World War II, unusually high tariffs between countries reduced the volume of world trade. When peace was reestablished following World War II, representatives of the Allied countries met on several occasions to discuss the rebuilding of Europe and issues such as high trade barriers and unstable exchange rates. One of these conferences, held in Bretton Woods, New Hampshire, in July 1944, established the International Monetary Fund (IMF) and the International Bank for Reconstruction and Development, later known as the World Bank. A second conference held at the Palais des Nations, in Geneva, Switzerland, in 1947 established the General Agreement on Tariffs and Trade (GATT), the purpose of which was to reduce barriers to international trade between nations.[2]

Under the GATT, countries met periodically for negotiations, called "rounds," to lower trade restrictions between countries. Each round is named for the country in which the meeting took place. The Uruguay Round of negotiations, which lasted from 1986 to 1994, established the World Trade Organization (WTO) on January 1, 1995. The WTO is a greatly expanded version of the GATT. It keeps most of the GATT's earlier provisions but adds rules that govern an expanded set of global interactions (including trade in services and intellectual property protection) through binding agreements. The most recent round of WTO negotiations, the Doha Round, began in Doha, Qatar, in November 2001.

Although the goal of the WTO is to keep tariffs low, it allows countries to charge a higher tariff on a specific import under some conditions. In Side Bar: Key Provisions of the GATT, we show some of the articles of the GATT that still govern trade in the WTO. Some of the main provisions are as follows:

1. A nation must extend the same tariffs to all trading partners that are WTO members. Article I of the GATT, the "most favored nation" clause, states that every country belonging to the WTO must be treated the same: if a country imposes low tariffs on one trading partner, then those low tariffs must be extended to every other trading partner belonging to the WTO.[3]
2. Tariffs may be imposed in response to unfair trade practices such as dumping. As we discuss in the next chapter, "dumping" is defined as the sale of export goods in another country at a price less than that charged at home, or alternatively, at a price less than costs of production and shipping. Article VI of the GATT states that an importing country may impose a tariff on goods dumped into its country by a foreign exporter.
3. Countries should not limit the quantity of goods and services that they import. Article XI states that countries should not maintain quotas against imports. We discuss exceptions to this rule later in this chapter.
4. Countries should declare export subsidies provided to particular firms, sectors, or industries. Article XVI deals with export subsidies, benefits such as tax breaks or other incentives for firms that produce goods specifically for export. The article states that countries should notify each other of the extent of subsidies and discuss the possibility of eliminating them. During the Doha Round of WTO negotiations, the

elimination of agricultural subsidies has recently been discussed.

5. Countries can temporarily raise tariffs for certain products. Article XIX, called the safeguard provision or the escape clause, is our focus in this chapter. Article XIX lists the conditions under which a country can temporarily raise tariffs on particular products. It states that a country can apply a tariff when it imports "any product . . . in such increased quantities and under such conditions as to cause or threaten serious injury to domestic producers." In other words, the importing country can temporarily raise the tariff when domestic producers are suffering due to import competition.

   The steel tariff of 2002–04 is an example of a tariff that was applied by the United States under Article XIX of the GATT (and the tire tariff of 2009–12 was applied under a related provision that focused on U.S. imports from China, discussed later in the chapter). European governments strenuously objected to the steel tariffs, however, and filed a complaint against the United States with the WTO. A panel at the WTO ruled in favor of the European countries. This ruling entitled them to retaliate against the United States by putting tariffs of their own on some $2.2 billion worth of U.S. exports. This pressure from Europe, along with pressure from companies in the United States that had been purchasing the cheaper imported steel, led President Bush to remove the steel tariffs in December 2003. Later in the chapter, we discuss the steel tariff in more detail, and see how Article XIX of the GATT is reflected in U.S. trade laws.

6. Regional trade agreements are permitted under Article XXIV of the GATT. The GATT recognizes the ability of blocs of countries to form two types of regional trade agreements: (i) free-trade areas, in which a group of countries voluntarily agrees to remove trade barriers between themselves, and (ii) customs unions, which are free-trade areas in which the countries also adopt identical tariffs between themselves and the rest of the world. We discuss regional trade agreements in a later chapter.

SIDE BAR

Key Provisions of the GATT

ARTICLE I
General Most-Favoured-Nation Treatment

1. With respect to customs duties . . . and with respect to all rules and formalities in connection with importation and exportation . . . any advantage, favour, privilege or immunity granted by any contracting party to any product originating in or destined for any other country shall be accorded immediately and unconditionally to the like product originating in or destined for the territories of all other contracting parties. . . .

ARTICLE VI
Anti-Dumping and Countervailing Duties

1. The contracting parties recognize that dumping, by which products of one country are introduced into the

commerce of another country at less than the normal value of the products, is to be condemned if it causes or threatens material injury to an established industry. . . . [A] product is to be considered . . . less than its normal value, if the price of the product exported from one country to another

a. is less than the comparable price . . . for the like product when destined for consumption in the exporting country, or,

b. in the absence of such domestic price, is less than either

i. the highest comparable price for the like product for export to any third country in the ordinary course of trade, or

ii. the cost of production of the product in the country of origin plus a reasonable addition for selling cost and profit. . . .

ARTICLE XI
General Elimination of Quantitative Restrictions

1. No prohibitions or restrictions other than duties, taxes or other charges, whether made effective through quotas, import or export licenses or other measures, shall be instituted or maintained by any contracting party on the importation of any product of the territory of any other contracting party or on the exportation or sale for export of any product destined for the territory of any other contracting party. . . .

ARTICLE XVI
Subsidies

1. If any contracting party grants or maintains any subsidy, including any form of income or price support, which operates directly or indirectly to increase exports of any product from, or to reduce imports of any product into, its territory, it shall notify the contracting parties in writing of the extent and nature of the subsidization. In any case in which it is determined that serious prejudice to the interests of any other contracting party is caused or threatened by any such subsidization, the contracting party granting the subsidy shall, upon request, discuss with the other contracting party . . . the possibility of limiting the subsidization.

ARTICLE XIX
Emergency Action on Imports of Particular Products

1.

a. If, as a result of unforeseen developments and of the effect of the obligations incurred by a contracting party under this Agreement, including tariff concessions, any product is being imported into the territory of that contracting party in such increased quantities and under such conditions as to cause or threaten serious injury to domestic producers in that territory of like or directly competitive products, the contracting party shall be free, in respect of such product, and to the extent and for such time as may be necessary to prevent or remedy such injury, to suspend the obligation in whole or in part or to withdraw or modify the concession. . . .

ARTICLE XXIV
Territorial Application—Frontier Traffic—Customs Unions and Free-Trade Areas

4. The contracting parties recognize the desirability of increasing freedom of trade by the development, through voluntary agreements, of closer integration between the economies of the countries party to such agreements. They also recognize that the purpose of a customs union or of a free-trade area should be to facilitate trade between the constituent territories and not to raise barriers to the trade of other contracting parties with such territories.

5. Accordingly, the provisions of this Agreement shall not prevent [the formation of customs unions and free-trade areas, provided that:]

a. . . . the duties [with outside parties] shall not on the whole be higher or more restrictive than the general incidence of the duties . . . prior to the formation. . . .

Source: http://www.wto.org/english/docs_e/legal_e/gatt47_01_e.htm#articleI.

2 The Gains from Trade

In earlier chapters, we demonstrated the gains from trade using a production possibilities frontier and indifference curves. We now instead demonstrate the gains from trade using Home's demand and supply curves, together with the concepts of consumer surplus and producer surplus. You may already be familiar with these concepts from an earlier economics course, but we provide a brief review here.

Consumer and Producer Surplus

Suppose that Home consumers have the demand curve D in panel (a) of Figure 8-1 and face the price of P_1. Then total demand is D_1 units. For the last unit purchased, the consumer buying it values that unit at close to its purchase price of P_1, so he or she obtains little or no surplus over the purchase price. But for all the earlier units purchased (from 0 to D_1 units), the consumers valued the product at *higher than* its purchase price: the consumers' willingness to pay for the product equals the height of the demand curve. For example, the person buying unit D_2 would have been willing to pay the price of P_2, which is the height of the demand curve at that quantity. Therefore, that individual obtains the surplus of $(P_2 - P_1)$ from being able to purchase the good at the price P_1.

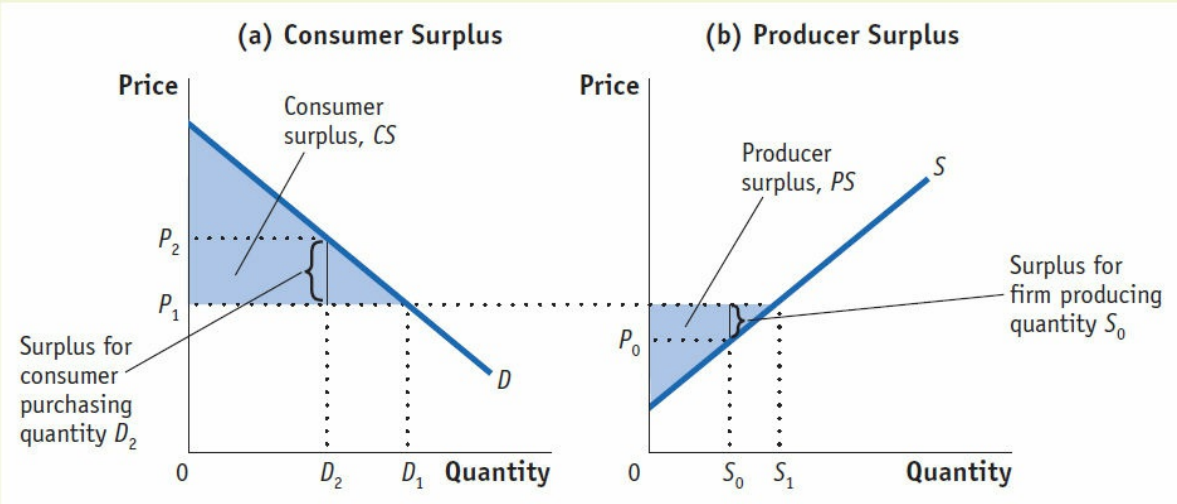


FIGURE 8-1

Consumer and Producer Surplus In panel (a), the consumer surplus from purchasing quantity D_1 at price P_1 is the area below the demand curve and above that price. The consumer who purchases D_2 is willing to pay price P_2 but has to pay only P_1. The difference is the consumer surplus and represents the satisfaction of consumers over and above the amount paid. In panel (b), the producer surplus from supplying the quantity S_1 at the price P_1 is the area above the supply curve and below that price. The supplier who supplies unit S_0 has marginal costs of P_0 but sells it for P_1. The difference is the producer surplus and represents the return to fixed factors of production in the industry.

For each unit purchased before D_1, the value that the consumer places on the product exceeds the purchase price of P_1. Adding up the surplus obtained on each unit purchased, from 0 to D_1, we can measure consumer surplus (CS) as the shaded region below the demand curve and above the price P_1. This region measures the satisfaction that consumers receive from the purchased quantity D_1, over and above the amount $P_1 \cdot D_1$ that they have paid.

Panel (b) of Figure 8-1 illustrates producer surplus. This panel shows the supply curve of an industry; the height of the curve represents the firm's marginal cost at each level of production. At the price of P_1, the industry will supply S_1. For the last unit supplied, the price P_1 equals the marginal cost of production for the firm supplying that unit. But for all earlier units supplied (from 0 to S_1 units), the firms were able to produce those units at a marginal cost *less than* the price P_1. For example, the firm supplying unit S_0 could produce it with a marginal cost of P_0, which is the height of the supply curve at that quantity. Therefore, that firm obtains the producer surplus of $(P_1 - P_0)$ from being able to sell the good at the price P_1.

For each unit sold before S_1, the marginal cost to the firm is less than the sale price of P_1. Adding up the producer surplus obtained for each unit sold, from 0 to S_1, we obtain producer surplus (PS) as the shaded region in panel (b) above the supply curve and below the price of P_1. It is tempting to think of producer surplus as the profits of firms, because for all units before S_1, the marginal cost of production is less than the sale price of P_1. But a more accurate definition of producer surplus is that it equals the *return to fixed factors of production in the industry*. That is, producer surplus is the difference between the sales revenue $P_1 \cdot S_1$ and the total variable costs of production (i.e., wages paid to labor and the costs of intermediate inputs). If there are fixed factors such as capital or land in the industry, as in the specific-factors model we studied in Chapter 3, then producer surplus equals the returns to these fixed factors of production. We might still loosely refer to this return as the "profit" earned in the industry, but it is important to understand that producer surplus is not *monopoly profit*, because we are assuming perfect competition (i.e., zero monopoly profits) throughout this chapter.[4]

Home Welfare

To examine the effects of trade on a country's welfare, we consider once again a world composed of two countries, Home and Foreign, with each country consisting of producers and consumers. Total Home welfare can be measured by adding up consumer and producer surplus. As you would expect, the greater the total amount of Home welfare, the better off are the consumers and producers overall in the economy. To measure the gains from trade, we will compare Home welfare in no-trade and free-trade situations.

No Trade

In panel (a) of Figure 8-2, we combine the Home demand and supply curves in a single diagram. The no-trade equilibrium occurs at the autarky price of P^A, where the quantity demanded equals the quantity supplied, of Q_0. Consumer surplus is the region above the price of P^A and below the demand curve, which is labeled as *CS* in panel (a) and also shown as area *a* in panel (b). Producer surplus is the area below the price of P^A and above the supply curve, which is labeled as *PS* in panel (a) and also shown as area (*b* + *c*) in panel (b). So the sum of consumer surplus and producer surplus is the area between the demand and supply curves, or *CS* + *PS* = area (*a* + *b* + *c*). That area equals Home's welfare in the market for this good in the absence of international trade.

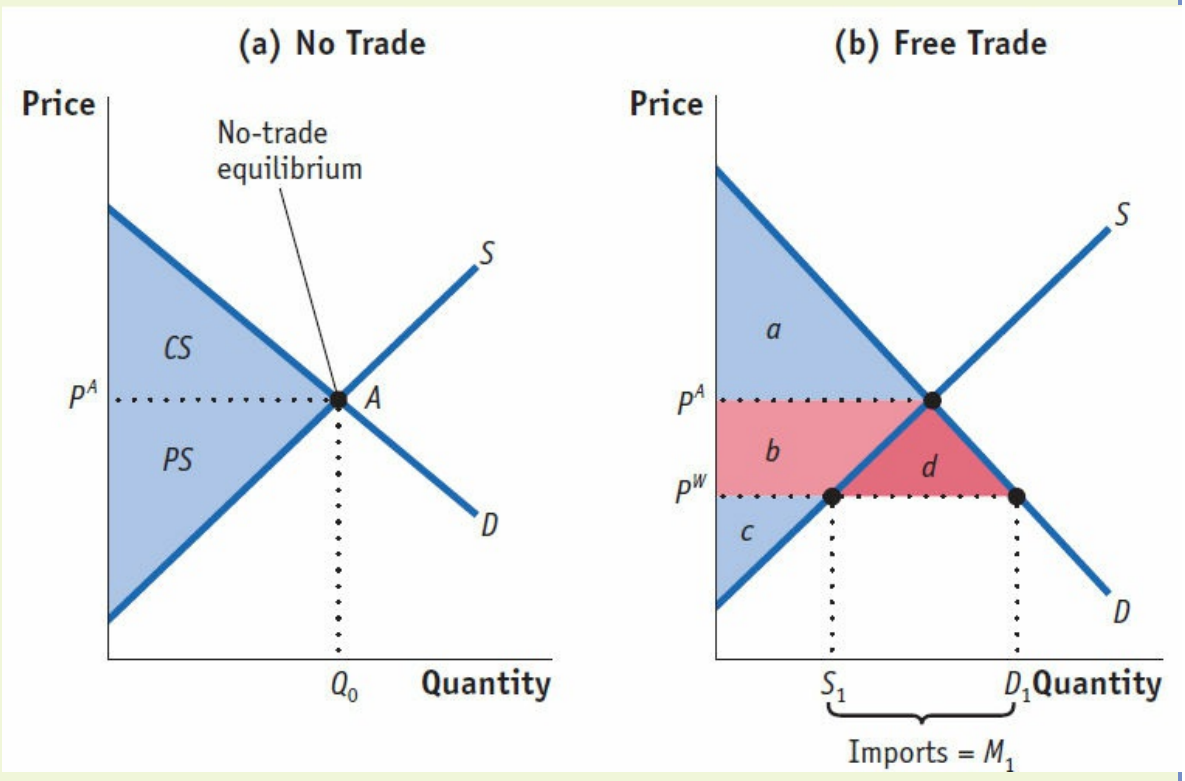


FIGURE 8-2

The Gains from Free Trade in Home With Home demand of *D* and supply of *S*, the no-trade equilibrium is at point A, at the price P^A producing Q_0. With free trade, the world price is P^W, so quantity demanded increases to D_1 and quantity supplied falls to S_1. Since quantity demanded exceeds quantity supplied, Home imports $D_1 - S_1$. Consumer surplus increases by the area (*b* + *d*), and producer surplus falls by area *b*. The gains from trade are measured by area *d*.

Free Trade for a Small Country

Now suppose that Home can engage in international trade for this good. As we have discussed in earlier chapters, the world price P^W is determined by the intersection of supply

and demand in the world market. Generally, there will be many countries buying and selling on the world market. We will suppose that the Home country is a small country, by which we mean that it is small in comparison with all the other countries buying and selling this product. For that reason, Home will be a *price taker* in the world market: it faces the fixed world price of P^W, and its own level of demand and supply for this product has no influence on the world price. In panel (b) of Figure 8-2, we assume that the world price P^W is *below* the Home no-trade price of P^A. At the lower price, Home demand will increase from Q_0 under no trade to D_1, and Home supply will decrease from Q_0 under no trade to S_1. The difference between D_1 and S_1 is *imports* of the good, or $M_1 = D_1 - S_1$. Because the world price P^W is below the no-trade price of P^A, the Home country is an importer of the product at the world price. If, instead, P^W were above P^A, then Home would be an exporter of the product at the world price.

Gains from Trade

Now that we have established the free-trade equilibrium at price P^W, it is easy to measure Home welfare as the sum of consumer and producer surplus with trade, and compare it with the no-trade situation. In panel (b) of Figure 8-2, Home consumer surplus at the price P^W equals the area $(a + b + d)$, which is the area below the demand curve and above the price P^W. In the absence of trade, consumer surplus was the area a, so the drop in price from P^A to P^W has increased consumer surplus by the amount $(b + d)$. Home consumers clearly gain from the drop in price.

Home firms, on the other hand, suffer a decrease in producer surplus from the drop in price. In panel (b), Home producer surplus at the price P^W equals the area c, which is the area above the supply curve and below the price P^W. In the absence of trade, producer surplus was the area $(b + c)$, so the drop in price from P^A to P^W has decreased producer surplus by the amount b. Home firms clearly lose from the drop in price.

Comparing the gains of consumers, $(b + d)$, with the losses of producers, area b, we see that consumers gain more than the producers lose, which indicates that total Home welfare (the sum of consumer surplus and producer surplus) has gone up. We can calculate the total change in Home welfare due to the opening of trade by adding the *changes* in consumer surplus and producer surplus:

Rise in consumer surplus:	$+(b + d)$
Fall in producer surplus:	$-b$
Net effect on Home's welfare:	+d

The area d is a measure of the *gains from trade* for the importing country due to free trade in this good. It is similar to the gains from trade that we have identified in earlier chapters using the production possibilities frontier and indifference curves, but it is easier to measure: the triangle d has a base equal to free-trade imports $M_1 = D_1 - S_1$, and a height that is the drop in price, $P^A - P^W$, so the gains from trade equal the area of the triangle, $12 \cdot (P^A - P^W) \cdot M_1$. Of course, with many goods being imported, we would need to add up the

areas of the triangles for each good and take into account the net gains on the export side to determine the overall gains from trade for a country. Because gains are positive for each individual good, after summing all imported and exported goods, the gains from trade are still positive.

Home Import Demand Curve

Before introducing a tariff, we use Figure 8-3 to derive the import demand curve, which shows the relationship between the world price of a good and the quantity of imports demanded by Home consumers. We first derived this curve in Chapter 2, for the Ricardian model. We now briefly review the derivation of the import demand curve before analyzing the effect of an import tariff on prices and welfare.

In panel (a) of Figure 8-3, we again show the downward-sloping demand curve (D) and the upward-sloping supply curve (S) for Home. The no-trade equilibrium is at point A, which determines Home's no-trade equilibrium price P^A, and its no-trade equilibrium quantity of Q_0. Because quantity demanded equals quantity supplied, there are zero imports of this product. Zero imports is shown as point A' in panel (b).

Now suppose the world price is at P^W, below the no-trade price of P^A. At the price of P^W, the quantity demanded in Home is D_1, but the quantity supplied by Home suppliers is only S_1. Therefore, the quantity imported is $M_1 = D_1 - S_1$, as shown by the point B in panel (b). Joining points A' and B, we obtain the downward-sloping import demand curve M.

Notice that the import demand curve applies for all prices *below* the no-trade price of P^A in Figure 8-3. Having lower prices leads to greater Home demand and less Home supply and, therefore, positive imports. What happens if the world price is *above* the no-trade price? In that case, the higher price would lead to greater Home supply and less Home demand, so Home would become an exporter of the product.

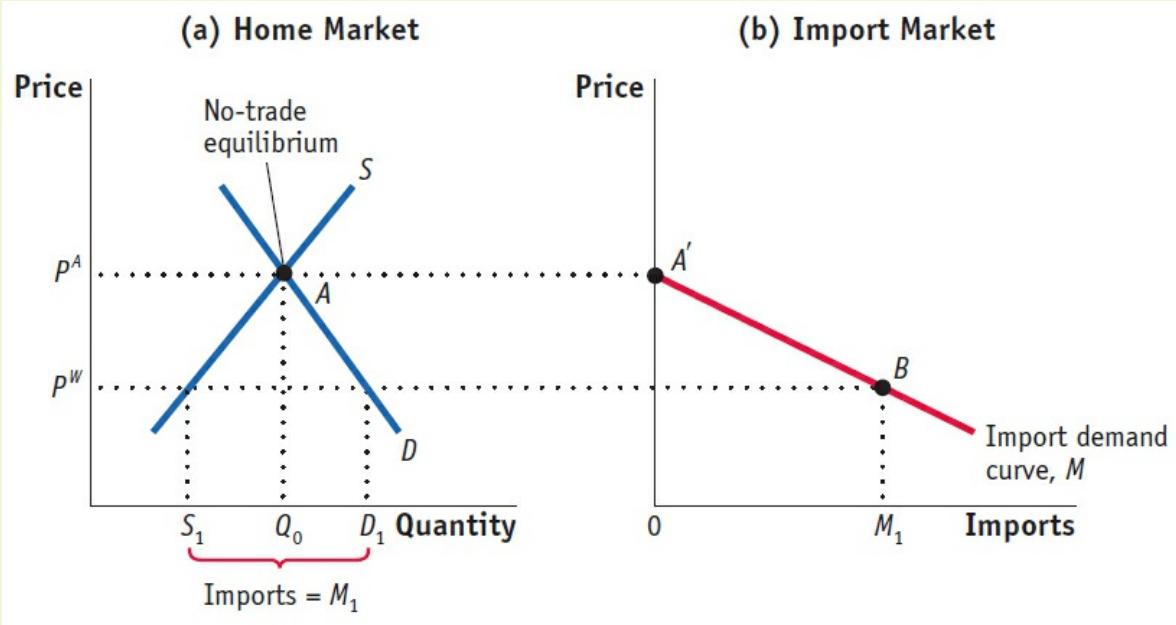


FIGURE 8-3

Home Import Demand With Home demand of D and supply of S, the no-trade equilibrium is at point A, with the price P^A and import quantity Q_0. Import demand at this price is zero, as shown by the point A' in panel (b). At a lower world price of P^W, import demand is $M_1 = D_1 - S_1$, as shown by point B. Joining up all points between A' and B, we obtain the import demand curve, M.

3 Import Tariffs for a Small Country

We can now use this supply and demand framework to show what happens when a small country imposes a tariff. As we have already explained, an importing country is "small" if its tariff does not have any effect on the world price of the good on which the tariff is applied. As we will see, the Home price of the good will increase due to the tariff. Because the tariff (which is a tax) is applied at the border, the price charged to Home's consumers will increase by the amount of the tariff.

Free Trade for a Small Country

In Figure 8-4, we again show the free-trade equilibrium for the Home country. In panel (b), the Foreign export supply curve X^* is horizontal at the world price P^W. The horizontal export supply curve means that Home can import any amount at the price P^W without having an impact on that price. The free-trade equilibrium is determined by the intersection of the Foreign export supply and the Home import demand curves, which is point B in panel (b), at the world price P^W. At that price, Home demand is D_1 and Home supply is S_1, shown in panel (a). Imports at the world price P^W are then just the difference between demand and supply, or $M_1 = D_1 - S_1$.

Effect of the Tariff

With the import tariff of t dollars, the export supply curve facing the Home country shifts up by exactly that amount, reflecting the higher price that must be paid to import the good. The shift in the Foreign export supply curve is analogous to the shift in domestic supply caused by a sales tax, as you may have seen in earlier economics courses; it reflects an effective increase in the costs of the firm. In panel (b) of Figure 8-4, the export supply curve shifts up to $X^* + t$. The intersection of the post-tariff export supply curve and the import demand curve now occurs at the price of $P^W + t$ and the import quantity of M_2. The import tariff has reduced the amount imported, from M_1 under free trade to M_2 under the tariff, because of its higher price.

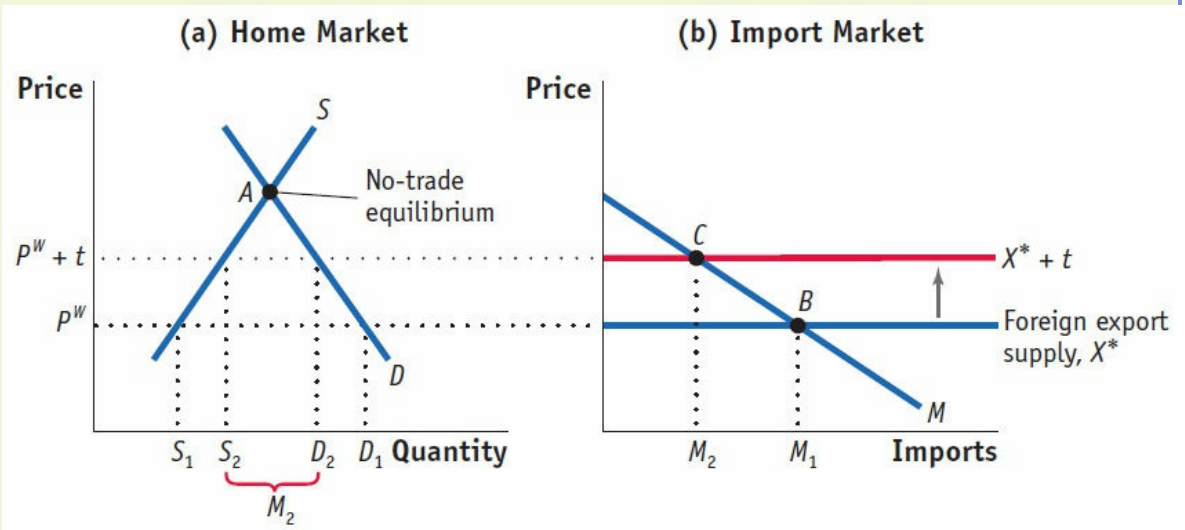


FIGURE 8-4

Tariff for a Small Country Applying a tariff of t dollars will increase the import price from P^W to $P^W + t$. The domestic price of that good also rises to $P^W + t$. This price rise leads to an increase in Home supply from S_1 to S_2, and a decrease in Home demand from D_1 to D_2, in panel (a). Imports fall due to the tariff, from M_1 to M_2 in panel (b). As a result, the equilibrium shifts from point B to C.

We assume that the imported product is identical to the domestic alternative that is available. For example, if the imported product is a women's cruiser bicycle, then the Home demand curve D in panel (a) is the demand for women's cruisers, and the Home supply curve is the supply of women's cruisers. When the import price rises to $P^W + t$, then we expect that the Home price for locally produced bicycles will rise by the same amount. This is because at the higher import price of $P^W + t$, the quantity of cruisers demanded in Home falls from its free-trade quantity of D_1 to D_2. At the same time, the higher price will encourage Home's firms to increase the quantity of cruisers they supply from the free-trade quantity of S_1 to S_2. As firms increase the quantity they produce, however, the marginal costs of production rise. The Home supply curve (S) reflects these marginal costs, so the Home price will rise along the supply curve until Home firms are supplying the quantity S_2, at a marginal cost just equal to the import price of $P^W + t$. Since marginal costs equal $P^W + t$, the price charged by Home firms will also equal $P^W + t$, and the domestic price will equal the import price.

Summing up, Home demand at the new price is D_2, Home supply is S_2, and the difference between these are Home imports of $M_2 = D_2 - S_2$. Foreign exporters still receive the "net-of-tariff" price (i.e., the Home price minus the tariff) of P^W, but Home consumers pay the higher price $P^W + t$. We now investigate how the rise in the Home price from P^W to $P^W + t$ affects consumer surplus, producer surplus, and overall Home welfare.

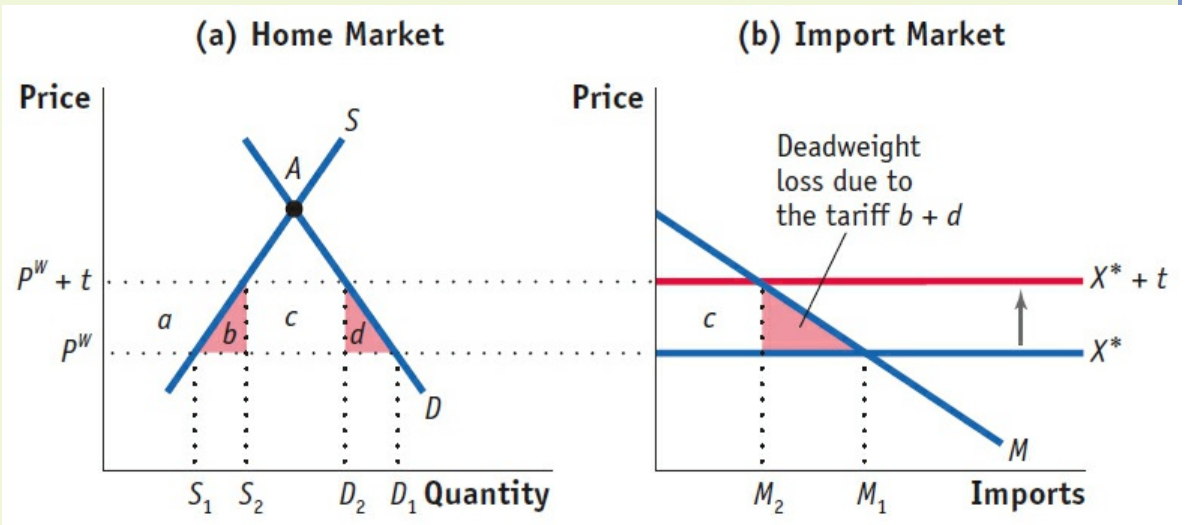


FIGURE 8-5

Effect of Tariff on Welfare The tariff increases the price from P^W to $P^W + t$. As a result, consumer surplus falls by $(a + b + c + d)$. Producer surplus rises by area a, and government revenue increases by the area c. Therefore, the net loss in welfare, the deadweight loss to Home, is $(b + d)$, which is measured by the two triangles b and d in panel (a) or the single (combined) triangle $b + d$ in panel (b).

Effect of the Tariff on Consumer Surplus

In Figure 8-5, we again show the effect of the tariff of t dollars, which is to increase the price of the imported and domestic good from P^W to $P^W + t$. Under free trade, consumer surplus in panel (a) was the area under the demand curve and above P^W. With the tariff, consumers now pay the higher price, $P^W + t$, and their surplus is the area under the demand curve and above the price $P^W + t$. The fall in consumer surplus due to the tariff is the area between the two prices and to the left of Home's demand, which is $(a + b + c + d)$ in panel (a) of Figure 8-5. This area is the amount that consumers lose due to the higher price caused by the tariff.

Effect of the Tariff on Producer Surplus

We can also trace the impact of the tariff on producer surplus. Under free trade, producer surplus was the area above the supply curve in panel (a) and below the price of P_W. With the tariff, producer surplus is the area above the supply curve and below the price $P_W + t$: since the tariff increases the Home price, firms are able to sell more goods at a higher price, thus increasing their surplus. We can illustrate this rise in producer surplus as the amount between the two prices and to the left of Home supply, which is labeled as a in panel (a). This area is the amount that Home firms gain because of the higher price caused by the tariff. As we have just explained, the rise in producer surplus should be thought of as an increase in the return to fixed factors (capital or land) in the industry. Sometimes we even think of labor as a partially fixed factor because the skills learned in one industry cannot

necessarily be transferred to other industries. In that case, it is reasonable to think that the increase in Home producer surplus can also benefit Home's workers in the import-competing industry, along with capital and land, but this benefit comes at the expense of consumer surplus.

Effect of the Tariff on Government Revenue

In addition to affecting consumers and producers, the tariff also affects government revenue. The amount of revenue collected is the tariff t times the quantity of imports ($D_2 - S_2$). In Figure 8-5, panel (a), this revenue is shown by the area c. The collection of revenue is a gain for the government in the importing country.

Overall Effect of the Tariff on Welfare

We are now in a position to summarize the impact of the tariff on the welfare of the Home importing country, which is the sum of producer surplus, consumer surplus, and government revenues. Thus, our approach is to *add up* these impacts to obtain a net effect. In adding up the losses of consumers and the gains of producers, one dollar of consumer surplus is the same as one dollar of producer surplus or government revenue. In other words, we do not care whether the consumers facing higher prices are poor or rich, and do not care whether the specific factors in the industry (capital, land, and possibly labor) earn a lot or a little. Under this approach, transferring one dollar from consumer to producer surplus will have no impact on overall welfare: the decrease in consumer surplus will cancel out the increase in producer surplus.

You may object to this method of evaluating overall welfare, and feel that a dollar taken away from a poor consumer and given to a rich producer represents a net loss of overall welfare, rather than zero effect, as in our approach. We should be careful in evaluating the impact of tariffs on different income groups in the society, especially for poor countries or countries with a high degree of inequality among income groups. But for now we ignore this concern and simply add up consumer surplus, producer surplus, and government revenue. Keep in mind that under this approach we are just evaluating the *efficiency* of tariffs and not their effect on equity (i.e., how fair the tariff is to one group versus another).

The overall impact of the tariff in the small country can be summarized as follows:

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$
Rise in government revenue:	$+c$
Net effect on Home's welfare:	$-(b + d)$

In Figure 8-5(b), the triangle ($b + d$) is the *net welfare loss* in a small importing country due to the tariff. We sometimes refer to this area as a deadweight loss, meaning that it is not offset by a gain elsewhere in the economy. Notice that in panel (a) the area a, which is a gain for producers, just cancels out that portion of the consumer surplus loss; the area a is effectively a transfer from consumers to producers via the higher domestic prices induced by the tariff. Likewise, area c, the gain in government revenue, also cancels out that portion

of the consumer surplus loss; this is a transfer from consumers to the government. Thus, the area ($b + d$) is the remaining loss for consumers that is not offset by a gain elsewhere. This deadweight loss is measured by the two triangles, b and d, in panel (a), or by the combined triangle ($b + d$) in panel (b). The two triangles b and d of deadweight loss can each be given a precise interpretation, as follows.

Production Loss

Notice that the base of triangle b is the net increase in Home supply due to the tariff, from S_1 to S_2. The height of this triangle is the increase in marginal costs due to the increase in supply. The unit S_1 was produced at a marginal cost equal to P^W, which is the free-trade price, but every unit above that amount is produced with higher marginal costs. The fact that marginal costs exceed the world price means that this country is producing the good inefficiently: it would be cheaper to import it rather than produce the extra quantity at home. The area of triangle b equals the increase in marginal costs for the extra units produced and can be interpreted as the production loss (or the *efficiency loss*) for the economy due to producing at marginal costs above the world price. Notice that the production loss is only a portion of the overall deadweight loss, which is ($b + d$) in Figure 8-5.

Consumption Loss

The triangle d in panel (a) (the other part of the deadweight loss) can also be given a precise interpretation. Because of the tariff and the price increase from P^W to $P^W + t$, the quantity consumed in Home is reduced from D_1 to D_2. The area of the triangle d can be interpreted as the drop in consumer surplus for those individuals who are no longer able to consume the units between D_1 and D_2 because of the higher price. We refer to this drop in consumer surplus as the consumption loss for the economy.

Why and How Are Tariffs Applied?

Our finding that a tariff always leads to deadweight losses for a small importing country explains why most economists oppose the use of tariffs. If a small country suffers a loss when it imposes a tariff, why do so many have tariffs as part of their trade policies? One answer is that a developing country does not have any other source of government revenue. Import tariffs are "easy to collect" because every country has customs agents at major ports checking the goods that cross the border. It is easy to tax imports, even though the deadweight loss from using a tariff is typically higher than the deadweight loss from using "hard-to-collect" taxes, such as income taxes or value-added taxes. These taxes are hard to collect because they require individuals and firms to honestly report earnings, and the government cannot check every report (as they can check imports at the border). Still, to the extent that developing countries recognize that tariffs have a higher deadweight loss, we would expect that over time they would shift away from such easy-to-collect taxes. That is exactly what has occurred, according to one research study.[5] The fraction of total tax revenue collected from easy-to-collect taxes such as tariffs fell during the 1980s and 1990s,

especially in developing countries, whereas the fraction of revenue raised from "hard to collect" taxes rose over this same period.

A second reason why tariffs are used even though they have a deadweight loss is politics. The tariff benefits Home producers, as we have seen, so if the government cares more about producer surplus than consumer surplus, it might decide to use the tariff despite the deadweight loss it incurs. Indeed, the benefits to producers (and their workers) are typically more concentrated on specific firms and states than the costs to consumers, which are spread nationwide. This is our interpretation of the tariff that President George W. Bush granted to the steel industry from 2002 to 2004: its benefits were concentrated in the steel-producing states of Pennsylvania, West Virginia, and Ohio, and its costs to consumers—in this case, steel-using industries—were spread more widely.[6] For the tariff on tires imported from China granted by President Obama from 2009 to 2012, the argument is a bit different. This tariff was requested by the United Steelworkers, the union who represents workers in the U.S. tire industry, and it was expected to benefit those workers. But U.S. tire producers did not support the tariff because many of them were already manufacturing tires in other countries—especially China—and this tariff made it more costly for them to do so.

In both the steel and tire cases, the president was not free to impose just any tariff, but had to follow the rules of the GATT discussed earlier in this chapter. Recall that Article XIX of the GATT, known as the "safeguard" or "escape clause," allows a temporary tariff to be used under certain circumstances. GATT Article XIX is mirrored in U.S. trade law. In Side Bar: Safeguard Tariffs, we list the key passages for two sections of the Trade Act of 1974, as amended, both of which deal with safeguard tariffs.

First, Section 201 states that a tariff can be requested by the president, by the House of Representatives, by the Senate, or by any other party such as a firm or union that files a petition with the U.S. International Trade Commission (ITC). That commission determines whether rising imports have been a "substantial cause of serious injury, or threat thereof, to the U.S. industry. . . ." The commission then makes a recommendation to the president who has the final authority to approve or veto the tariff. Section 201 goes further in defining a "substantial cause" as a "cause that is important and not less than any other cause." Although this kind of legal language sounds obscure, it basically means that rising imports have to be *the most important* cause of injury to justify import protection. The steel tariff used by President Bush met this criterion, but as we see in later chapters, many other requests for tariffs do not meet this criterion and are not approved.

A second, more recent amendment to the Trade Act of 1974 is Section 421 that applies only to China. This provision was added by the United States as a condition to China's joining the WTO in 2001.[7] Because the United States was worried about exceptional surges in imports from China, it drafted this legislation so that tariffs could be applied in such a case. Under Section 421, various groups can file a petition with the U.S. International Trade Commission, which makes a recommendation to the president. The commission must determine whether rising imports from China cause "market disruption" in a U.S. industry, which means "a significant cause of material injury, or threat of material injury, to the domestic industry." Furthermore, the term "significant cause" refers to "a cause which contributes significantly to the material injury of the domestic industry, but need not be equal to or greater than any other cause." Again, the legal language can be hard to follow, but it indicates that tariffs can be applied even when rising imports from China *are not the most important* cause of injury to the domestic industry. Section 421 can

therefore be applied under weaker conditions than Section 201, and it was used by President Obama to justify the tariff on tires imported from China.

SIDE BAR

Safeguard Tariffs

The U.S. Trade Act of 1974, as amended, describes conditions under which tariffs can be applied in the United States, and it mirrors the provisions of the GATT and WTO. Two sections of the Trade Act of 1974 deal with the use of "safeguard" tariffs:

Section 201

Upon the filing of a petition. . . , the request of the President or the Trade Representative, the resolution of either the Committee on Ways and Means of the House of Representatives or the Committee on Finance of the Senate, or on its own motion, the [International Trade] Commission shall promptly make an investigation to determine whether an article is being imported into the United States in such increased quantities as to be a *substantial cause of serious injury, or the threat thereof, to the domestic industry* producing an article like or directly competitive with the imported article.

. . . For purposes of this section, the term "substantial cause" means a cause which is *important and not less than any other cause*.

Section 421

Upon the filing of a petition . . . the United States International Trade Commission . . . shall promptly make an investigation to determine whether products of the People's Republic of China are being imported into the United States in such increased quantities or under such conditions as to *cause or threaten to cause market disruption to the domestic producers* of like or directly competitive products.

. . . (1) For purposes of this section, *market disruption* exists whenever imports of an article like or directly competitive with an article produced by a domestic industry are increasing rapidly, either absolutely or relatively, so as to be a *significant cause of material injury, or threat of material injury, to the domestic industry*.

(2) For purposes of paragraph (1), the term "significant cause" refers to a cause which contributes significantly to the material injury of the domestic industry, *but need not be equal to or greater than any other cause*. [Italics added]

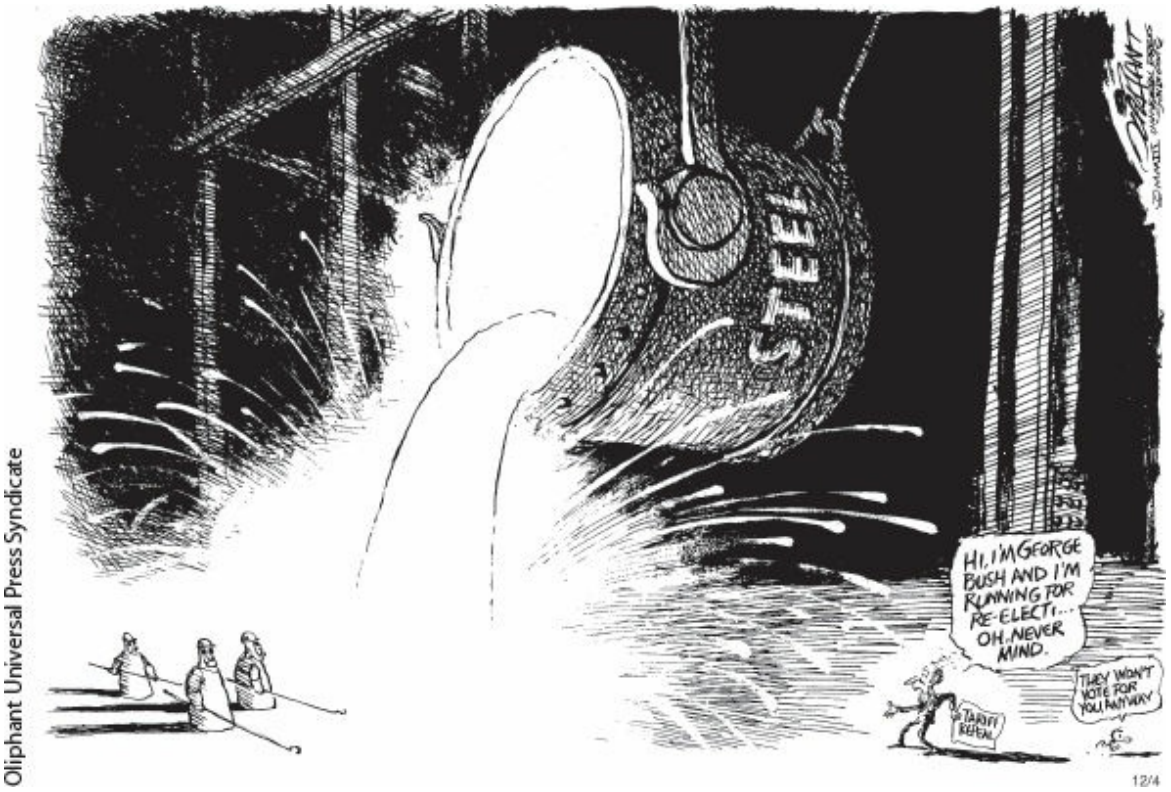
Source: http://www.law.cornell.edu/uscode/text/19/2252 and http://www.law.cornell.edu/uscode/text/19/2451.

APPLICATION

U.S. Tariffs on Steel and Tires

The U.S. steel and tire tariffs highlight the political motivation for applying tariffs despite the deadweight losses associated with them. We can use our small-country model introduced previously to calculate a rough estimate of how costly these tariffs were in terms of welfare. Although the United States may not be a small country when it comes to its influence on import and export prices, it is a good starting point for our analysis, and we will examine the large-country case in the next section. For now, we stay with our small-country model and illustrate the deadweight loss due to a tariff with the U.S. steel tariff in place from March 2002 to December 2003. After that calculation, we compare the steel tariff with the more recent tariff on tires.

To fulfill his campaign promise to protect the steel industry, President George W. Bush requested that the ITC initiate a Section 201 investigation into the steel industry. This was one of the few times that a president had initiated a Section 201 action; usually, firms or unions in an industry apply to the ITC for import protection. After investigating, the ITC determined that the conditions of Section 201 and Article XIX were met, and it recommended that tariffs be put in place to protect the U.S. steel industry. The tariffs recommended by the ITC varied across products, ranging from 10% to 20% for the first year, as shown in Table 8-1, and then falling over time so as to be eliminated after three years.



The ITC decision was based on several factors.[8] First, imports had been rising and prices were falling in the steel industry from 1998 to early 2001, leading to substantial losses for U.S. firms. Those losses, along with falling investment and employment, met the condition of "serious injury." An explanation given by the ITC for the falling import prices was that the U.S. dollar appreciated substantially prior to 2001: as the dollar rises in value, foreign currencies become cheaper and so do imported products such as steel, as occurred during this period. To meet the criterion of Section 201 and Article XIX, rising imports need to be a "substantial cause" of serious injury, which is defined as "a cause which is important and not less than any other cause." Sometimes another cause of injury to U.S. firms can be a domestic recession, but that was not the case in the years preceding 2001, when demand for steel products was rising.[9]

TABLE 8-1

U.S. ITC Recommended and Actual Tariffs for Steel Shown here are the tariffs recommended by the U.S. International Trade Commission for steel imports, and the actual tariffs that were applied in the first year.

Product Category	U.S. ITC Recommendation (First Year, %)	Actual U.S. Tariff (First Year, %)
Carbon and Alloy Flat Products		
Slab	20	30
Flat products	20	30
Tin mill products	U*	30
Carbon and Alloy Long Products		
Hot-rolled bar	20	30
Cold-finished bar	20	30

Rebar	10	15
Carbon and Alloy Tubular Products		
Tubular products	?**	15
Alloy fittings and flanges	13	13
Stainless and Tool Steel Products		
Stainless steel bar	15	15
Stainless steel rod	?**	15
Stainless steel wire	U*	8

* Uncertain—the ITC was divided on whether a tariff should be used.
** A specific recommendation was not made by the U.S. ITC.

Data from: Robert Read, 2005, "*The Political Economy of Trade Protection: The Determinants and Welfare Impact of the 2002 U.S. Emergency Steel Safeguard Measures*," The World Economy, *1119–1137*.

President Bush accepted the recommendation of the ITC but applied even higher tariffs, ranging from 8% to 30%, as shown in Table 8-1, with 30% tariffs applied to the most commonly used steel products (such as flat-rolled steel sheets and steel slab). Initially, the tariffs were meant to be in place for three years and to decline over time. Knowing that U.S. trading partners would be upset by this action, President Bush exempted some countries from the tariffs on steel. The countries exempted included Canada, Mexico, Jordan, and Israel, all of which have free-trade agreements with the United States, and 100 small developing countries that were exporting only a very small amount of steel to the United States.

Deadweight Loss Due to the Steel Tariff

To measure the deadweight loss due to the tariffs levied on steel, we need to estimate the area of the triangle $b + d$ in Figure 8-5(b). The base of this triangle is the change in imports due to the tariffs, or $\Delta M = M_1 - M_2$. The height of the triangle is the increase in the domestic price due to the tariff, or $\Delta P = t$. So the deadweight loss equals

$$DWL = 1/2 \cdot t \cdot \Delta M$$

It is convenient to measure the deadweight loss relative to the value of imports, which is $P^W \cdot M$. We will also use the percentage tariff, which is t/P^W, and the percentage change in the quantity of imports, which is $\%\Delta M = \Delta M/M$. The deadweight loss relative to the value of imports can then be rewritten as

$$DWL/P^W \cdot M = 1/2 \cdot t \cdot \Delta M/P^W \cdot M = 1/2 \cdot (t/P^W) \cdot \%\Delta M$$

For the tariffs on steel, the most commonly used products had a tariff of 30%, so that is the percentage increase in the price: $t/P^W = 0.3$. It turns out that the quantity of steel imports also fell by 30% the first year after the tariff was imposed, so that $\%\Delta M = 0.3$. Therefore, the deadweight loss is

$$DWL/P^W \cdot M = 1/2(0.3 \cdot 0.3) = 0.045, \text{ or } 4.5\% \text{ of the import value}$$

The value of steel imports that were affected by the tariff was about $4.7 billion in

the year prior to March 2002 and $3.5 billion in the year after March 2002, so average imports over the two years were (4.7 + 3.5) = $4.1 billion (these values do not include the tariffs).[10]

If we apply the deadweight loss of 4.5% to the average import value of $4.1 billion, then the dollar magnitude of deadweight loss is 0.045 · 4.1 billion = $185 million. As we discussed earlier, this deadweight loss reflects the net annual loss to the United States from applying the tariff. If you are a steelworker, then you might think that the price of $185 million is money well spent to protect your job, at least temporarily. On the other hand, if you are a consumer of steel, then you will probably object to the higher prices and deadweight loss. In fact, many of the U.S. firms that purchase steel—such as firms producing automobiles—objected to the tariffs and encouraged President Bush to end them early. But the biggest objections to the tariffs came from exporting countries whose firms were affected by the tariffs, especially the European countries.

Response of the European Countries

The tariffs on steel most heavily affected Europe, Japan, and South Korea, along with some developing countries (Brazil, India, Turkey, Moldova, Romania, Thailand, and Venezuela) that were exporting a significant amount of steel to the United States. These countries objected to the restriction on their ability to sell steel to the United States.

The countries in the European Union (EU) therefore took action by bringing the case to the WTO. They were joined by Brazil, China, Japan, South Korea, New Zealand, Norway, and Switzerland. The WTO has a formal dispute settlement procedure under which countries that believe that the WTO rules have not been followed can bring their complaint and have it evaluated. The WTO evaluated this case and, in early November 2003, ruled that the United States had failed to sufficiently prove that its steel industry had been harmed by a sudden increase in imports and therefore did not have the right to impose "safeguard" tariffs.

The WTO ruling was made on legal grounds: that the United States had essentially failed to prove its case (i.e., its eligibility for Article XIX protection).[11] But there are also economic grounds for doubting the wisdom of the safeguard tariffs in the first place. Even if we accept that there might be an argument on equity or fairness grounds for temporarily protecting an industry facing import competition, it is hard to argue that such protection should occur because of a change in exchange rates. The U.S. dollar appreciated for much of the 1990s, including the period before 2001 on which the ITC focused, leading to much lower prices for imported steel. But the appreciation of the dollar also lowered the prices for *all other* import products, so many other industries in the United States faced import competition, too. On fairness grounds, there is no special reason to single out the steel industry for protection.

The WTO ruling entitled the European Union and other countries to retaliate against the United States by imposing tariffs of their own against U.S. exports. The European countries quickly began to draw up a list of products—totaling some $2.2 billion in U.S. exports—against which they would apply tariffs. The European countries naturally picked products that would have the greatest negative impact on the United States, such as oranges from Florida, where Jeb Bush, the president's brother, was governor.

The threat of tariffs being imposed on these products led President Bush to reconsider the U.S. tariffs on steel. On December 5, 2003, he announced that they would be suspended after being in place for only 19 months rather than the three years as initially planned. This chain of events illustrates how the use of tariffs by an importer can easily lead to a response by exporters and a tariff war. The elimination of the steel tariffs by President Bush avoided such a retaliatory tariff war.

Tariff on Tires

The tariff on tires imported from China, announced by President Obama on September 11, 2009, was requested by the United Steel, Paper and Forestry, Rubber, Manufacturing, Energy, Allied Industrial, and Service Workers International Union (or the United Steelworkers, for short), the union that represents American tire workers. On April 20, 2009, they filed a petition with the U.S. ITC for import relief under Section 421 of U.S. trade law. As discussed in Side Bar: Safeguard Tariffs, this section of U.S. trade law enables tariffs to be applied against products imported from China if the imports are "a significant cause of material injury" to the U.S. industry. A majority of the ITC commissioners felt that rising numbers of imports from China of tires for cars and light trucks fit this description and recommended that tariffs be applied for a three-year period. Their recommendation was for tariffs of 55% in the first year, 45% in the second year, and 35% in the third year (these tariffs would be in addition to a 4% tariff already applied to U.S. tire imports).

President Obama decided to accept this recommendation from the ITC, which was the first time that a U.S. president accepted a tariff recommendation under Section 421.

From 2000 to 2009, there had been six other ITC investigations under Section 421, and in four of these cases a majority of commissioners voted in favor of tariffs. But President George W. Bush declined to apply tariffs in all these cases. In accepting the recommendation to apply tariffs on tires, however, President Obama reduced the amount of the tariff to 35% in the first year starting September 26, 2009, 30% in the second year, and 25% in the third year, with the tariff expiring on September 27, 2012.

We've already noted one key difference between the tariff on tires and the earlier tariff on steel: the tire tariff was applied to imports from a single country—China—under Section 421 of U.S. trade law, whereas the steel tariff was applied against many countries under Section 201. For this reason we will refer to the tariff on tires applied against China as a discriminatory tariff, meaning a tariff that is applied to the imports from a specific country. Notice that a discriminatory tariff violates the "most favored nation" principle of the WTO and GATT (see Sidebar: Key Provisions of the GATT), which states that all members of the WTO should be treated equally. It was possible for the United States to apply this discriminatory tariff against China because Section 421 was negotiated as a condition for China entering the WTO.

A second difference between these cases is that steel producers in the United States supported that tariff, but no U.S. tire producers joined in the request for the tariff on tires. There are 10 producers of tires in the United States, and seven of them—including well-known firms like Goodyear, Michelin, Cooper, and Bridgestone—also produce tires in China and other countries. These firms naturally did not want the tariff put in place because it would harm rather than help them.

There are also a number of similarities in the two cases. As occurred in steel, the tariff on tires led to retaliation. China responded with actual or potential tariffs on products such as chicken feet (a local delicacy), auto parts, certain nylon products, and even passenger cars. For its part, the United States went on to apply new tariffs on steel pipe imported from China, and also investigated several other products. Another similarity with the steel case is that China made an official complaint to the WTO under its dispute settlement procedure, just as the European countries did in the steel case. China claimed that the "significant cause of material injury" conditions of Section 421 had not been met. China also questioned whether it was legal under the WTO for the United States to apply a discriminatory tariff. Unlike the steel case, the WTO concluded that the United States was justified in applying the tariff on tires.

The final comparison we make between the steel and tire tariffs focuses on the calculation of the deadweight losses. Because the tariff on tires was applied against only one country—China—you might think that it would have a lower deadweight loss than the steel tariff, which was applied against many countries selling to the United States. It turns out that the opposite is true: the tariff on tires had a *higher* deadweight loss than that tariff on steel, precisely because it was a discriminatory tariff that was applied against only one country. To explain this surprising outcome, we will make use of Figure 8-6.

A Discriminatory Tariff

We suppose that China can sell any amount of tires to the United States at the price of P^W in Figure 8-6. What is new in this figure is the treatment of the *other* countries

exporting to the United States. We represent these countries by the upward-sloping supply curve X^*, which is added onto the U.S. supply of S to obtain total supply from all countries other than China of $S + X^*$.

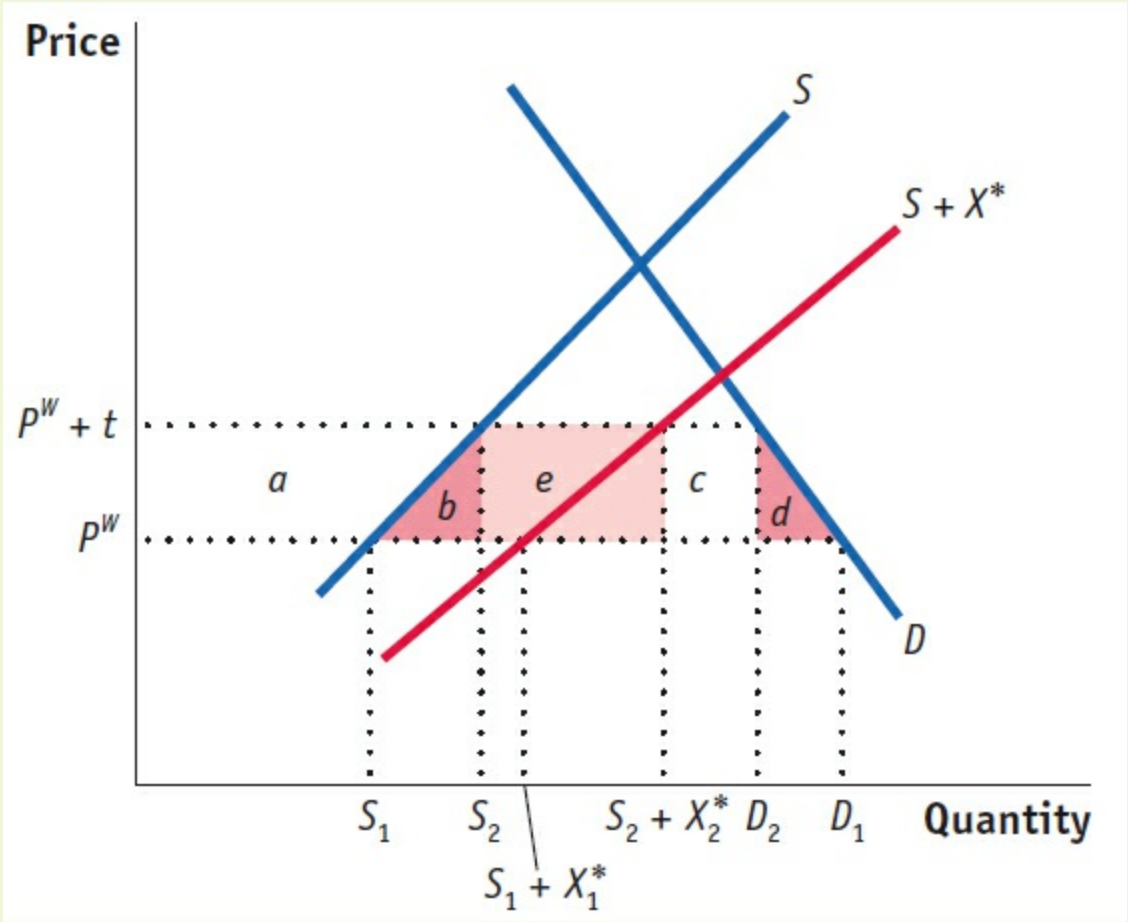


FIGURE 8-6

Effect of the Tariff on Tires The tariff on tires increases the price of tires from China from P^W to $P^W + t$. The supply from the United States is shown by S, and the supply from other exporting countries by X^*. As a result of the tariff, these two sources of supply increase from S1+X1* to S2+X2*; China supplies the rest of the market up to demand D_1. Because the other exporting countries do not face the tariff, they collect area e from the higher prices charged in the U.S. market. Therefore, the deadweight loss from the tariff is $(b + d + e)$.

Under free trade, the price for tires is P^W and the supply from the United States is S_1, while supply from the United States and exporting countries other than China is S1+X1*, and China exports the difference between S1+X1* and demand of D_1. When the tariff of t is applied against China, the price of tires rises to $P^W + t$, and supply from the United States rises to S_2. Supply from the United States and exporting countries other than China rises to S2+X2*. China exports the difference between S2+X2*.

Because the price has risen to $P^W + t$, both U.S. producers and exporting countries other than China are selling more (moving along their supply curves) while China must be selling less (because the other countries are selling more and total demand has gone down).

So far the diagram looks only a bit different from our treatment of the tariff in Figure 8-5. But when we calculate the effect of the tariff on welfare in the United States, we find a new result. We will not go through each of the steps in calculating the change in consumer and producer surplus, but we will focus on tariff revenue and the difference with our earlier treatment in Figure 8-5. The key idea to keep in mind is that the tariff applies only to China, and not to other exporting countries. So with the increase in the price of tires from P^W to $P^W + t$, the other exporting countries get to keep that higher price: it is not collected from these countries as tariff revenue. Under these circumstances, the amount of tariff revenue is only the quantity that China exports (the difference between S2+X2* and demand of D_2) times the tariff t, which is the area shown by c. In comparison, the area shown by e is the increase in the price charged by *other* exporters times their exports of X2*. Area e is not collected by the U.S. government as tariff revenue, and becomes part of the deadweight loss for the United States. The total deadweight loss for the United States is then $b + d + e$, which exceeds the deadweight loss of $b + d$ that we found in Figure 8-5. The reason that the deadweight loss has gone up is that other exporters are selling for a higher price in the United States, and the government does not collect any tariff revenue from them.

Deadweight Loss Due to the Tire Tariff

Figure 8-6 shows that a discriminatory tariff applied against just one country has a higher deadweight loss, of $b + d + e$, than an equal tariff applied against all exporting countries, in which case the deadweight loss is just $b + d$ as we found in Figure 8-5. To see whether this theoretical result holds in practice, we can compare the tariff on tires with the tariff on steel. In the end, we will find that the tariff on tires was costlier to the United States because other countries—especially Mexico and other countries from Asia—were able to sell more tires to the United States at higher prices.

The effect of the tariff on the percentage of U.S. import value coming from China and other countries is shown in Figure 8-7. Just before the tariff was imposed in September 2009, imports into the United States were evenly divided, with one-third coming from China, one-third from other Asian countries, and one-third from Canada, Mexico, and all other countries. The lowest area in the graph represents the value of imports from China. We can see that Chinese imports dropped in the fourth quarter (Q4) of 2009, after the tariff began in September, and rose again in the fourth quarter (Q4) of 2012, after the tariff ended in September of that year. The value of imports from China fell from about 33% of overall imports to 15% when the tariff began, and rose from about 12% of overall imports to 22% after the tariff ended. But this 18-percentage-point decline in imports from China when the tariff began was substantially made up for by increased imports from other Asian countries. We can see this result by looking at the next area shown in the graph, above China, which represents imports from all other Asian countries. When adding up the Chinese and other Asian imports, we obtain about 60% of the total imports, and while this percentage varies to some

extent when the tariff begins and ends, it varies much less than does the percentage imported from China itself. In other words, other Asian countries made up for the reduction in China exports by increasing their own exports; similarly, Mexico (included within the top area in the graph) also increased its exports to the United States during the time the tariff was applied.

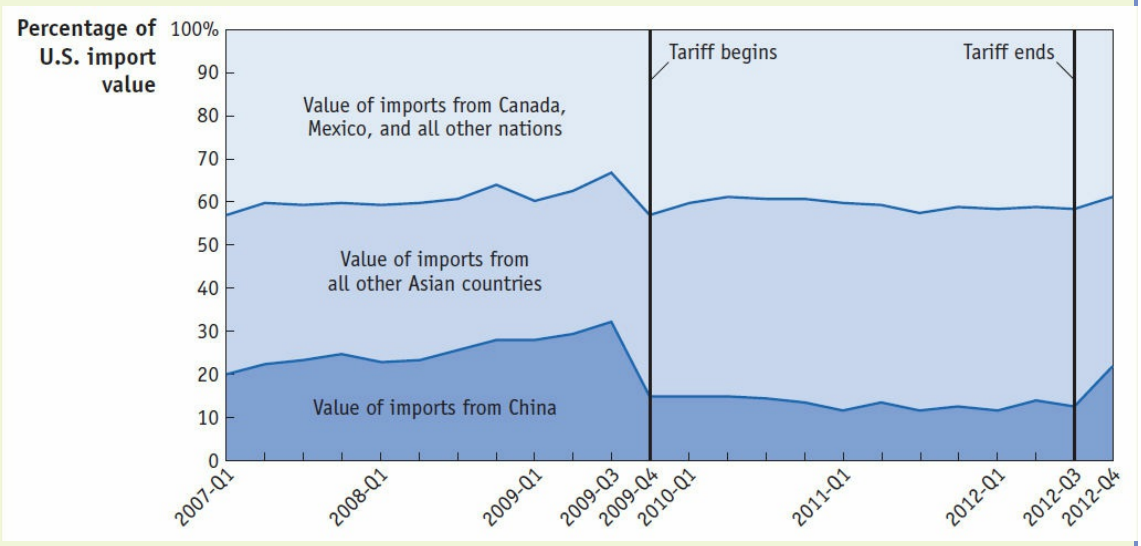


FIGURE 8-7

U.S. Imports of Tires The tariff applied to U.S. imports of tires began in the fourth quarter of 2009 (2009Q4) and ended in the third quarter of 2012 (2012Q3). The value of imports from China fell from about 33% of overall imports to 15% when the tariff began, and rose from about 12% of overall imports to 22% when the tariff ended. This decline in imports from China was substantially made up by increased imports from other Asian countries and Mexico, which exported more to the United States.

This increase in sales from other Asian countries and Mexico is consistent with Figure 8-6, which shows that sales from other exporters increase from X1* to X2* due to the tariff on China. The evidence also indicates that these other exporters were able to charge higher prices for the tires they sold to the United States. For car tires, the average price charged by countries other than China increased from $54 to $64 during the times of the tariff, while for light truck tires, the average prices increased from $76 to $90. Both these increases are higher than we would expect from inflation during 2009–12. As shown in Figure 8-6, these price increases for other exporters occur because they are competing with Chinese exporters who must pay the tariff.

An estimate of the area *e*—which is the total increase in the amount paid to tire exporters other than China—is $716 million per year for imports of car tires and another $101 million per year for imports of light truck tires, totaling $817 million per year.[12] This is in addition to the deadweight loss $b + d$. This area e for the tire tariff substantially exceeds the deadweight loss of for the steel tariff of $185 million per year that we calculated above. So we see that a discriminatory tariff, applied against just one

exporting country, can be more costly than an equal tariff applied against all exporters.

At the beginning of the chapter we included a quote from President Obama in his State of the Union address in 2012, in which he said that "over a thousand Americans are working today because we stopped a surge in Chinese tires." Although 1,000 jobs in the tire industry is roughly the estimate of how many jobs were saved, we have shown that these jobs came at a very high cost because the tariff was discriminatory.[13] In a later chapter we will discuss another example like this that shows that opening up free trade with just one country can have a surprising negative effect on welfare as compared with opening up free trade with all countries.

4 Import Tariffs for a Large Country

Under the small-country assumption that we have used so far, we know for sure that the deadweight loss is positive; that is, the importing country is always harmed by the tariff. The small-country assumption means that the world price P^W is unchanged by the tariff applied by the importing country. If we consider a large enough importing country or a large country, however, then we might expect that its tariff will change the world price. In that case, the welfare for a large importing country can be improved by a tariff, as we now show.

Foreign Export Supply

If the Home country is large, then we can no longer assume that it faces a Foreign export supply curve X^* that is horizontal at the given world price P^W. Instead, we need to derive the Foreign export supply curve using the Foreign market demand and supply curves. In panel (a) of Figure 8-8, we show the demand curve D^* and supply curve S^* for Foreign. These intersect at the point A^*, with a no-trade equilibrium price of P^{A*}. Because Foreign demand equals supply at that price, Foreign exports are zero, which we show by point $A^{*\prime}$ in panel (b), where we graph Foreign exports against their price.

Now suppose the world price P^W is above the Foreign no-trade price of P^{A*}. At the price of P^W, the Foreign quantity demanded is lower, at D1* in panel (a), but the quantity supplied by Foreign firms is larger, at S1*. Because Foreign supply exceeds demand, Foreign will export the amount X1* = S1* – D1* at the price of P^W, as shown by the point B^* in panel (b). Drawing a line through points $A^{*\prime}$ and B^*, we obtain the upward-sloping Foreign export supply curve X^*.

We can then combine the Foreign export supply curve X^* and Home import demand curve M, which is also shown in panel (b). They intersect at the price P^W, the world equilibrium price. Notice that the Home import demand curve starts at the no-trade price P^A on the price axis, whereas the Foreign export supply curve starts at the price P^{A*}. As we have drawn them, the Foreign no-trade price is lower, $P^{A*} < P^A$. In Chapter 2 through Chapter 5 of this book, a country with comparative advantage in a good would have a lower no-trade relative price and would become an exporter when trade was opened. Likewise, in panel (b), Foreign exports the good since its no-trade price P^{A*} is lower than the world price, and Home imports the good since its no-trade price P^A is higher than the world price. So the world equilibrium illustrated in panel (b) is similar to that in some of the trade models presented in earlier chapters.

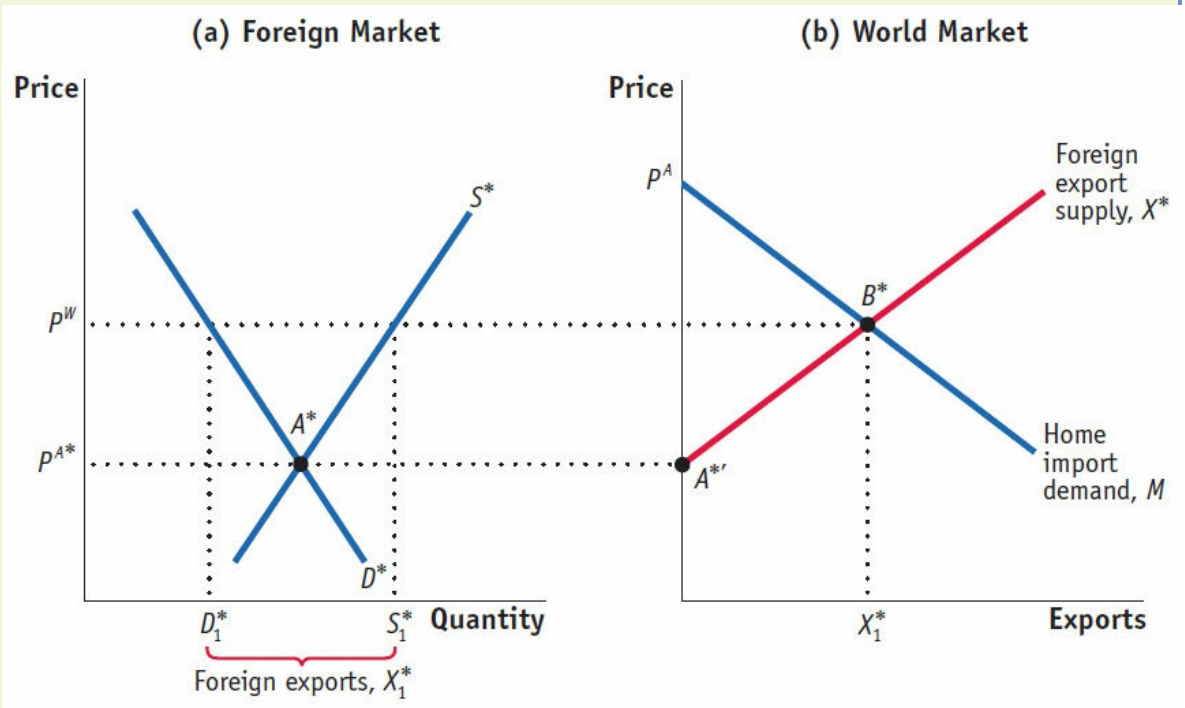


FIGURE 8-8

Foreign Export Supply In panel (a), with Foreign demand of D^* and Foreign supply of S^*, the no-trade equilibrium in Foreign is at point A^*, with the price of P^{A*}. At this price, the Foreign market is in equilibrium and Foreign exports are zero—point A^* in panel (a) and point $A^{*\prime}$ in panel (b), respectively. When the world price P^W is higher than the Foreign no-trade price, the quantity supplied by Foreign, S^*_1, exceeds the quantity demanded by Foreign, D^*_1, and Foreign exports $X^*_1 = S^*_1 - D^*_1$. In panel (b), joining up points $A^{*\prime}$ and B^*, we obtain the upward-sloping export supply curve X^*. With the Home import demand of M, the world equilibrium is at point B^*, with the price P^W.

Effect of the Tariff

In panel (b) of Figure 8-9, we repeat the Home import demand curve M and Foreign export supply curve X^*, with the world equilibrium at B^*. When Home applies a tariff of t dollars, the cost to Foreign producers of supplying the Home market is t more than it was before. Because of this increase in costs, Foreign export supply curve shifts up by exactly the amount of the tariff, as shown in panel (b) with the shift from X^* to $X^* + t$. The $X^* + t$ curve intersects import demand M at point C, which establishes the Home price (including the tariff) paid by consumers. On the other hand, the Foreign exporters receive the net-of-tariff price, which is directly below the point C by exactly the amount t, at point C^*. Let us call the price received by Foreign exporters P^*, at point C^*, which is the new world price.

The important feature of the new equilibrium is that the price Home pays for its imports, $P^* + t$, rises by *less than* the amount of the tariff t as compared with the initial world price P^W. The reason that the Home price rises by less than the full amount of the

tariff is that the price received by Foreign exporters, P^*, has fallen as compared with the initial world price P^W. So Foreign producers are essentially "absorbing" a part of the tariff, by lowering their price from P^W (in the initial free-trade equilibrium) to P^* (after the tariff).

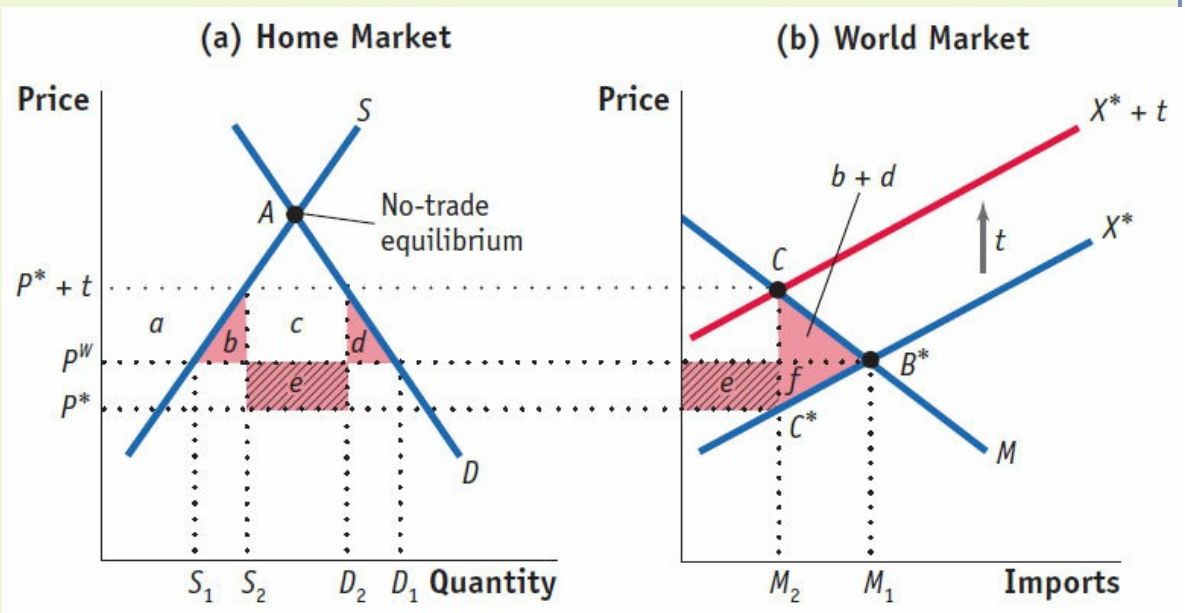


FIGURE 8-9

Tariff for a Large Country The tariff shifts up the export supply curve from X^* to $X^* + t$. As a result, the Home price increases from P^W to $P^* + t$, and the Foreign price falls from P^W to P^*. The deadweight loss in Home is the area of the triangle $(b + d)$, and Home also has a terms-of-trade gain of area e. Foreign loses the area $(e + f)$, so the net loss in world welfare is the triangle $(b + d + f)$.

In sum, we can interpret the tariff as driving a wedge between what Home consumers pay and what Foreign producers receive, with the difference (of t) going to the Home government. As is the case with many taxes, the amount of the tariff (t) is shared by both consumers and producers.

Terms of Trade

In Chapter 2, we defined the terms of trade for a country as the ratio of export prices to import prices. Generally, an improvement in the terms of trade indicates a gain for a country because it is either receiving more for its exports or paying less for its imports. To measure the Home terms of trade, we want to use the net-of-tariff import price P^* (received by Foreign firms) since that is the total amount transferred from Home to Foreign for each import. Because this price has fallen (from its initial world price of P^W), it follows that the Home terms of trade have increased. We might expect, therefore, that the Home country gains from the tariff in terms of Home welfare. To determine whether that is the case, we need to analyze the impact on the welfare of Home consumers, producers, and government

revenue, which we do in Figure 8-9.

Home's Welfare

In panel (a), the Home consumer price increases from P^W to $P^* + t$, which makes consumers worse off. The drop in consumer surplus is represented by the area between these two prices and to the left of the demand curve D, which is shown by $(a + b + c + d)$. At the same time, the price received by Home firms rises from P^W to $P^* + t$, making Home firms better off. The increase in producer surplus equals the area between these two prices, and to the left of the supply curve S, which is the amount a. Finally, we also need to keep track of the changes in government revenue. Revenue collected from the tariff equals the amount of the tariff (t) times the new amount of imports, which is $M_2 = D_2 - S_2$. Therefore, government revenue equals the area $(c + e)$ in panel (a).

By summing the change in consumer surplus, producer surplus, and government revenue, we obtain the overall impact of the tariff in the large country, as follows:

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$
Rise in government revenue:	$+(c + e)$
Net effect on Home welfare:	$+e - (b + d)$

The triangle $(b + d)$ is the deadweight loss due to the tariff (just as it is for a small country). But for the large country, there is also a source of gain—the area e—that offsets this deadweight loss. If e exceeds $(b + d)$, then Home is better off due to the tariff; if e is less than $(b + d)$, then Home is worse off.

Notice that the area e is a rectangle whose height is the fall in the price that Foreign exporters receive, the difference between P^W and P^*. The base of this rectangle equals the quantity of imports, M_2. Multiplying the drop in the import price by the quantity of imports to obtain the area e, we obtain a precise measure of the terms-of-trade gain for the importer. If this terms-of-trade gain exceeds the deadweight loss of the tariff, which is $(b + d)$, then Home gains from the tariff.

Thus, we see that a large importer might gain by the application of a tariff. We can add this to our list of reasons why countries use tariffs, in addition to their being a source of government revenue or a tool for political purposes. However, for the large country, any net gain from the tariff comes at the expense of the Foreign exporters, as we show next.

Foreign and World Welfare

Although Home might gain from the tariff, Foreign, the exporting country, definitely loses. In panel (b) of Figure 8-9, the Foreign loss is measured by the area $(e + f)$. We should think of $(e + f)$ as the loss in Foreign producer surplus from selling fewer goods to Home at a lower price. Notice that the area e is the terms-of-trade gain for Home but an equivalent terms-of-trade *loss* for Foreign; Home's gain comes at the expense of Foreign. In addition, the large-country tariff incurs an extra deadweight loss of f in Foreign, so the combined total outweighs the benefits to Home. For this reason, we sometimes call a tariff imposed

by a large country a "beggar thy neighbor" tariff.

Adding together the change in Home's welfare and Foreign welfare, the area *e* cancels out and we are left with a *net loss* in world welfare of (*b* + *d* + *f*), the triangle in panel (b). This area is a deadweight loss for the world. The terms-of-trade gain that Home has extracted from the Foreign country by using a tariff comes at the expense of the Foreign exporters, and in addition, there is an added world deadweight loss. The fact that the large-country tariff leads to a world deadweight loss is another reason that most economists oppose the use of tariffs.

Optimal Tariff for a Large Importing Country

We have found that a large importer might gain by the application of tariffs, but have yet to determine what *level* of tariff a country should apply in order to maximize welfare. It turns out there is a shortcut method we can use to evaluate the effect of the tariff on the welfare of a large importing country. The shortcut method uses the concept of the optimal tariff.

The optimal tariff is defined as the tariff that leads to the maximum increase in welfare for the importing country. For a large importing country, a small tariff initially increases welfare because the terms-of-trade gain exceeds the deadweight loss. That is, the area of the rectangle *e* in panel (a) of Figure 8-9 exceeds the area of the triangle (*b* + *d*) in panel (b) when the tariff is small enough. The reason for this is that both the height and base of the triangle (*b* + *d*) shrink to zero when the tariff is very small, so the area of the triangle is very small indeed; but for the rectangle *e*, only the height shrinks to zero when the tariff is small, so the area of the rectangle exceeds that of the triangle. By this mathematical reasoning, the Home gains are positive—$e > (b + d)$—when the Home tariff is sufficiently small.

In Figure 8-10, we graph Home welfare against the level of the tariff. Free trade is at point *B*, where the tariff is zero. A small increase in the tariff, as we have just noted, leads to an *increase* in Home welfare (because the terms-of-trade gain exceeds the deadweight loss). Therefore, starting at point *B*, the graph of Home welfare must be upward-sloping. But what if the tariff is very large? If the tariff is too large, then welfare will fall *below* the free-trade level of welfare. For example, with a prohibitive tariff so high that no imports are purchased at all, then the importer's welfare will be at the no-trade level, shown by point *A*. So while the graph of welfare must be increasing for a small tariff from point *B*, as the tariff increases, welfare eventually falls past the free-trade level at point *B′* to the no-trade welfare at point *A*.

Given that points *B* and *A* are both on the graph of the importer's welfare (for free trade and no trade, respectively) and that welfare must be rising after point *B*, it follows that there must be a highest point of welfare, shown by point *C*. At this point, the importer's welfare is highest because the difference between the terms-of-trade gain and deadweight loss is maximized. We will call the tariff at that point the "optimal tariff." For increases in the tariff beyond its optimal level (i.e., between points *C* and *A*), the importer's welfare falls because the deadweight loss due to the tariff overwhelms the terms-of-trade gain. But whenever the tariff is below its optimal level, between points *B* and *C*, then welfare is higher than its free-trade level because the terms-of-trade gain exceeds the deadweight loss.

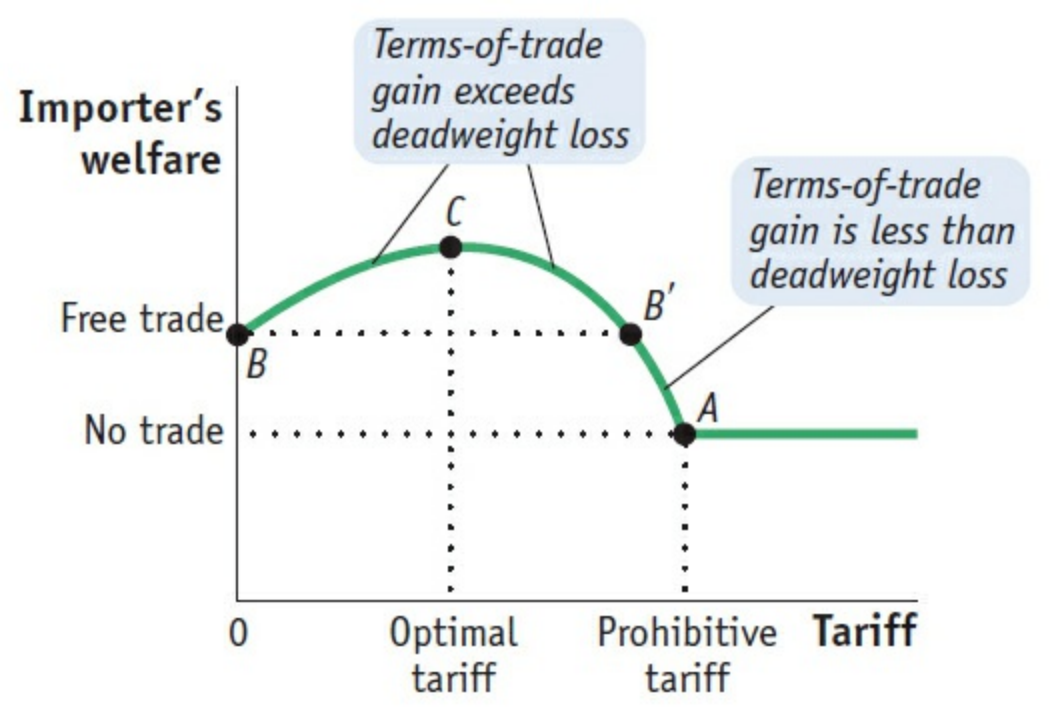


FIGURE 8-10

Tariffs and Welfare for a Large Country For a large importing country, a tariff initially increases the importer's welfare because the terms-of-trade gain exceeds the deadweight loss. So the importer's welfare rises from point *B*. Welfare continues to rise until the tariff is at its optimal level (point *C*). After that, welfare falls. If the tariff is too large (greater than at *B*), then welfare will fall below the free-trade level. For a prohibitive tariff, with no imports at all, the importer's welfare will be at the no-trade level, at point *A*.

Optimal Tariff Formula

It turns out that there is a simple formula for the optimal tariff. The formula depends on the elasticity of Foreign export supply, which we call EX*. Recall that the elasticity of any supply curve is the percentage increase in supply caused by a percentage increase in price. Likewise, the elasticity of the Foreign export supply curve is the percentage change in the quantity exported in response to a percent change in the world price of the export. If the export supply curve is very steep, then there is little response of the quantity supplied, and so the elasticity EX* is low. Conversely, if the export supply curve is very flat, there is a large response of the quantity supplied due to a change in the world price, and so EX* is high. Recall also that a small importing country faces a perfectly horizontal, or perfectly elastic, Foreign export supply curve, which means that the elasticity of Foreign's export supply is infinite.

Using the elasticity of Foreign export supply, the optimal tariff equals

$$\text{optimal tariff} = \frac{1}{EX^*}$$

That is, the optimal tariff (measured as a percentage) equals the inverse of the elasticity of Foreign export supply. For a small importing country, the elasticity of Foreign export

supply is infinite, and so the optimal tariff is zero. That result makes sense, since any tariff higher than zero leads to a deadweight loss for the importer (and no terms-of-trade gain), so the best tariff to choose is zero, or free trade.

For a large importing country however, the Foreign export supply is less than infinite, and we can use this formula to compute the optimal tariff. As the elasticity of Foreign export supply decreases (which means that the Foreign export supply curve is steeper), the optimal tariff is higher. The reason for this result is that with a steep Foreign export supply curve, Foreign exporters will lower their price more in response to the tariff.[14] For instance, if EX* decreases from 3 to 2, then the optimal tariff increases from 13 = 33% to 12 = 50%, reflecting the fact that Foreign producers are willing to lower their prices more, taking on a larger share of the tariff burden. In that case, the Home country obtains a larger terms-of-trade increase and hence the optimal level of the tariff is higher.

APPLICATION

U.S. Tariffs on Steel Once Again

Let us return to the U.S. tariff on steel, and reevaluate the effect on U.S. welfare in the large-country case. The calculation of the deadweight loss that we did earlier in the application assumed that the United States was a small country, facing fixed world prices for steel. In that case, the 30% tariff on steel was fully reflected in U.S. prices, which rose by 30%. But what if the import prices for steel in the United States did not rise by the full amount of the tariff? If the United States is a large enough importer of steel, then Foreign export price will fall and the U.S. import price will rise by less than the tariff. It is then possible that the United States gained from the tariff.

To determine whether the United States gained from the tariff on steel products, we can compute the deadweight loss (area $b + d$) and the terms-of-trade gain (area e) for each imported steel product using the optimum tariff formula.

Optimal Tariffs for Steel

Let us apply this formula to the U.S. steel tariffs to see how the tariffs applied compare with the theoretical optimal tariff. In Table 8-2, we show various steel products along with their respective elasticities of export supply to the United States. By taking the inverse of each export supply elasticity, we obtain the optimal tariff. For example, alloy steel flat-rolled products (the first item) have a low export supply elasticity, 0.27, so they have a very high optimal tariff of $1/0.27 = 3.7 = 370\%$. In contrast, iron and nonalloy steel flat-rolled products (the last item) have a very high export supply elasticity of 750, so the optimal tariff is $1/750 \approx 0\%$. Products between these have optimal tariffs ranging from 1% to 125%.

TABLE 8-2

Optimal Tariffs for Steel Products This table shows optimal tariffs for steel products, calculated with the elasticity formula.

Product Category	Elasticity of Export Supply	Optimal Tariff (%)	Actual Tariff (%)
Alloy steel flat-rolled products	0.27	370	30
Iron and steel rails and railway track	0.80	125	0
Iron and steel bars, rods, angles, shapes	0.80	125	15–30
Ferrous waste and scrap	17	6	0
Iron and steel tubes, pipes, and fittings	90	1	13–15
Iron and nonalloy steel flat-rolled products	750	0	0

Data from: Elasticities of export supply provided by Christian Broda and David Weinstein, May 2006, "Globalization and the Gains from Variety," Quarterly Journal of Economics, *121(2), 541–585.*

In the final column of Table 8-2, we show the actual tariffs that were applied to these products. For alloy steel flat-rolled products (the first item), the actual tariff was 30%, which is far below the optimal tariff. That means the terms-of-trade gain for that product was higher than the deadweight loss: the tariff is on the portion of the welfare graph between *B* and *C* in Figure 8-10, and U.S. welfare is above its free-trade level. The same holds for iron and steel bars, rods, angles, and shapes, for which the tariffs of 15% to 30% are again less than their optimal level, so the United States obtains a terms-of-trade gain that exceeds the deadweight loss. However, for iron and steel tubes, pipes, and fittings, the U.S. tariffs were 13% to 15%, but the optimal tariff for that product was only 1%. Because of the very high elasticity of export supply, the United States has practically no effect on the world price, so the deadweight loss for that product exceeds the terms-of-trade gain.

To summarize, for the three product categories in Table 8-2 to which the United States applied tariffs, in two products the terms-of-trade gain exceeded the deadweight loss, so U.S. welfare rose due to the tariff, but in a third case the deadweight loss was larger, so U.S. welfare fell due to the tariff. The first two products illustrate the large-country case for tariffs, in which the welfare of the importer can rise because of a tariff, whereas the third product illustrates the small-country case, in which the importer loses from the tariff.

From the information given in Table 8-2, we do not know whether the United States gained or lost overall from the steel tariffs: that calculation would require adding up the gains and losses due to the tariff over all imported steel products, which we have not done. But in the end, we should keep in mind that any rise in U.S. welfare comes at the expense of exporting countries. Even if there was an overall terms-of-trade gain for the United States when adding up across all steel products, that gain would be at the expense of the European countries and other steel exporters. As we have already discussed, the steel exporters objected to the U.S. tariffs at the WTO and were entitled to apply *retaliatory* tariffs of their own against U.S. products. If these tariffs had been applied, they would have eliminated and reversed any U.S. gain. By removing the tariffs in less than two years, the United States avoided a costly tariff war. Indeed, that is one of the main goals of the WTO: by allowing exporting countries to retaliate with tariffs, the WTO prevents importers from using optimal tariffs to their own advantage. In a later chapter, we show more carefully how such a tariff war will end up being costly to all countries involved.

5 Import Quotas

On January 1, 2005, China was poised to become the world's largest exporter of textiles and apparel. On that date, a system of worldwide import quotas known as the Multifibre Arrangement (MFA) was abolished. Import quotas are a restriction on the amount of a particular good that one country can purchase from another country. Under the MFA, begun in 1974, import quotas restricted the amount of nearly every textile and apparel product that was imported to Canada, the European countries, and the United States. These countries limited their textile imports to protect their own domestic firms producing those products. With the end of the MFA, China was ready to enjoy greatly increased exports—but this did not occur. The threat of import competition from China led the United States and Europe to negotiate *new* temporary import quotas with China, as we discuss in this section.

Besides the MFA, there are many other examples of import quotas. For example, since 1993 Europe had a quota on the imports of bananas that allowed for a greater number of bananas to enter from its former colonies in Africa than from Latin America. In 2005 that quota was simplified and converted into a tariff, even though that tariff still discriminated among countries based on their colonial past. Then, in 2009, Europe agreed to reduce the tariff on Latin American bananas, effectively bringing to an end this "banana war," which had lasted for more than 15 years. Another example is the quota on U.S. imports of sugar, which is still in place despite calls for its removal. In Headlines: Sugar Could Sweeten U.S. Australia Trans-Pacific Trade Talks, we describe how Australia's sugar growers hoped that the Trans-Pacific Trade Partnership (TTP) would eliminate the sugar quota, which restricts its exports to the United States. As we discuss in Chapter 11, the TTP is a free trade agreement between 12 countries, including Australia and the United States, which was signed on February 4, 2016, but still needs to be ratified by the governments of each country. The final text of that agreement does not actually remove the sugar quota that applies to Australia, but increases the amount of sugar that Australia is permitted to export to the United States under the quota.

HEADLINES

Sugar Could Sweeten U.S. Australia Trans-Pacific Trade Talks

This article discusses the reasons for the sugar quota in the United States that has been in place since before World War II. Under current negotiations for the Trans-Pacific Partnership, Australia has asked the United States to reconsider this quota and allow more exports from Australia.

Australia's sugar growers and investors could end up with a sweeter deal under the upcoming Trans-Pacific Partnership negotiations as the U.S. faces growing calls to put its long-standing sugar import restrictions on the table. The U.S. has been leading the wide-ranging regional talks, which aim to eliminate barriers to trade between the world's largest economy and some of the fastest-growing markets. In all, the 11 countries in the

talks—which include Australia—account for one-third of U.S. trade. . . . [The] U.S. may finally be forced to reconsider the limits on sugar imports it has had in place since before the start of the Second World War.

To be sure, sugar is a sticky subject in the U.S. That's not only because it's already the world's largest importer of sugar, buying from more than 40 countries, the largest market for sweeteners or because, with annual production in excess of 8 million short tons, it's also one of the world's largest producers. It's because the sugar industry—which employs around 142,000 people and generates nearly $20 billion a year, according to lobby group the American Sugar Alliance—is extremely politically vocal and represents important votes in key swing states. For this reason the industry has been able to keep trade barriers intact that, for decades, kept domestic prices at roughly double the world price until about 5 years ago.

. . . [A]s the world's third-largest sugar exporter, Australia stands to reap significant benefits if the U.S. relaxes its regulations. Tom Earley, vice president for Agralytica Consulting, estimates there's an annual shortfall of more than 1 million metric tons in the U.S. that isn't met by fixed quotas and so would be up for grabs under any changes. "Australian negotiators are saying everything should be on the table and that makes sense to me," he said. "At the end of the day everything is on the table." . . . A spokesman for Australia's Department of Agriculture, Fisheries and Forestry said the U.S. remains a "valued market for the Australian sugar industry, despite volumes being constrained." The government "continues to press for increased sugar access to the U.S., although this remains a difficult issue for both countries," he added.

Source: Excerpted from Caroline Henshaw, "Sugar Could Sweeten U.S. Australia Trans-Pacific Trade Talks," The Wall Street Journal, *October 18, 2012.*

In this section, we explain how quotas affect the importing and exporting countries and examine the differences between quotas and tariffs. Like a tariff, an import quota often imposes a welfare cost on the importing country. But we will find that quotas can often lead to higher welfare losses for the importer than tariffs.

Import Quota in a Small Country

Applying an import quota for a small country is similar to applying a tariff, so we can use the graphs developed earlier in the chapter to analyze quotas, too.

Free-Trade Equilibrium

In panel (a) of Figure 8-11, we show the demand curve D and supply curve S for Home. At the free-trade world price of P^W, Home quantity demanded is D_1 and quantity supplied is S_1, so imports are $M_1 = D_1 - S_1$. The import demand curve $M = D - S$ is shown in panel (b). The assumption that the Home country is small means that the fixed world price P^W is not affected by the import quota, so under free trade, the Foreign export supply curve X^* is a horizontal line at the world price P^W. The Home import demand curve M and Foreign export supply curve X^* intersect at point B, resulting in the free-trade level of imports, M_1.

Effect of the Quota

Now suppose that an import quota of $M_2 < M_1$ is imposed, meaning that the quantity imported cannot exceed this amount. This quota effectively establishes a vertical export supply curve labeled as in X^- panel (b), which fixes the import quantity at M_2. The vertical export supply curve now intersects import demand at point C, which establishes the Home

price of P_2. In panel (a), the price of P_2 leads firms to increase the quantity supplied to S_2 and consumers to decrease their quantity demanded to D_2.

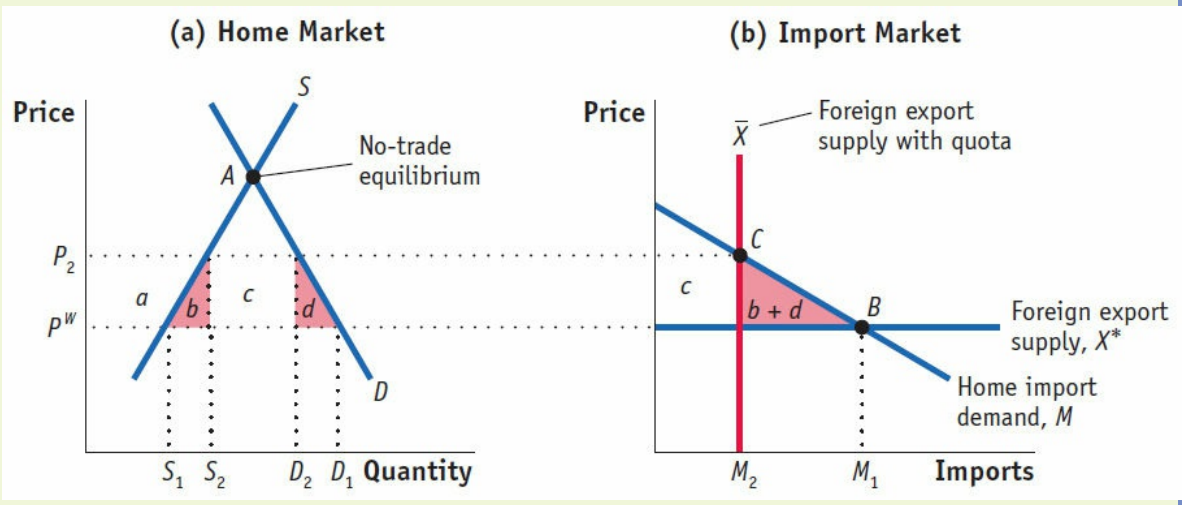


FIGURE 8-11

Quota for a Small Country Under free trade, the Foreign export supply curve is horizontal at the world price, P^W, and the free-trade equilibrium is at point B with imports of M_1. Applying an import quota of $M_2 < M_1$ leads to the vertical export supply curve $\bar{X}$ with the equilibrium at point C. The quota increases the import price from P^W to P_2. There would be the same impact on price and quantities if instead of the quota, a tariff of $t = P_2 - P^W$ had been used.

The import quota therefore leads to an increase in the Home price and a reduction in Home imports, just like a tariff. Furthermore, notice that there would be an equivalent effect on the import price and quantity if instead of the quota, the government had imposed an import tariff of $t = P_2 - P^W$. That is, the tariff of $t = P_2 - P^W$ would raise the Home price to P_2 and reduce imports to the level M_2. We conclude that for every level of the import quota, there is an equivalent import tariff that would lead to the same price and quantity of imports in Home.[15]

Effect on Welfare

As we have shown, the quota leads to an increase in the Home price. The rise in the price for consumers leads to a fall in consumer surplus. That fall is measured by the area between the prices P_2 and P^W and to the left of the demand curve, which is the area $(a + b + c + d)$ in panel (a) of Figure 8-11. On the other hand, the increase in the price facing Home producers leads to a gain in producer surplus. That gain is measured by the area between the prices P_2 and P^W and to the left of the supply curve, which is the area a in Figure 8-11(a). These two welfare effects are the same as would occur under a tariff.

The quota and tariff differ, however, in terms of area c, which would be collected as government revenue under a tariff. Under the quota, this area equals the difference between the domestic price P_2 and the world price P^W, times the quantity of imports M_2. Therefore, whoever is actually importing the good will be able to earn the difference between the world price P^W and the higher Home price P_2 by selling the imports in the Home market. We call the difference between these two prices the *rent* associated with the quota, and hence the area c represents the total quota rents. There are four possible ways that these quota rents can be allocated:

1. Giving the Quota to Home Firms

First, quota licenses (i.e., permits to import the quantity allowed under the quota system) can be given to Home firms, which are then able to import at the world price P^W and sell locally at P_2, earning the difference between these as rents. An example of this is the dairy industry in the United States, in which U.S. producers of cheese receive licenses to import from abroad. With home firms earning the rents c, the net effect of the quota on Home welfare is

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$
Quota rents earned in Home:	$+c$
Net effect on Home welfare:	$-(b + d)$

We see from this calculation that the net effect on Home welfare is a loss of amount $(b + d)$. That loss is the same as what we found in Section 3 of this chapter for the loss of a tariff in a small country. As in that section, we still refer to $(b + d)$ as a deadweight loss.

2. Rent Seeking

One complication of simply giving valuable quota licenses to Home firms is that these firms may engage in some kind of inefficient activities to obtain them. For example, suppose that Home firms are producing batteries and import the chemical needed as an input. If licenses for the imported chemicals are allocated in proportion to each firm's production of batteries in the previous years, then the Home firms will likely produce more batteries than they can sell (and at lower quality) *just to obtain the import licenses for the following year*. Alternatively, firms might engage in bribery or other lobbying activities to obtain the licenses. These kinds of inefficient activities done to obtain quota licenses are called rent seeking. It has been suggested that the waste of resources devoted to rent-seeking activities could be as large as the value of rents themselves so that the area c would be wasted rather than accrue to Home firms. If rent seeking occurs, the welfare loss due to the quota would be

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$

Net effect on Home welfare:	$(b + c + d)$

The waste of resources due to rent seeking leads to a fall in Home welfare of $(b + c + d)$, which is larger than that for a tariff. It is often thought that rent seeking is more severe in some developing countries where rules are not well enforced and officials are willing to take bribes in exchange for the licenses.

3. Auctioning the Quota

A third possibility for allocating the rents that come from the quota is for the government of the importing country to auction off the quota licenses. This occurred in Australia and New Zealand during the 1980s. In Australia, the auctions covered imports of textiles, apparel, footwear, and motor vehicles. The quota auctions used for imports of textiles and apparel in Australia were an alternative to the Multifibre Arrangement (MFA). Auctions of import quotas have also been proposed in the United States but have never actually occurred.[16] In a well-organized, competitive auction, the revenue collected should exactly equal the value of the rents, so that area c would be earned by the Home government. Using the auction method to allocate quota rents, the net loss in domestic welfare due to the quota becomes

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$
Auction revenue earned in Home:	+c
Net effect on Home welfare:	$-(b + d)$

The net effect on Home welfare in this case is the deadweight loss of $(b + d)$, which is once again the same loss as incurred from a tariff.

4. "Voluntary" Export Restraint

The final possibility for allocating quota rents is for the government of the importing country to give authority for implementing the quota to the government of the *exporting* country. Because the exporting country allocates the quota among its own producers, this is sometimes called a "voluntary" export restraint (VER), or a "voluntary" restraint agreement (VRA). In the 1980s the United States used this type of arrangement to restrict Japanese automobile imports. In that case, Japan's Ministry of International Trade and Industry (MITI), a government agency that implements Japan's trade policies, told each Japanese auto manufacturer how much it could export to the United States. In this case, the quota rents are earned by foreign producers, so the loss in Home welfare equals

Fall in consumer surplus:	$-(a + b + c + d)$
Rise in producer surplus:	$+a$
Net effect on Home welfare:	$-(b + c + d)$

The VER gives a higher net loss ($b + c + d$) for the importer than does a tariff because the quota rents are earned by Foreign exporters. This result raises the question of why VERs are used at all. One answer is that by giving the quota rents to firms in the exporting country, that country is much less likely to retaliate by adopting import tariffs or quotas of its own. In other words, the transfer of quota rents to the exporter becomes a way to avoid a tariff or quota war.

Costs of Import Quotas in the United States

Table 8-3 presents some estimates of the home deadweight losses, along with the quota rents, for major U.S. quotas in the years around 1985. In all cases except dairy, the rents were earned by foreign exporters. We discuss the case of automobiles in the next chapter, for which the quota rents earned by foreigners range from $2 billion to $8 billion. Textiles and apparel also had very large quota rents and U.S. deadweight losses (about $5 billion each) under the MFA. In addition, the MFA imposed large losses on the exporting countries, due to rent-seeking activities by exporters to obtain the quota permits. Adding up the costs shown in Table 8-3, the total U.S. deadweight loss from these quotas was in the range of $8 billion to $12 billion annually in the mid-1980s, whereas the quota rents transferred to foreigners were another $7 billion to $17 billion annually.

Some, but not all, of these costs for the United States are no longer relevant today. The quota in automobiles ceased being applied after 1987 because Japanese producers built plants in the United States and therefore reduced their imports. The quotas in the steel industry were replaced by the "safeguard" tariffs that President Bush temporarily imposed from 2002 to 2003. But the quotas used in sugar remain, though the amount of U.S. sales allowed under the quota has been increased under the Trans-Pacific Partnership for Australia, Canada, Vietnam, Malaysia, and Japan (see Headlines: Sugar Could Sweeten U.S. Australia Trans-Pacific Trade Talks). Finally, while the MFA expired on January 1, 2005, it was replaced by a new set of quotas with China that were in place until 2008. There were continuing losses for the United States due to quotas in these textiles and apparel industries, as we discuss in the next application.

TABLE 8-3

Annual Cost of U.S. Import Protection ($ billions) Shown here are estimates of the dead weight losses and quota rents due to U.S. import quotas in the 1980s, for the years around 1985. Many of these quotas are no longer in place today.

	U.S. Deadweight Loss (area $b + d$)	Quota Rents (area c)
Automobiles	0.2–1.2	2.2–7.9
Dairy	1.4	0.25*
Steel	0.1–0.3	0.7–2.0
Sugar	0.1	0.4–1.3
Textiles and apparel	4.9–5.9	4.0–6.1
Import tariffs	1.2–3.4	0
Total	7.9–12.3	7.3–17.3

*In dairy the quota rents are earned by U.S. importers and so are not included in the total.

Data from: Robert Feenstra, Summer 1992, "How Costly Is Protectionism?" Journal of Economic Perspectives, 159–178.

APPLICATION

China and the Multifibre Arrangement

One of the founding principles of GATT was that countries should not use quotas to restrict imports (see Article XI of Side Bar: Key Provisions of the GATT). The Multifibre Arrangement (MFA), organized under the auspices of the GATT in 1974, was a major exception to that principle and allowed the industrial countries to restrict imports of textile and apparel products from the developing countries. Importing countries could join the MFA, and arrange quotas bilaterally (i.e., after negotiating with exporters) or unilaterally (on their own). In practice, the import quotas established under the MFA were very detailed and specified the amount of each textile and apparel product that each developing country could sell to countries including Canada, Europe, and the United States.

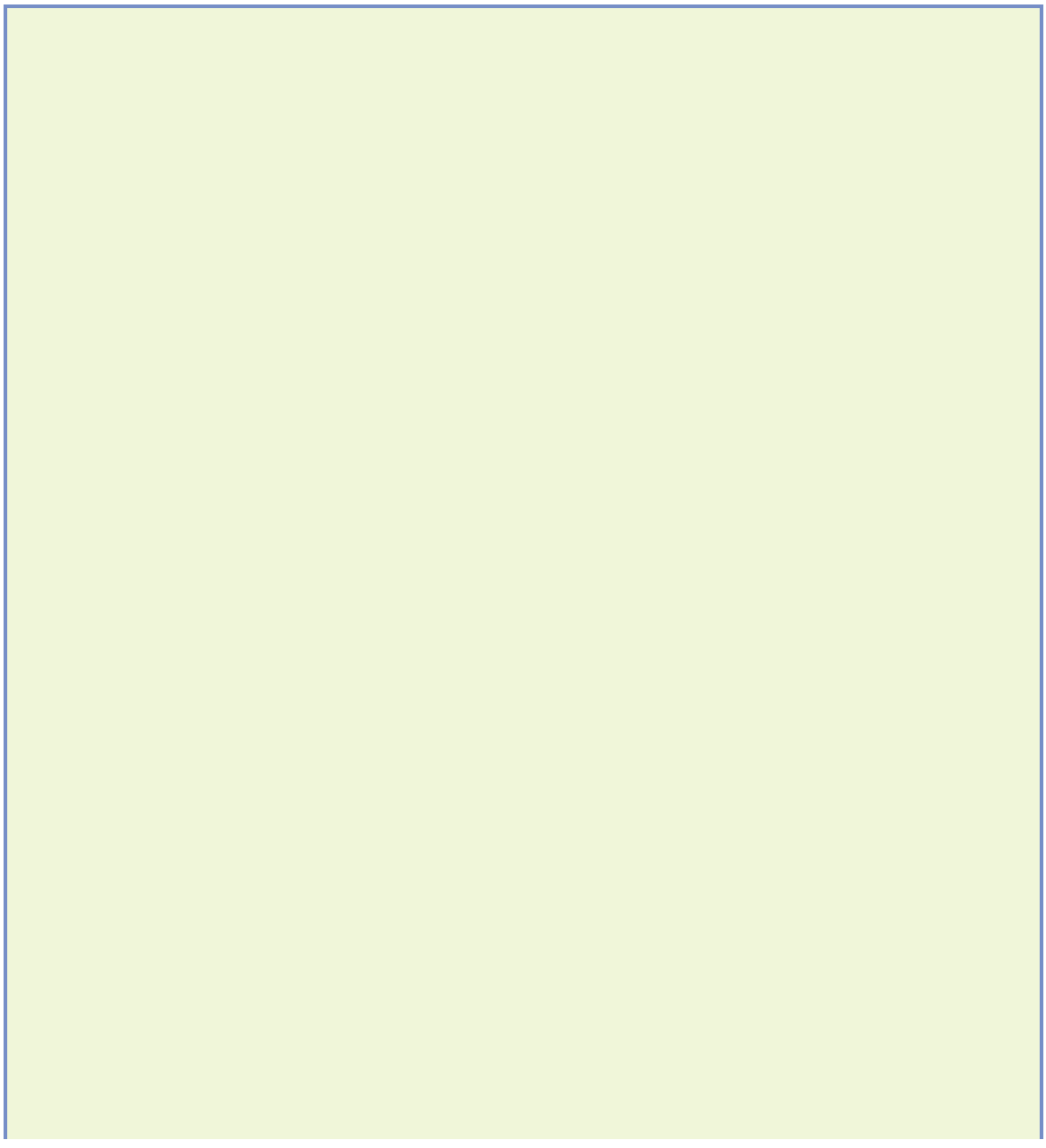
Although the amount of the quotas was occasionally revised upward, it did not keep up with the increasing ability of new supplying countries to sell. Under the Uruguay Round of WTO negotiations held from 1986 to 1994, developing countries were able to negotiate an end to this system of import quotas. The MFA expired on January 1, 2005. The biggest potential supplier of textile and apparel products was China, so the expiration of the MFA meant that China could export as much as it wanted to other countries—or so it thought. The potential for a huge increase in exports from China posed a problem for many other countries. Some developing countries expected that rising exports from China would compete with their own export of apparel items, on which many workers depended for their livelihood. The large producers in importing countries were also concerned with the potential rise in Chinese exports because it could lead to the loss of jobs for their own workers in textiles and apparel.

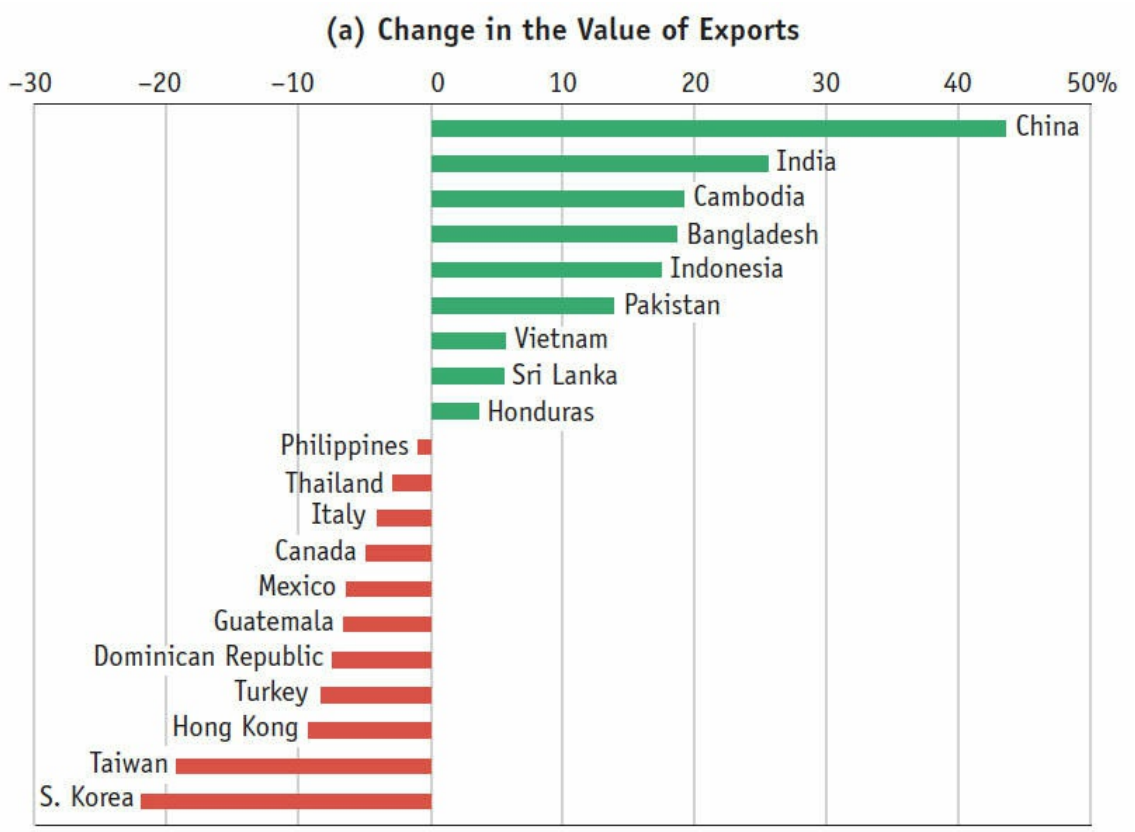
Growth in Exports from China

Immediately after January 1, 2005, exports of textiles and apparel from China grew rapidly. For example, exports of Chinese tights and pantyhose to the European Union increased by 2,000% in January and February, as compared with a year earlier; imports of pullovers and jerseys from China jumped nearly 1,000%; and imports of trousers more than tripled. Overall in 2005, China's textile and apparel imports to the United States rose by more than 40% as compared with the year before, as shown in Figure 8-12, where we include the top 20 exporters to the U.S. market.[17] In panel (a), we show the change in the value of textile and apparel imports from each country. The surge of imports from China came at the expense of some higher-cost exporters, such as South Korea, Hong Kong, and Taiwan, whose exports to the United States declined by 10%

to 20%.

In panel (b) of Figure 8-12, we show the percentage change in the prices of textiles and apparel products from each country, depending on whether the products were "constrained goods," subject to the MFA quota before January 1, 2005. China has the largest drop in prices from 2004 to 2005, 38% in the "constrained goods" categories. Many other countries also experienced a substantial fall in their prices due to the end of the MFA quota: 18% for Pakistan; 16% for Cambodia; and 8% to 9% for the Philippines, Bangladesh, India, Indonesia, and Sri Lanka. A drop in price due to the removal of the import quota is exactly what we predict from the theory, as we move from the price P_2 in Figure 8-11 to the free-trade price P^W. Surprisingly, a few countries in Figure 8-12 show increases in their prices, such as Mexico. However, less than 1% of Mexico's sales of textiles and apparel to the United States were constrained by the quota, so that price increase does not appear to be due to the removal of the MFA.




(a) Change in the Value of Exports
−30
−20
−10
0
10
20
30
40
50%
China
India
Cambodia
Bangladesh
Indonesia
Pakistan
Vietnam
Sri Lanka
Honduras
Philippines
Thailand
Italy
Canada
Mexico
Guatemala
Dominican Republic
Turkey
Hong Kong
Taiwan
S. Korea

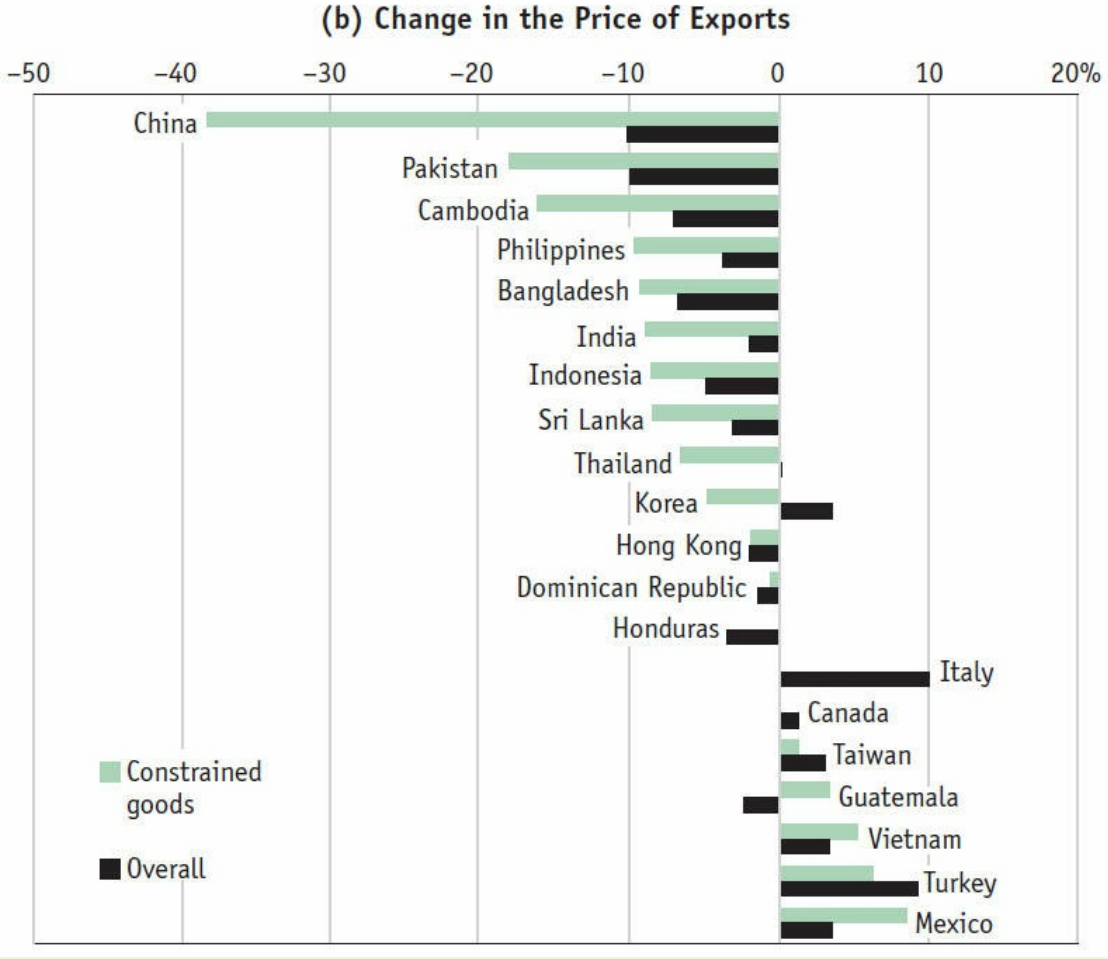

(b) Change in the Price of Exports
−50
−40
−30
−20
−10
0
10
20%
China
Pakistan
Cambodia
Philippines
Bangladesh
India
Indonesia
Sri Lanka
Thailand
Korea
Hong Kong
Dominican Republic
Honduras
Italy
Canada
Taiwan
Guatemala
Vietnam
Turkey
Mexico
Constrained goods
Overall

FIGURE 8-12

Changes in Clothing and Textile Exports to the United States after the MFA, 2004–05 After the expiration of the Multifibre Arrangement (MFA), the value of clothing and textile exports from China rose dramatically, as shown in panel (a). This reflects the surge in the quantity of exports that were formerly constrained under the MFA as well as a shift to Chinese exports from other, higher-cost producers such as Hong Kong, Taiwan, and South Korea. In panel (b), we see that the prices of goods constrained by the MFA typically fell by more than the average change in export prices after the MFA's expiry. This is exactly what our theory of quotas predicts: The removal of quotas lowers import prices for consumers.

Data from: James Harrigan and Geoffrey Barrows, 2009, Testing the Theory of Trade Policy: Evidence from the Abrupt End of the Multifibre Arrangement, The Review of Economics and Statistics, *91(2), pp. 282–294.*

Welfare Cost of MFA

Given the drop in prices in 2005 from countries selling to the United States, it is possible to estimate the welfare loss due to the MFA. The United States did not auction the quota licenses for textiles and apparel, so the quota rents were earned by foreign exporting firms. That means the welfare loss for the United States due to the MFA is the area ($b + c + d$) in Figure 8-11. Using the price drops from 2004 to 2005, that area is estimated to be in the range of $6.5 billion to $16.2 billion in 2005.[18] The simple average of these estimates is $11.4 billion as the total cost to the United States. To put that welfare loss in perspective, there were 111 million households in the United States in 2005, and the typical household spent about $1,400 on apparel. Dividing the loss of $11.4 billion by the 111 million households, we obtain about $100 per household, or 7% of their annual spending on apparel as the welfare cost of the MFA.[19]

Import Quality

Besides the overall decline in prices, there was also an interesting pattern to the price drops: the prices of textile and apparel products dropped the most (in percentage terms) for the lower-priced items. So, an inexpensive T-shirt coming from China and priced at $1 had a price drop of more than 38% (more than 38¢), whereas a more expensive item priced at $10 experienced a price drop of less than 38% (less than $3.80). As a result, U.S. demand shifted toward the lower-priced items imported from China: there was "quality downgrading" in the exports from China.

To understand why this quality downgrading occurred, it is easiest to think about the problem in reverse: when a quota like the MFA is applied, what is the effect on quality? The MFA, like most other quotas, was applied to the *quantity* of the import sent to each country: it was applied to yards of cloth, or number of shirts, or dozens of pairs of socks, and so on. Faced with a quota of that type, the exporting firm would have an incentive to *upgrade* the type of cloth, shirts, or socks that it sells, since selling a higher value for the same quantity will still meet the quota limitation. So when the MFA starts, we expect to see "quality upgrading" in the exports for each country. By the same logic, when the MFA was removed, there was "quality downgrading" in the exports from China to the United States and exports from other countries, too.

Reaction of the United States and Europe

The surge in exports from China to the United States and Europe was short-lived, however. The European Union threatened to impose new quotas on Chinese exports, and in response, China agreed on June 11, 2005, to "voluntary" export restraints that would limit its growth of textile exports to about 10% per year through the end of 2008. For the United States, the ability to negotiate a new system of quotas with China had been guaranteed by a special agreement with China when it joined the WTO in 2001. Under this agreement, China was limited to a 7.5% annual growth in its textile exports to the United States, from 2005 to 2008. This temporary quota expired at the end of 2008, at which time we might have expected the U.S. textile and apparel industry to renew its call for quota protection once again. But because of the worldwide recession, Chinese exports in this industry were much lower in 2009 than they had been in earlier years. For that reason, China indicated that it would not accept any further limitation on its ability to export textile and apparel products to the United States and to Europe, and both these quotas expired.

6 Conclusions

A tariff on imports is the most commonly used trade policy tool. In this chapter, we have studied the effect of tariffs on consumers and producers in both importing and exporting countries. We have looked at several different cases. First, we assumed that the importing country is so small that it does not affect the world price of the imported good. In that case, the price faced by consumers and producers in the importing country will rise by the full amount of the tariff. With a rise in the consumer price, there is a drop in consumer surplus; and with a rise in the producer price, there is a gain in producer surplus. In addition, the government collects revenue from the tariff. When we add together all these effects—the drop in consumer surplus, gain in producer surplus, and government revenue collected—we still get a *net loss* for the importing country. We have referred to that loss as the deadweight loss resulting from the tariff.

The fact that a small importing country always has a net loss from a tariff explains why most economists oppose the use of tariffs. Still, this result leaves open the question of why tariffs are used. One reason that tariffs are used, despite their deadweight loss, is that they are an easy way for governments to raise revenue, especially in developing countries. A second reason is politics: the government might care more about protecting firms than avoiding losses for consumers. A third reason is that the small-country assumption may not hold in practice: countries may be large enough importers of a product so that a tariff will affect its world price. In this large-country case, the decrease in imports demanded due to the tariff causes foreign exporters to lower their prices. Of course, consumer and producer prices in the importing country still go up, since these prices include the tariff, but they rise by less than the full amount of the tariff. We have shown that if we add up the drop in consumer surplus, gain in producer surplus, and government revenue collected, it is possible for a small tariff to generate welfare gains for the importing country.

Still, any gain for the importer in this large-country case comes at the expense of the foreign exporters. For that reason, the use of a tariff in the large-country case is sometimes called a "beggar thy neighbor" policy. We have found that the drop in the exporter's welfare due to the tariff is greater than the gain in the importer's welfare. Therefore, the world loses overall because of the tariff. This is another reason that most economists oppose their use.

In addition to an import tariff, we have also studied import quotas, which restrict the quantity of imports into a country. The WTO has tried to limit the use of import quotas and has been somewhat successful. For example, the Multifibre Arrangement (MFA) was a complex system of quotas intended to restrict the import of textiles and apparel into many industrialized countries. It was supposed to end on January 1, 2005, but both the United States and the European Union then established new quotas against imports of textiles and apparel from China, which expired at the end of 2008. The United States continues to have a quota on imports of sugar, and up until very recently, the European Union had a quota and then a discriminatory tariff on imports of bananas (that "banana war" has now ended). These are some of the best-known import quotas, and there are other examples, too.

Under perfect competition, the effect of applying an import quota is similar to the effect of applying an import tariff: they both lead to an increase in the domestic price in the

importing country, with a loss for consumers and a gain for producers. One difference, however, is that under a tariff the government in the importing country collects revenue, whereas under a quota, whoever is able to bring in the import earns the difference between the domestic and world prices, called "quota rents." For example, if firms in the importing country have the licenses to bring in imports, then they earn the quota rents. Alternatively, if resources are wasted by firms trying to capture these rents, then there is an additional deadweight loss. It is more common, however, for the foreign exporters to earn the quota rents, as occurs under a "voluntary" export restraint, administered by the foreign government. A fourth possibility is that the government in the importing country auctions the quota licenses, in which case it earns the equivalent of the quota rents as auction revenue; this case is identical to the tariff in its welfare outcome.

KEY POINTS

1. The government of a country can use laws and regulations, called "trade policies," to affect international trade flows. An import tariff, which is a tax at the border, is the most commonly used trade policy.
2. The rules governing trade policies in most countries are outlined by the General Agreement on Tariffs and Trade (GATT), an international legal convention adopted after World War II to promote increased international trade. Since 1995 the new name for the GATT is the World Trade Organization (WTO).
3. In a small country, the quantity of imports demanded is assumed to be very small compared with the total world market. For this reason, the importer faces a fixed world price. In that case, the price faced by consumers and producers in the importing country will rise by the full amount of the tariff.
4. The use of a tariff by a small importing country always leads to a net loss in welfare. We call that loss the "deadweight loss."
5. A discriminatory tariff, which is applied against just one exporting country (such as the tariff on tires applied against China), has a higher deadweight loss than an equal tariff applied against all exporters.
6. In a large country, the decrease in imports demanded due to the tariff causes foreign exporters to lower their prices. Consumer and producer prices in the importing country still go up, since these prices include the tariff, but they rise by less than the full amount of the tariff (since the exporter price falls).
7. The use of a tariff for a large country can lead to a net gain in welfare because the price charged by the exporter has fallen; this is a terms-of-trade gain for the importer.
8. The "optimal tariff" is the tariff amount that maximizes welfare for the importer. For a small country, the optimal tariff is zero since any tariff leads to a net loss. For a large country, however, the optimal tariff is positive.
9. The formula for the optimal tariff states that it depends inversely on the foreign export supply elasticity. If the foreign export supply elasticity is high, then the optimal tariff is low, but if the foreign export supply elasticity is low, then the optimal tariff is high.

10. "Import quotas" restrict the quantity of a particular import, thereby increasing the domestic price, increasing domestic production, and creating a benefit for those who are allowed to import the quantity allotted. These benefits are called "quota rents."
11. Assuming perfectly competitive markets for goods, quotas are similar to tariffs since the restriction in the amount imported leads to a higher domestic price. However, the welfare implications of quotas are different from those of tariffs depending on who earns the quota rents. These rents might be earned by firms in the importing country (if they have the licenses to import the good), or by firms in the exporting country (if the foreign government administers the quota), or by the government in the importing country (if it auctions off the quota licenses). The last case is most similar to a tariff, since the importing government earns the revenue.

KEY TERMS

import tariff

trade policy

import quota

export subsidy

dumping

safeguard provision

escape clause

regional trade agreements

free-trade areas

customs unions

consumer surplus

producer surplus

small country

import demand curve

deadweight loss

production loss

consumption loss

dispute settlement procedure

tariff war

discriminatory tariff

large country

terms of trade

terms-of-trade gain

optimal tariff

Multifibre Arrangement (MFA)

equivalent import tariff

quota rents

quota licenses

rent seeking

"voluntary" export restraint (VER)

"voluntary" restraint agreement (VRA)

PROBLEMS

1. Discovering Data At the opening of this chapter, we referred to the events of May 1995, when the United States considered putting tariffs on imports of luxury cars from Japan. Specifically, on May 16, 1995, U.S. Trade Representative Mickey Kantor announced that the United States would impose trade sanctions against Japan, targeting 13 Japanese import vehicles for 100% tariffs valued at $5.9 billion annually. Those targeted vehicles included all Lexus models and several Acura and Infiniti models. To determine how U.S. interest rates reacted to this announcement, use the FRED database at: https://research.stlouisfed.org/fred2/.
    a. Search for "Interest rate on US treasury bills," and choose the 3-Month Treasury Bill: Secondary Market Rate, Weekly. Adjust the graph to see what happened to the interest rate in the week including May 16, 1995. How does this movement in the interest rate compare with neighboring weeks?
    b. What type of retaliation by the government of Japan for the proposed tariff can explain this change in interest rates?
    c. About one month later, President Clinton announced that the two countries had reached an agreement, which ended the threat of the tariffs being imposed. What happened to the interest rates during the month of June?
2. The following questions refer to Side Bar: Key Provisions of the GATT.
    a. If the United States applies a tariff to a particular product (e.g., steel) imported from one country, what is the implication for its steel tariffs applied to all other countries according to the "most favored nation" principle?
    b. Is Article XXIV an exception to most favored nation treatment? Explain why or why not.
    c. Under the GATT articles, instead of a tariff, can a country impose a quota (quantitative restriction) on the number of goods imported? What has been one exception to this rule in practice?
3. Consider a small country applying a tariff t to imports of a good like that represented in Figure 8-5.
    a. Suppose that the country decides to *reduce* its tariff to t'. Redraw the graphs for the Home and import markets and illustrate this change. What happens to the quantity and price of goods produced in Home? What happens to the quantity of imports?
    b. Are there gains or losses to domestic consumer surplus due to the reduction in tariff? Are there gains or losses to domestic producer surplus due to the reduction in tariff? How is government revenue affected by the policy change? Illustrate these on your graphs.
    c. What is the overall gain or loss in welfare due to the policy change?

4. Consider a large country applying a tariff t to imports of a good like that represented in Figure 8-9.
    a. How does the export supply curve in panel (b) compare with that in the small-country case? Explain why these are different.
    b. Explain how the tariff affects the price paid by consumers in the *importing* country and the price received by producers in the *exporting* country. Use graphs to illustrate how the prices are affected if (i) the export supply curve is very elastic (flat) or (ii) the export supply curve is inelastic (steep).
5. Consider a large country applying a tariff t to imports of a good like that represented in Figure 8-9. How does the size of the terms-of-trade gain compare with the size of the deadweight loss when (i) the tariff is very small and (ii) the tariff is very large? Use graphs to illustrate your answer.
6.
    a. If the foreign export supply is perfectly elastic, what is the optimal tariff Home should apply to increase welfare? Explain.
    b. If the foreign export supply is less than perfectly elastic, what is the formula for the optimal tariff Home should apply to increase welfare?
    c. What happens to Home's welfare if it applies a tariff higher than the optimal tariff?

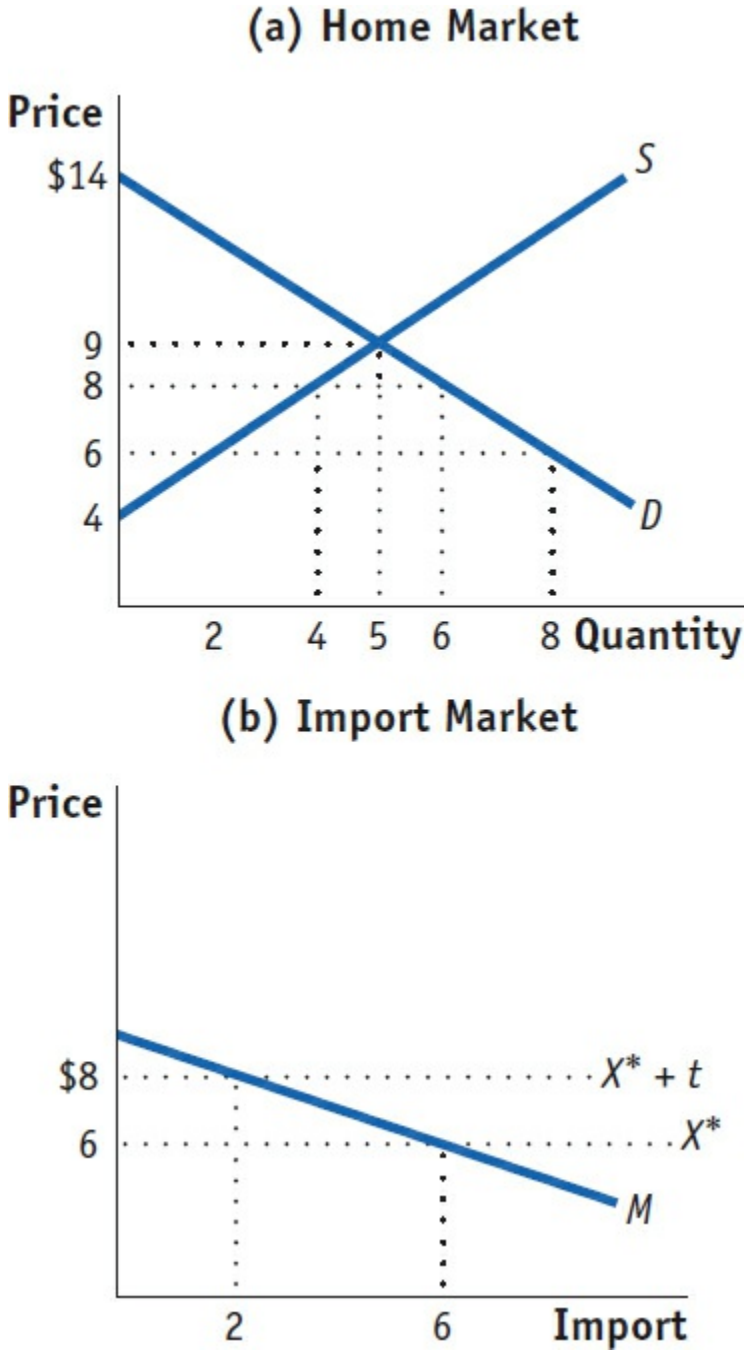
WORK IT OUT LaunchPad | interactive activity

Rank the following in ascending order of Home welfare and justify your answers. If two items are equivalent, indicate this accordingly.

a. Tariff of t in a small country corresponding to the quantity of imports M
b. Tariff of t in a large country corresponding to the same quantity of imports M
c. Tariff of t' in a large country corresponding to the quantity of imports $M' > M$

7. Rank the following in ascending order of Home welfare and justify your answers. If two items are equivalent, indicate this accordingly.
    a. Tariff of t in a small country corresponding to the quantity of imports M
    b. Quota with the same imports M in a small country, with quota licenses distributed to Home firms and no rent seeking
    c. Quota of M in a small country with quota licenses auctioned to Home firms
    d. Quota of M in a small country with the quota given to the exporting firms
    e. Quota of M in a small country with quota licenses distributed to rent-seeking Home firms
8. Why did President George W. Bush suspend the U.S. tariffs on steel 17 months ahead of schedule?
9. What provision of U.S. trade law was used by President Barack Obama to apply a tariff on tires imported from China? Does this provision make it easier or harder to apply a tariff than Section 201?
10. No U.S. tire producers joined in the request for the tariff on tires in 2009. Rather, the petition for a tariff on tires imported from China was brought by the United Steelworkers of America, the union that represents workers in the tire industry. Why did major tire manufacturers operating in the United States, such as Goodyear, Michelin, Cooper, and Bridgestone, not support the tariff?

11. Suppose Home is a small country. Use the graphs below to answer the questions.



a. Calculate Home consumer surplus and producer surplus in the absence of trade.

b. Now suppose that Home engages in trade and faces the world price, $P^* = \$6$. Determine the consumer and producer surplus under free trade. Does Home benefit from trade? Explain.

c. Concerned about the welfare of the local producers, the Home government imposes a tariff in the amount of \$2 (i.e., $t = \$2$). Determine the net effect of the tariff on the Home economy.

12. Refer to the graphs in Problem 11. Suppose that instead of a tariff, Home applies an import quota limiting the amount Foreign can sell to 2 units.

a. Determine the net effect of the import quota on the Home economy if the quota licenses are allocated to local producers.

b. Calculate the net effect of the import quota on Home welfare if the quota rents are earned by Foreign exporters.

c. How do your answers to parts (a) and (b) compare with part (c) of Problem 11?

13. Consider a small country applying a tariff t as in Figure 8-5. Instead of a tariff on *all* units imported, however, we will suppose that the tariff applies only to imports *in excess* of some quota amount M' (which is less than the total imports). This is called a "tariff-rate quota" (TRQ) and is commonly used on agricultural goods, including sugar imports into the United States.

    a. Redraw Figure 8-5, introducing the quota amount M'. Remember that the tariff applies only to imports *in excess* of this amount. With this in mind, what is the rectangle of tariff revenue collected? What is the rectangle of quota rents? Explain briefly what quota rents mean in this scenario.

    b. How does the use of a TRQ rather than a tariff at the same rate affect Home welfare? How does the TRQ, as compared with a tariff at the same rate, affect Foreign welfare? Does it depend on who gets the quota rents?

    c. Based on your answer to (b), why do you think TRQs are used quite often?

14. Consider the following hypothetical information pertaining to a country's imports, consumption, and production of T-shirts following the removal of the MFA quota:

	With MFA	Without MFA (Free Trade)
World price ($/shirt)	2.00	2.00
Domestic price ($/shirt)	3.00	2.00
Domestic consumption (million shirts/year)	200	250
Domestic production (million shirts/year)	150	100
Imports (million shirts/year)	50	150

    a. Graph the effects of the quota removal on domestic consumption and production.

    b. Determine the gain in consumer surplus from the removal of the quota.

    c. Determine the loss in producer surplus from the removal of the quota.

    d. Calculate the quota rents that were earned under the quota.

    e. Determine how much the country has gained from removal of the quota.

15. Suppose that a producer in China is constrained by the MFA to sell a certain number of shirts, regardless of the type of shirt. For a T-shirt selling for $2.00 under free trade, the MFA quota leads to an increase in price to $3.00. For a dress shirt selling for $10.00, the MFA will also lead to an increase in price.

	With MFA	Without MFA (Free Trade)
Domestic price of T-shirt ($/shirt)	3.00	2.00
Domestic price of dress shirt ($/shirt)	?	10.00

    a. Suppose that the MFA leads to an increase in the price of dress shirts from $10 to $12. Will the producer be willing to export both T-shirts and dress shirts? (Remember that only a fixed number of shirts can be exported, but of any type.) Explain why or why not.

    b. For the producer to be willing to sell *both* T-shirts and dress shirts, what must be the price of dress shirts under the MFA?

    c. Based on your answer to part (b), calculate the price of dress shirts *relative* to T-shirts before and after the MFA. What has happened to the relative price due to the MFA?

    d. Based on your answer to part (c), what will happen to the relative demand in the United States for dress shirts versus T-shirts from this producer due to the MFA?

e. Thinking now of the total export bundle of this producer, does the MFA lead to quality upgrading or downgrading? How about the removal of the MFA?

---

[1] As reported in Maggie Haberman, "Donald Trump Says He Favors Big Tariffs on Chinese Exports," New York Times, Online, First Draft, January 7, 2016.

[2] A history of the GATT is provided in Douglas A. Irwin, Petros C. Mavroidis, and Alan O. Sykes, 2008, *The Genesis of the GATT* (New York: Cambridge University Press).

[3] In the United States, the granting of most favored nation trade status to a country is now called "normal trade relations" because most countries now belong to the WTO and enjoy that status.

[4] Recall from Chapter 6 that under imperfect competition, firms can influence the price of their goods and hence earn positive monopoly profits.

[5] Joshua Aizenman and Yothin Jinjarak, January 2006, "Globalization and Developing Countries—A Shrinking Tax Base?" National Bureau of Economic Research (NBER) Working Paper No. 11933.

[6] Although the steel tariff was used to obtain votes from the steel-producing states, it also served another political purpose. In 2002 President George W. Bush faced a vote on whether the president should be granted "fast-track authority" to negotiate trade agreements with other countries. Fast-track authority allows the president to present a new trade agreement to the Congress for an up-or-down vote within 90 days, without having the terms of the trade agreement revised by the Congress. This authority expires every five years. In 2002 the steel tariff prompted some members of Congress to vote in favor of fast-track authority, which passed in Congress by only two votes. Fast-track authority, also called "trade promotion authority," was allowed to lapse in July 2007 and was not renewed again until June 2015.

[7] Section 421 was added to U.S. trade law for 12 years, and expired on December 11, 2013.

[8] We focus here on the ITC conclusions for flat-rolled carbon steel, from U.S. International Trade Commission, 2001, Steel: Investigation No. TA-201-73, Volume I, Publication 3479, Washington, D.C.

[9] A short recession began in the United States in March 2001 and ended eight months later, in November 2001.

[10] The drop in imports of 30% corresponds to a fall in import value of $1.2 billion (since $1.2/4.1 \approx 0.30$, or 30%).

[11] One of the legal reasons for the WTO ruling was that imports of flat-rolled steel into the United States had fallen from 1998 to 2001, so this product did not meet the requirement that imports had to be increasing to receive Article XIX protection. Even though imports of other steel products were rising, flat-rolled steel was considered one of the most important imported products.

[12] See Gary Clyde Hufbauer and Sean Lowry, 2012, "U.S. Tire Tariffs: Saving Few Jobs at High Cost," Peterson Institute for International Economics, Policy Brief no. PB12-9.

[13] According to Gary Clyde Hufbauer and Sean Lowry, 2012, cited in the previous footnote, there were 1,200 jobs saved in the tire industry. But taking the area e cost of $817 million and dividing it by 1,200 jobs gives an annual cost per job of $681,000, which is many times more than the annual earnings of a tire worker. So the discriminatory tariff was an expensive way to save these jobs.

[14] See Problem 4 at the end of the chapter, where you will show that steeper export supply leads Foreign to absorb more of the tariff.

[15] As we show in the next chapter, this conclusion depends on our assumption of perfect competition and does not hold without that assumption.

[16] The proposals to auction import quotas in the United States were made during the 1980s; see C. Fred Bergsten, 1987, *Auction Quotas and United States Trade Policy* (Washington, D.C.: Peterson Institute for International Economics). Government auctions have occurred in the United States for bandwidth in radio frequencies and also for off-shore oil drilling.

[17] Figure 8-12 and the welfare estimates in the following paragraphs are from James Harrigan and Geoffrey Barrows, 2009, "Testing the Theory of Trade Policy: Evidence from the Abrupt End of the Multifibre Arrangement," *The Review of Economics and Statistics*, 91(2), pp. 282–294.

[18] Notice that this range of estimates for 2005 is comparable with (but wider than) the range of estimates for the welfare costs of textiles and apparel in Table 8-3, which is $8.9 billion to $12 billion for 1985, obtained by adding up

the deadweight loss and the quota rents.

[19] In comparison, there were 737,000 U.S. workers in the textile and apparel industries in 2004, with an average annual salary of $31,500. If we divide the total loss of $11.4 billion by all these workers, we obtain about $15,500 per job protected in the U.S. industry, or about one-half of the annual salary of each worker.

10 Export Policies in Resource-Based and High-Technology Industries

Questions to Consider

1. Why do wealthy countries subsidize their farmers?
2. Can countries control the export of their rare natural resources?
3. Why do countries subsidize their high-tech exports?

The decision you have taken today on export competition is truly extraordinary; it is the WTO's [World Trade Organization's] most significant outcome on agriculture.

Robêrto Azevedo, Director General of the WTO, December 2015

The Middle East has its oil, China has rare earth.

Deng Xiaoping, architect of China's economic reforms, Southern Tour of China, January 1992

On July 21, 2008, representatives of the 152 countries belonging to the World Trade Organization (WTO) met in Geneva, Switzerland, to discuss reforms of the world trading system. Like earlier meetings in Seattle (1999), Cancún, Mexico (2003), and Hong Kong (2005), this meeting was marked by large-scale protests. Groups including farmers from South Korea and fishermen from the Philippines objected to the impact that agricultural reforms could have on lowering food prices, thereby threatening their livelihoods. Farmers in South Korea, along with those in Japan, Europe, and the United States, benefit from an intricate system of tariffs (taxes on imports) and subsidies (payments to exporters) that keeps prices for their crops high but in some cases lowers prices in the rest of the world. The lower world price hurts farmers in land-rich developing countries such as Brazil, India, China, and some African nations by making it harder for them to export their own

agricultural products. On the other hand, the lower world prices are a benefit to land-poor developing countries that must import agricultural products. Consumers in those countries will be hurt if prices end up rising as a result of agricultural reforms in the WTO.

The first goal of this chapter is to explain subsidy policies that affect resource-based industries (such as agriculture, mining, and fuel production) and high-tech industries. The primary reason that countries subsidize exports is political, but there are other reasons as well. For example, agricultural subsidies benefit a group in society (such as farmers) that the government wants to support. Such subsidies occur in the United States, Europe, Japan, South Korea, and many other countries. Because these subsidies are costly to the governments of these countries and because they harm exporters from land-rich developing countries, many countries have called for their removal.

Guang Niu/Getty Images

Police fight rioters outside the World Trade Organization's meeting in Hong Kong, 2005. The protesters included South Korean farmers worried about rice imports.

Agricultural subsidies played a key role in the Doha Round of WTO tariff negotiations. These negotiations began in 2001 in the city of Doha, Qatar, continued through the 1999, 2003, 2005, 2008, and 2013 meetings, and concluded with a meeting in Nairobi, Kenya, in 2015. An agreement to remove agricultural export subsidies was reached in 2015, as indicated by the first quote at the beginning of the chapter, but other issues discussed in the Doha Round were not resolved (as we'll see in Chapter 11). One goal of this chapter is to understand the various types of agricultural export subsidies. To that end, we begin with a discussion of the tentative agreement to reduce agricultural subsidies made at the 2005 Hong Kong meeting of the WTO.

Export subsidies are not the only kind of policy that governments use to influence trade in resource-based industries. The second goal of this chapter is to explain the effect of two other policies, export tariffs and export quotas, on the countries that use them. To raise

government revenue, some countries impose export tariffs, which are taxes applied by the exporting country when a good leaves the country.[1] Argentina, for example, charges export tariffs on many agricultural and resource exports. In 2014, the tariffs were 35% on soybeans, 30% on sunflower meal and oil, 23% on wheat, 20% on corn, and 14% to 15% on biodiesel (soy oil–based diesel fuel). Another trade policy that can sometimes benefit companies is an export quota, a restriction on the amount that producers are allowed to export. China, for example, applied quotas on firms exporting "rare earth" minerals in 2011 and 2012. China has significant deposits of these minerals (as indicated by the second quote at the beginning of the chapter), which are valuable because they are used in many high-tech products.[2] Because the export quota limited the amount that was exported, Chinese firms enjoyed a substantial increase in the price they received for their exports.

The third goal of the chapter is to examine how governments can strategically use export subsidies to bolster high-technology companies and industries. A difference between agricultural production and high-tech production is that we usually think of agriculture as a perfectly competitive industry (many producers, each of which has no control over the price of their products), whereas many high-tech industries are imperfectly competitive (a small number of producers that have some control over the price of their products). The production of large commercial aircraft, for example, has only two worldwide producers: Airbus in Europe and Boeing in the United States. Both of these producers receive generous government subsidies, because legislators often believe that subsidies to high-tech industries will raise those industries' profits and benefit the country. Export subsidies often lead to political friction between the countries that use them, however. We assess whether the "strategic" use of subsidies in high-tech industries is beneficial to the countries using those policies.

1 WTO Goals on Agricultural Subsidies

In Table 10-1, we describe the goals established at the Hong Kong meeting of the WTO in December 2005. Four of the items in Table 10-1 deal with agricultural subsidies and tariffs, which were the focus of that meeting. Since that time, some of these goals have been implemented by the WTO. The accompanying Headlines: WTO Leaders Agree to End Farm Subsidies as Doha Unresolved describes the agreements reached at the 2015 meeting of the WTO held in Nairobi, Kenya, that finally implemented the 2005 goal of eliminating agricultural export subsidies. The broader development goals of the Doha Round were not achieved, however.

TABLE 10-1

Goals Made at the Hong Kong WTO Meeting, December 2005 This table shows the goals that were set at the 2005 WTO meeting in Hong Kong, which had as its major focus the subsidies on agricultural products. This meeting was part of the Doha Round of WTO negotiations. Some of these goals have been achieved since 2005.

Issue	Goals Made in Hong Kong	Unresolved in Hong Kong
Agricultural export subsidies	Abolition by end of 2013, with a "substantial part" scrapped before 2011, and parallel elimination of indirect subsidies.	Must agree [on] value of indirect subsidies and detailed phase-out programs.
Domestic farm supports	Agreement to classify WTO members in three bands based on their level of domestic farm support (top—European Union, middle—United States and Japan, bottom—everyone else).	Must agree [on] size of subsidy reduction and rules to stop countries from shifting trade-distorting subsidies into categories sheltered from deep cuts.
Agricultural tariffs	Agreement on four tiers (different for rich and poor countries) and on a mechanism allowing poor nations to raise duties to counter import surges.	Must decide size of tariff cuts and number and treatment of "sensitive" and "special" products.
Cotton Agreement	Agreement to eliminate export subsidies in 2006 and grant unrestricted access for cotton exports from West African producers and other least developed countries (LDCs).	United States will have the "objective" of cutting its $4 billion subsidies to cotton growers further and faster than the still-to-be-agreed-upon overall reduction for domestic farm supports.
Industrial goods	Agreement on formula and on a "comparably high level of ambition" for tariff cuts in agriculture and industrial goods so rich nations do not demand more cuts than they give.	Must agree [on] key elements of formula, how much to cut, flexibilities for developing countries, and role of sectoral negotiations.
Services	Some negotiating guidelines for trade in services agreed upon . . .	The European Union is pressing for liberalization timing targets opposed by developing countries; poor nations want rich ones to accept more temporary service workers.
Development	Duty-free, quota-free access extended to 97% of product[s] . . . from least developed countries by 2008, allowing significant exclusions (e.g., U.S. textiles imports). More pledges of aid for trade.	Must agree [on] other measures to strengthen special treatment provisions for poor countries.

Information from: Guy de Jonquières, "Tentative Steps Forward Seen as Better Than None at All," Financial Times, *December 19, 2005, p. 2.*

Agricultural Export Subsidies

An export subsidy is payment to firms for every unit exported (either a fixed amount or a fraction of the sales price). Governments give subsidies to encourage domestic firms to

produce more in particular industries. As shown in Table 10-1, the member countries of the WTO made a goal of abolishing all export subsidies in agriculture by the end of 2013, although that goal was not achieved by that deadline. At the 2015 meeting of the WTO, as described in the Headlines article, the member countries of the WTO agreed that developed countries should immediately eliminate their export subsidies in agriculture, while developed countries would have until 2018 to end their export subsidies.

HEADLINES

WTO Leaders Agree to End Farm Subsidies as Doha Unresolved

This article describes the agreements that were reached at a 2015 meeting of the WTO, and especially the agreement to remove export subsidies in agriculture. The 2015 meeting was part of the Doha Round of WTO negotiations, but the participants at this meeting failed to reaffirm the broader development goals of the Doha Round.

Negotiators at the World Trade Organization's ministerial conference in Nairobi agreed to end direct export subsidies on farm produce even as 14-year-old talks on trade development remain unresolved.

Developed countries will immediately eliminate export-subsidy entitlements while developing nations must end direct support by the end of 2018, according to the ministerial declaration accepted on Saturday in the Kenyan capital. The declaration gives developing countries the right to use a special safeguard mechanism that allows them to raise tariffs temporarily to deal with a surge in imports or falling prices. It will also make it easier for so-called least-developed countries to benefit from preferential market access for their goods.

"Our work to secure a global ban on export subsidies will help level the playing field for American farmers and ranchers," U.S. Trade Representative Michael Froman said in an e-mailed statement. "The WTO's actions in this area will put an end to some of the most trade-distorting subsidies in existence." Agricultural subsidies in the rich world have been a key stumbling block in trade talks over 15 years. Trade leaders agreed to end cotton subsidies in developed countries immediately and in developing countries by the start of 2017. African producers threatened earlier to open a case under the WTO's dispute-settlement mechanism as early as January, in the event rich nations don't significantly reduce or eliminate trade-distorting support to their farmers.

The outcome is "better than I expected, it does something for cotton, it does something for export competition," Andrew Crosby, managing director for operations and strategy at the Geneva-based International Centre for Trade and Sustainable Development, said in an interview in Nairobi. "It does some things that are important, but they are agreeing to disagree on Doha."

Source: Excerpted from Rene Vollgraaff and David Malingha Doya, "WTO Leaders Agree to End Farm Subsidies as Doha Unresolved," *December 19, 2015, www.bloomberg.com*.

Indirect Subsidies

Included in the Hong Kong export subsidy agreement is the parallel elimination of indirect subsidies to agriculture, including food aid from developed countries to poor countries and other exports by state-sponsored trading companies in advanced countries. Europe has already eliminated its food aid subsidies and argues that *cash aid* to poor countries is much more effective; the United States continues to export agricultural commodities as aid. Later

in the chapter, we explore the argument made by the European Union that cash aid is more effective than food aid in assisting developing countries.

Domestic Farm Supports

In addition to export subsidies, many countries give subsidies to farmers regardless of whether the crop is exported or sold domestically. Europe maintains a system of agricultural subsidies known as the Common Agricultural Policy (CAP). For example, to help its sugar growers, the CAP pays European farmers up to 50 euros per ton of harvested sugar beets, which is five times the world market price. Because of the subsidy, European farmers can afford to sell the sugar made from their sugar beets at a much lower price than the world market price. As a result, the sugar beet subsidy makes Europe a leading supplier of sugar worldwide, even though countries in tropical climates such as Brazil and India have a natural comparative advantage in producing sugar through growing sugar cane.

Other countries maintain agricultural subsidies that are just as generous. The United States, for example, pays cotton farmers to grow more cotton and then subsidizes agribusiness and manufacturers to buy the American cotton, so both the production *and* the sale of cotton receive subsidies. Japan allows 10% of the approximately 7 million tons of milled rice it consumes annually to enter into the country tariff-free but imposes a 500% tariff on any rice in excess of this 10% limit. There are many other examples of agricultural protection like this from countries all over the world.

Also discussed in the Hong Kong agreement were domestic farm supports, which refers to any assistance given to farmers, even if it is not directly tied to exports. Such domestic assistance programs can still have an indirect effect on exports by lowering the costs (hence augmenting the competitiveness) of domestic products. The Hong Kong agreement was only a first step toward classifying the extent of such programs in each country, without any firm commitment as to when they might be eliminated.

Cotton Subsidies

Finally, export subsidies in cotton received special attention at the Hong Kong meeting, because that crop is exported by many low-income African countries and it has been highly subsidized in the United States. Cotton subsidies have also been the subject of a WTO case brought against the United States. At the 2015 Nairobi meeting, it was agreed that cotton subsidies would end in developed countries immediately, and would end in developing countries by early 2017 (see the Headlines article).

Other Matters from the Hong Kong WTO Meeting

In addition to the elimination of the subsidies themselves, other issues related to export subsidies were discussed at the 2005 Hong Kong meeting. One of these issues is the use of tariffs as a response to other countries' use of subsidies.

Tariffs in Agriculture

Export subsidies applied by large countries depress world prices, so that exporting countries can expect tariffs to be imposed on the subsidized products when they are imported by other countries. At the 2005 Hong Kong meeting, importing countries wanted a "special safeguard mechanism" that could be applied to all other agricultural products. Under this mechanism, tariffs could be temporarily raised whenever imports suddenly rose or their prices suddenly fell. This provision was agreed to 10 years later, at the 2015 Nairobi meeting, when the developing countries won the right to impose such a special safeguard mechanism (see the Headlines article).

Issues Involving Trade in Industrial Goods and Services

Other issues were also discussed in Hong Kong, as listed in Table 10-1. To achieve further cuts in the tariffs on industrial goods, there was agreement in principle to use some formula for the cuts, but the exact nature of that formula was left for future negotiation. There was also a goal to open trade in service sectors, which would benefit the industrial countries and their large service industries. The developing countries are expected to make some future offers to open their markets to trade in services, but in return they will expect wealthy countries to accept a greater number of temporary immigrant workers in their service sectors.

Finally, there was a goal to allow 97% of imported products from the world's 50 least-developed countries (LDCs) to enter WTO member markets tariff free and duty free. The United States already allows duty-free and tariff-free access for 83% of products from those 50 countries, and under this new goal, the United States would extend that access to nearly all products. Omitted from this goal, however, are textile imports into the United States from LDCs because the United States wants to protect its domestic textile producers from low-priced imports from countries such as Bangladesh and Cambodia. This is not surprising, given our discussion of the United States' sensitivity to low-cost imports in the clothing and textiles industries, as illustrated by the history of quotas on clothing imports (see Chapter 8).

2 Export Subsidies in a Small Home Country

Having seen the importance of agricultural subsidies at the WTO meetings, we now describe the effect of export subsidies on prices, exports, and welfare. We begin with a small country called Home that faces a fixed world price for its exports. Following that, we see how the outcomes differ when Home is large enough to affect world prices.

Consider a small country exporting sugar. The Home no-trade equilibrium is at point A in Figure 10-1. With free trade, Home faces the world price of sugar P^W. In panel (a) of Figure 10-1, the quantity supplied in Home at that price is S_1 and the quantity demanded is D_1 tons of sugar. Because quantity demanded is less than quantity supplied, the Home country exports $X_1 = S_1 - D_1$ tons under free trade. That quantity of exports is shown as point B in panel (b) corresponding to the free-trade price of P^W. By determining the level of exports at other prices, we can trace out the Home export supply curve X.

Impact of an Export Subsidy

Now suppose that because the government wishes to boost the exports of the domestic sugar producers, each ton of sugar exported receives a subsidy of s dollars from the government. Panel (a) of Figure 10-1 traces the effect of this subsidy on the domestic economy. With an export subsidy of s dollars per ton, exporters will receive $P^W + s$ for each ton exported rather than the lower free-trade price P^W. Because they are allowed to export any amount they want at the subsidized price, the Home firms will not accept a price less than $P^W + s$ for their domestic sales: if the domestic price was less than $P^W + s$, the firms would just export all their sugar at the higher price. Thus, the domestic price for sugar must rise to $P^W + s$ so that it equals the export price received by Home firms.

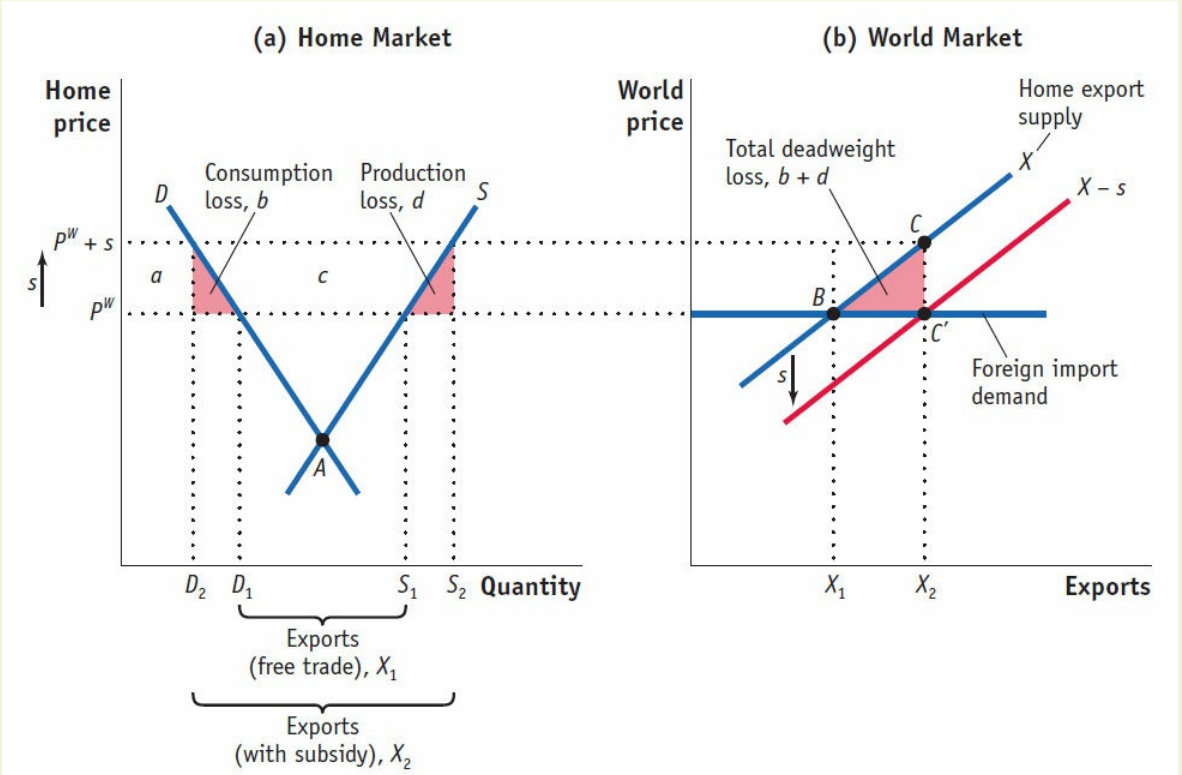


FIGURE 10-1

Export Subsidy for a Small Country Applying a subsidy of s dollars per unit exported will increase the price that Home exporters receive from P^W to $P^W + s$. As a result, the domestic price of the similar good will also rise by that amount. This price rise leads to an increase in Home quantity supplied from S_1 to S_2 and a decrease in Home quantity demanded from D_1 to D_2, in panel (a). Exports rise as a result of the subsidy, from X_1 to X_2 in panel (b). The Home export supply curve shifts down by exactly the amount of the subsidy since the marginal cost of a unit of exports decreases by exactly s. As in the case of a tariff, the deadweight loss as a result of the subsidy is the triangle ($b + d$), the sum of consumer loss b and producer loss d.

Notice that with the domestic sugar price rising to $P^W + s$, Home consumers could in principle *import* sugar at the price of P^W rather than buy it from local firms. To prevent imports from coming into the country, we assume that the Home government has imposed an import tariff equal to (or higher than) the amount of the export subsidy. This is a realistic assumption. Many subsidized agricultural products that are exported are also protected by an import tariff to prevent consumers from buying at lower world prices. We see that the combined effect of the export subsidy and import tariff is to raise the price paid by Home consumers and received by Home firms.

With the price rising to $P^W + s$, the quantity supplied in Home increases to S_2, while the quantity demanded falls to D_2 in panel (a). Therefore, Home exports increase to $X_2 = S_2 - D_2$. The change in the quantity of exports can be thought of in two ways as reflected by points C and C' in panel (b). On one hand, if we were to measure the Home price P^W

on the vertical axis, point C is on the original Home export supply curve X: that is, the rise in Home price has resulted in a *movement along* Home's initial supply curve from point B to C since the quantity of exports has increased with the Home price.

On the other hand, with the vertical axis of panel (b) measuring the world price and given our small-country assumption that the world price is fixed at P^W, the increase in exports from X_1 to X_2 because of the subsidy can be interpreted as a *shift* of the domestic export supply curve to $X - s$, which includes point C'. Recall from Chapter 8 that the export supply curve shifts by precisely the amount of the tariff. Here, because the export subsidy is like a negative tariff, the Home export supply curve shifts down by exactly the amount s. In other words, the subsidy allows firms to sell their goods to the world market at a price exactly s dollars lower *at any point* on the export supply curve; thus, the export supply curve shifts down. According to our small-country assumption, Home is a price taker in the world market and thus always sells abroad at the world price P^W; the only difference is that with the subsidy, Home exports higher quantities.

Summary

From the domestic perspective, the export subsidy increases both the price and quantity of exports, a movement along the domestic export supply curve. From the world perspective, the export subsidy results in an increase in export supply and, given an unchanged world price (because of the small-country assumption), the export supply curve shifts down by the amount of the subsidy s. As was the case with a tariff, the subsidy has driven a wedge between what domestic exporters receive ($P^W + s$ at point C) and what importers abroad pay (P^W at point C').

Impact of the Subsidy on Home Welfare

Our next step is to determine the impact of the subsidy on the welfare of the exporting country. The rise in Home price lowers consumer surplus by the amount $(a + b)$ in panel (a). That is the area between the two prices (P^W and $P^W + s$) and underneath the demand curve D. On the other hand, the price increase raises producer surplus by the amount $(a + b + c)$, the area between the two prices (P^W and $P^W + s$), and above the supply curve S. Finally, we need to determine the effect on government revenue. The export subsidy costs the government s per unit exported, or $s \cdot X_2$ in total. That revenue cost is shown by the area $(b + c + d)$.

Adding up the impact on consumers, producers, and government revenue, the overall impact of the export subsidy is

Fall in consumer surplus:	$-(a + b)$
Rise in producer surplus:	$+(a + b + c)$
Fall in government revenue:	$-(b + c + d)$
Net effect on Home welfare:	$-(b + d)$

The triangle ($b + d$) in panel (b) is the net loss or deadweight loss due to the subsidy in a small country. The result that an export subsidy leads to a deadweight loss for the exporter is similar to the result that a tariff leads to a deadweight loss for an importing country. As with a tariff, the areas b and d can be given precise interpretations. The triangle d equals the increase in marginal costs for the extra units produced because of the subsidy and can be interpreted as the production loss or the *efficiency loss* for the economy. The area of the triangle b can be interpreted as the drop in consumer surplus for those individuals no longer consuming the units between D_1 and D_2, which we call the consumption loss for the economy. The combination of the production and consumption losses is the deadweight loss for the exporting country.

3 Export Subsidies in a Large Home Country

Now suppose that the Home country is a large enough seller on international markets so that its subsidy affects the world price of the sugar (e.g., this occurs with European sugar subsidies and U.S. cotton subsidies). This large-country case is illustrated in Figure 10-2. In panel (b), we draw the Foreign import demand curve M^* as downward-sloping because changes in the amount exported, as will occur when Home applies a subsidy, now affect the world price.

Under free trade, the Home and world price is P^W. At this price, Home exports $X_1 = S_1 - D_1$, and the world export market is in equilibrium at the intersection of Home export supply X and Foreign import demand M^*. Home and Foreign consumers pay the same price for the good, P^W, which is the world price.

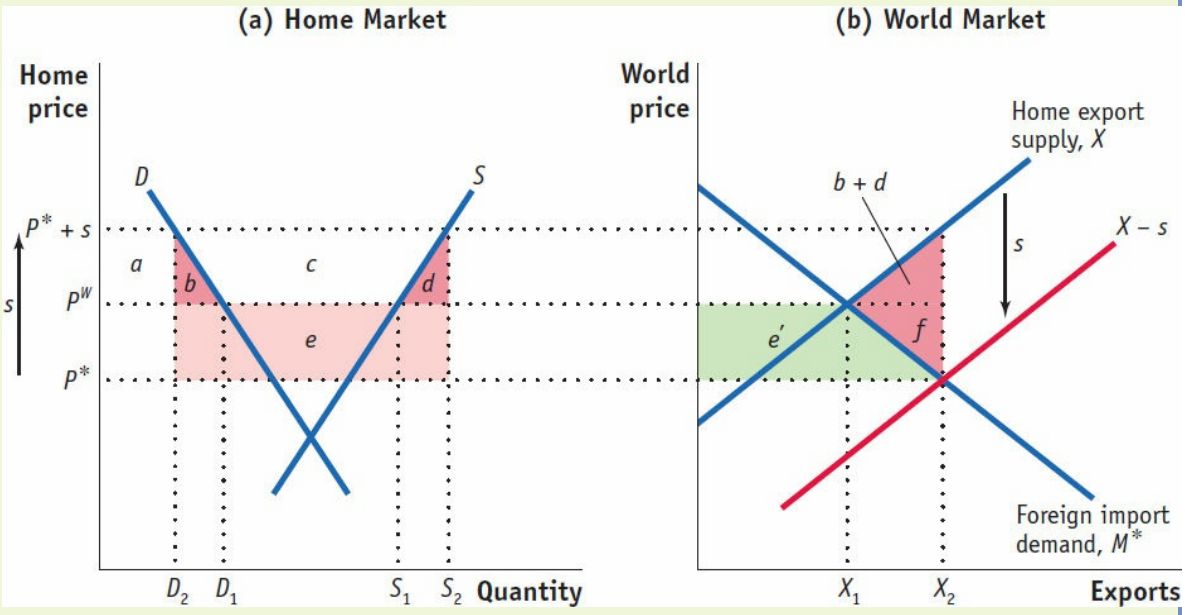


FIGURE 10-2

Export Subsidy for a Large Country Panel (a) shows the effects of the subsidy in Home. The Home price increases from P^W to $P^* + s$, Home quantity demanded decreases from D_1 to D_2, and Home quantity supplied increases from S_1 to S_2. The deadweight loss for Home is the area of triangle $(b + d)$, but Home also has a terms-of-trade loss of area e. In the world market, the Home subsidy shifts out the export supply curve from X to $X - s$ in panel (b). As in the small-country case, the export supply curve shifts down by the amount of the subsidy, reflecting the lower marginal cost of exports. As a result, the world price falls from P^W to P^*. The Foreign country gains the consumer surplus area e', so the world deadweight loss due to the subsidy is the area $(b + d + f)$. The extra deadweight loss f arises because only a portion of the Home terms-of-trade loss is a Foreign gain.

Effect of the Subsidy

Suppose that Home applies a subsidy of s dollars per ton of sugar exported. As we found for the small country, a subsidy to Home export production is shown as a downward shift of the Home export supply curve in panel (b) by the amount s; the vertical distance between the original export supply curve X and the new export supply curve $X - s$ is precisely the amount of the subsidy s. The new intersection of Home export supply, $X - s$, and Foreign import demand M^* corresponds to a new world price of P^*, decreased from the free-trade world price P^W, and a Home price $P^* + s$, increased from the free-trade price P^W. Furthermore, the equilibrium with the subsidy now occurs at the export quantity X_2 in panel (b), increased from X_1.

In Chapter 2, we defined the terms of trade for a country as the ratio of export prices to import prices. Generally, a fall in the terms of trade indicates a loss for a country because it is either receiving less for exports or paying more for imports. We have found that with the export subsidy, Foreign consumers pay a lower price for Home exports, which is therefore a fall in the Home terms of trade but a gain in the Foreign terms of trade. We should expect, therefore, that the Home country will suffer an overall loss because of the subsidy but that Foreign consumers will gain. To confirm these effects, let's investigate the impact of the subsidy on Home and Foreign welfare.

Home Welfare

In panel (a) of Figure 10-2, the increase in the Home price from P^W to $P^* + s$ reduces consumer surplus by the amount $(a + b)$. In addition, the increase in the price benefits Home firms, and producer surplus rises by the amount $(a + b + c)$. We also need to take into account the cost of the subsidy. Because the amount of the subsidy is s, and the amount of Home exports (after the subsidy) is $X_2 = S_2 - D_2$, it follows that the revenue cost of the subsidy to the government is the area $(b + c + d + e)$, which equals $s \cdot X_2$ (the government pays s for every unit exported). Therefore, the overall impact of the subsidy in the large country can be summarized as follows:

Fall in consumer surplus:	$-(a + b)$
Rise in producer surplus:	$+(a + b + c)$
Fall in government revenue:	$-(b + c + d + e)$
Net effect on Home welfare:	$-(b + d + e)$

In the world market, panel (b), the triangle $(b + d)$ is the deadweight loss due to the subsidy, just as it is for a small country. For the large country, however, there is an extra source of loss, the area e, which is the terms-of-trade loss to Home: $e = e' + f$ in panel (b). When we analyze Foreign and world welfare, it will be useful to divide the Home terms-of-trade loss into two sections, e' and f, but from Home's perspective, the terms-of-trade welfare loss is just their sum, area e. This loss is the decrease in export revenue because the world price has fallen to P^*; Home loses the difference between P^W and P^* on each of X_2 units exported. So a large country loses even more from a subsidy than a small country because of the reduction in the world price of its exported good.

Foreign and World Welfare

While Home definitely loses from the subsidy, the Foreign importing country definitely gains. Panel (b) of Figure 10-2 illustrates the consumer surplus benefit to Foreign of the Home subsidy; the price of Foreign imports decreases and Foreign's terms of trade improves. The change in consumer surplus for Foreign is area e', the area below its import demand curve M^* and between the free-trade world price P^W and the new world price (with subsidy) P^*.

When we combine the total Home consumption and production losses ($b + d$) plus the Home terms-of-trade loss e, and subtract the Foreign terms-of-trade gain e', there is an overall deadweight loss for the world, which is measured by the area ($b + d + f$) in panel (b). The area f is the additional world deadweight loss due to the subsidy, which arises because the terms-of-trade loss in Home is not completely offset by a terms-of-trade gain in Foreign.

Because there is a transfer of terms of trade from Home to Foreign, the export subsidy might seem like a good policy tool for large wealthy countries seeking to give aid to poorer countries. However, this turns out not to be the case. The deadweight loss f means that using the export subsidy to increase Home production and send the excess exported goods overseas (as was the case for food aid, discussed earlier as an example of an indirect subsidy) is an inefficient way to transfer gains from trade among countries. It would be more efficient to simply give cash aid in the amount of the Home terms-of-trade loss to poor importers, a policy approach that, because it does not change the free-trade levels of production and consumption in either country, would avoid the deadweight loss ($b + d + f$) associated with the subsidy. This argument is made by the European countries, which, several years ago, eliminated transfers of food as a form of aid and switched to cash payments. The United States has now agreed to make the same policy change, as discussed in the following application.

APPLICATION

Who Gains and Who Loses?

Now that we have studied the effect of export subsidies on world prices and trade volume in theory, we return to the agreement to eliminate export subsidies that was reached at the 2015 Nairobi meeting of the WTO and ask: Which countries will gain and which will lose when export subsidies (including the "indirect" subsidies like food aid) are eliminated?

Gains

The obvious gainers from this action will be current agricultural exporters in developing countries such as Brazil, Argentina, Indonesia, and Thailand, along with potential exporters such as India and China. These countries will gain from the rise in world prices as agricultural subsidies by the industrialized countries—especially Europe and the United States—are eliminated. These countries will gain even more when and if an agreement is reached on the elimination of agricultural tariffs in the industrial countries, including Japan and South Korea, that protect crops such as rice. Both of these actions will also benefit the industrial countries themselves, which suffer both a deadweight loss *and* a terms-of-trade loss from the combination of export subsidies and import tariffs in agriculture. Farmers in the industrial countries who lose the subsidies will be worse off, and the government might choose to offset that loss with some type of adjustment assistance. In the United States and Europe, however, it is often the largest farmers who benefit the most from subsidy programs, and they may be better able to adjust to the elimination of subsidies (through switching to other crops) than small farmers.

Losses

Which countries will lose from the elimination of export subsidies? To the extent that the elimination of export subsidies leads to higher world prices, as we expect from our analysis (in Figure 10-2, the price would rise from P^* to P^W), then the food-importing countries, typically the poorer non–food-producing countries, will lose. This theoretical result is confirmed by several empirical studies. One study found that the existing pattern of agricultural supports (tariffs and subsidies) raises the per capita income of two-thirds of 77 developing nations, including most of the poorest countries, such as Burundi and Zambia.[3] This result is illustrated in Figure 10-3. Panel (a) shows net agricultural exports graphed against countries' income per capita over the period 1990

to 2000. The poorer countries (i.e., those lower on the income scale on the horizontal axis) export more agricultural products and therefore would benefit from a rise in their prices. But for *food* exports in panel (b), rather than *total agricultural* exports (which includes nonfood items like cotton), it is the middle-income countries that export the most. Panel (c) shows that poor countries are *net importers* of essential food items such as corn, rice, and wheat (summarized as "cereal exports") and would be harmed by an increase in their world price. Many of the world's poorest individuals depend on cereal crops for much of their diet and would be especially hard hit by any increase in those prices.

Food Aid

At the 2015 meeting of the WTO, member countries made a commitment to eliminate export subsidies in agriculture, which would increase the world prices of subsidized crops. Because the poorest countries are net importers of cereal exports, they will be harmed by any increase in these world prices. It is important that food aid be offered to countries that face an increase in prices due to elimination of export subsidies or due to natural catastrophes such as poor weather leading to crop failure.

The United States has been a principal supplier of food aid, which it uses for both humanitarian purposes and to get rid of surpluses of food products at home. No country will argue the need for donations in cases of starvation, as have occurred in the Darfur region of Sudan and in Ethiopia, but the United States also provides food shipments to regions without shortages, an action that can depress local prices and harm local producers. European countries stopped this practice many years ago and argue that it is better to instead have United Nations relief agencies buy food from local farmers in poor regions and then distribute it to the poorest individuals in a country. In this way, the European countries boost production in the country and help to feed its poorest citizens. In the Hong Kong talks of the WTO in 2005, the European Union insisted that the indirect subsidies to regions without shortages be eliminated.

For these reasons, the United States has moved in the direction of providing more food aid in the form of cash rather than agricultural commodities. The U.S. Agency for International Development (USAID) is responsible for giving food aid under its Food for Peace program. For the fiscal year 2017, President Obama requested that $1.35 billion be budgeted for food aid, and that up to 25% of that amount be used for market-based aid such as cash transfers that allow recipients to purchase food from local farmers. U.S. exports of agricultural commodities still make up the majority of aid given under this USAID program, including exports for humanitarian purposes.[4] The complete elimination of agricultural export subsidies, including indirect subsidies in the form of commodity exports, carries some risk to the livelihood of consumers in the poorest countries. The challenge for more prosperous countries is to engage in research and education to assist farmers in the poorest regions to provide more locally grown food, thereby enhancing the food security in those countries.

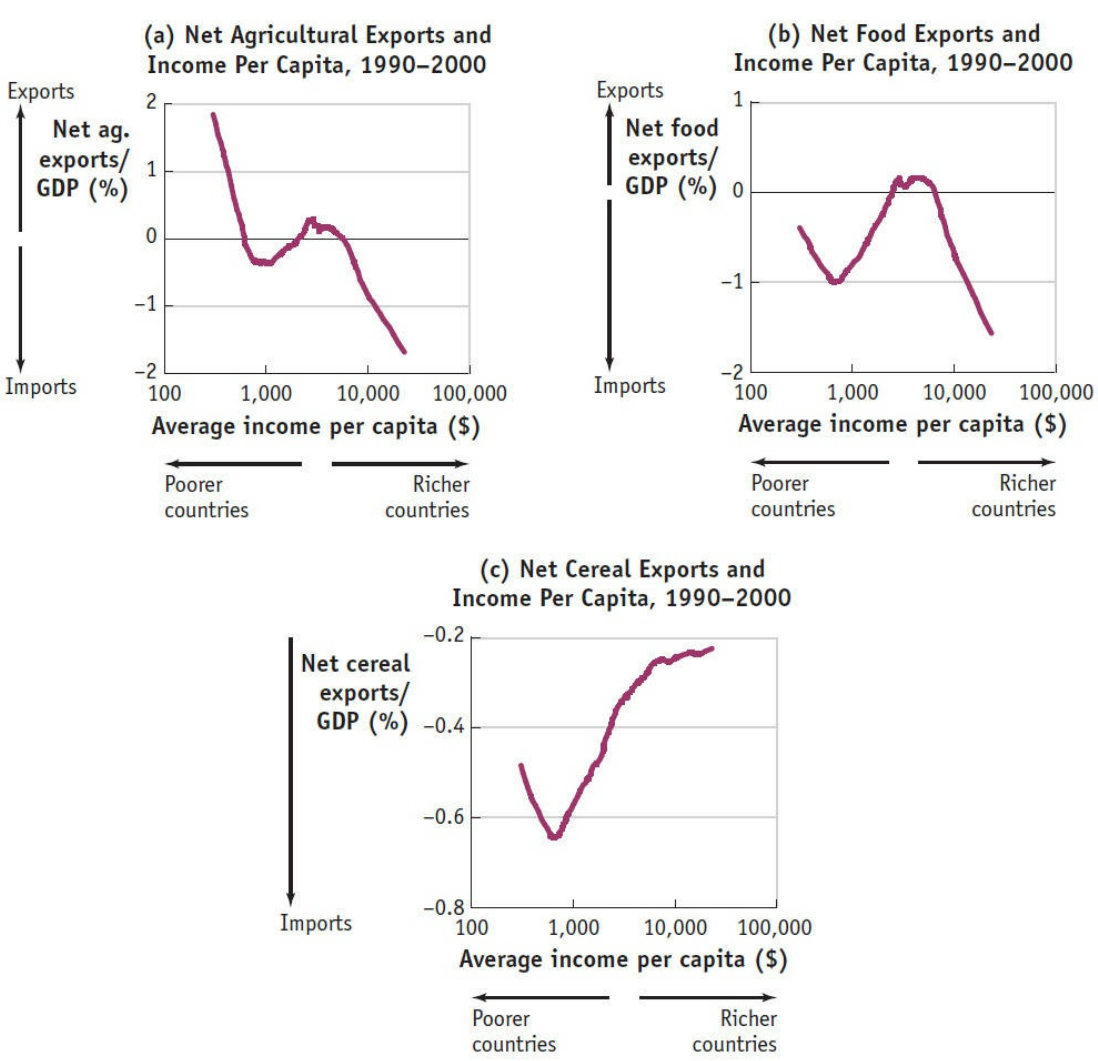


FIGURE 10-3

Agriculture, Food, and Cereal Exports Panel (a) shows net agricultural exports graphed against countries' income per capita. The poorer countries export more agricultural products overall and would thus benefit from a rise in the prices due to the removal of subsidies. On the other hand, panel (b) shows that it is middle-income countries that export the most food. Panel (c) shows that poor countries are net *importers* of essential food items (cereals) such as corn, rice, and wheat and would be harmed by an increase in their world price.

Data from: Margaret McMillan, Alix Peterson Zwane, and Nava Ashraf, 2007, "My Policies or Yours: Have OECD Agricultural Policies Affected Incomes in Developing Countries?" In Ann Harrison, Globalization and Poverty (Chicago: University of Chicago Press and NBER), pp. 183–232.

4 Production Subsidies

The goals reached in Hong Kong in 2005 distinguish between export subsidies in agriculture—which will be eliminated according to the 2015 agreement—and all other forms of domestic support that increase production (e.g., tax incentives and other types of subsidies). These other forms of agricultural support are expected to have less impact on exports than direct subsidies. Therefore, there is less impact on other countries from having domestic support programs as compared with export subsidies. To illustrate this idea, let's examine the impact of a "production subsidy" in agriculture for both a small and a large country.

Suppose the government provides a subsidy of s dollars for *every unit* (e.g., ton of sugar in our example) that a Home firm produces. This is a production subsidy because it is a subsidy to every unit produced and not just to units that are exported. There are several ways that a government can implement such a subsidy. The government might guarantee a minimum price to the farmer, for example, and make up the difference between the minimum price and any lower price for which the farmer sells. Alternatively, the government might provide subsidies to users of the crop to purchase it, thus increasing demand and raising market prices; this would act like a subsidy to every unit produced. As mentioned earlier, the United States has used both methods to support its cotton growers.

These policies all fall under Article XVI of the GATT (see Side Bar: Key Provisions of the GATT in Chapter 8). Article XVI states that partner countries should be notified of the extent of such subsidies, and when possible, they should be limited. In Hong Kong, the WTO members further agreed to classify countries according to the extent of such subsidies, with the European Union classified as having a high level of production subsidies, the United States and Japan having a middle level, and all other countries having low subsidies (see Table 10-1). No further resolution has been reached about the timing and extent of future cuts in these production subsidies.

Effect of a Production Subsidy in a Small Home Country

To illustrate the effect of a production subsidy, we begin with a small country that faces a fixed world price of P^W. In Figure 10-4, panel (a), the production subsidy of s increases the price received by Home producers to $P^W + s$ and increases Home's quantity supplied from S_1 to S_2. The quantity *demanded* in Home does not change, however, because producers *continue to charge the world price* in Home. This is the case (in contrast to the export subsidy) because Home producers receive a subsidy regardless of whom they sell to (domestic consumers or Foreign consumers through exporting). So with a production subsidy, Home producers charge the world price to Foreign consumers and receive the extra subsidy from the government and likewise charge the world price to Home consumers, and again receive the extra subsidy. In contrast, for an export subsidy, Home firms receive the subsidy *only* for export sales and not for domestic sales.

Because the price for Home consumers with the production subsidy is still P^W, there is no change in the quantity demanded in Home, which remains at D_1. In panel (b), we see that the production subsidy increases the quantity of exports from $X_1 = S_1 - D_1$ to $X_2 = S_2$

– D_1. Because demand is not affected, the production subsidy increases exports by less than an export subsidy would. That result occurs because the quantity demanded decreases with an export subsidy due to higher Home prices, leading to greater Home exports. In contrast, with the production subsidy, the quantity demanded in Home is unchanged, so exports do not rise as much.

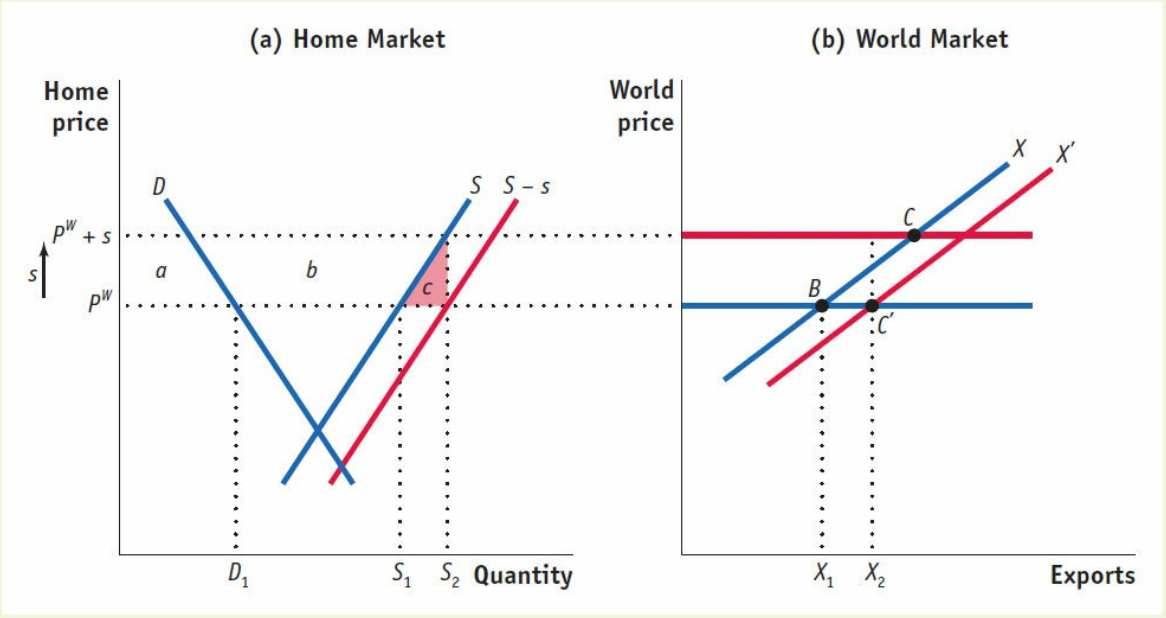


FIGURE 10-4

Production Subsidy for a Small Country In panel (a), applying a production subsidy of s dollars per unit produced will increase the price that Home firms receive from P^W to $P^W + s$. This price rise leads to an increase in Home quantity supplied from S_1 to S_2. The consumer price in Home is not affected because the production subsidy does not distinguish between items sold in Home or exported (firms therefore continue to charge the world price in Home), so the quantity demanded stays at D_1. The deadweight loss of the subsidy for a small country is the area c. In panel (b), exports rise as a result of the production subsidy, from X_1 to X_2, though the increase in exports is less than for the export subsidy because, for the production subsidy, quantity demanded does not change in Home.

Home Welfare

With the increase in the price received by Home producers, from P_W to $P_W + s$, there is a corresponding rise in producer surplus of the amount $(a + b)$ in panel (a). The government revenue cost of the subsidy is the entire area $(a + b + c)$, which equals the amount of the subsidy s, times Home production S_2. So the overall impact of the production subsidy is

Change in consumer surplus:	*none* (because demand is not affected)
Rise in producer surplus:	$+(a + b)$

Fall in government revenue:	$-(a + b + c)$
Net effect on Home welfare:	$-c$

The deadweight loss caused by the production subsidy in a small country, area c, is less than that caused by the export subsidy in Figure 10-1, which is area $(b + d)$. The reason that the production subsidy has a lower deadweight loss than the export subsidy is that consumer decisions have not been affected at all: Home consumers still face the price of P^W. The production subsidy increases the quantity supplied by Home producers, just as an export subsidy does, but the production subsidy does so without raising the price for Home consumers. The only deadweight loss is in production inefficiency: the higher subsidized price encourages Home producers to increase the amount of production at higher marginal costs (i.e., farther right along the supply curve) than would occur in a market equilibrium without the subsidy.

Targeting Principle

Our finding that the deadweight loss is lower for the production subsidy makes it a better policy instrument than the export subsidy to achieve an increase in Home supply. This finding is an example of the targeting principle: *to achieve some objective, it is best to use the policy instrument that achieves the objective most directly*. If the objective of the Home government is to increase cotton supply, for example, and therefore benefit cotton growers, it is better to use a production subsidy than an export subsidy. Of course, the benefits to cotton growers come at the expense of government revenue.

There are many examples of this targeting principle in economics. To limit the consumption of cigarettes and improve public health, the best policy is a tax on cigarette purchases, as many countries use. To reduce pollution from automobiles, the best policy would be a tax on gasoline, the magnitude of which is much higher in Europe than in the United States. And, to use an example from this book, to compensate people for losses from international trade, it is better to provide trade adjustment assistance directly (discussed in Chapter 3) to those affected than to impose an import tariff or quota.

Effect of the Production Subsidy in a Large Home Country

We will not draw the large-country case in detail but will use Figure 10-4 to briefly explain the effects of a production subsidy on prices, exports, and welfare. When the price for Home producers rises from P^W to $P^W + s$, the quantity of the exported good supplied increases from S_1 to S_2. Because demand has not changed, exports increase by exactly the same amount as the quantity supplied by domestic producers. We show that increase in exports by the outward shift of the export supply curve, from X to X' in panel (b). As mentioned previously, the rise in the quantity of exports due to the production subsidy, from point B to C' in Figure 10-4, is *less than* the increase in the quantity of exports for the export subsidy, from point B to C' shown in Figure 10-1. With the export subsidy, the price for Home producers *and* consumers rose to $P^W + s$, so exports increased because of both the rise in quantity supplied and the drop in quantity demanded. As a result, the

export subsidy shifted down the Home export supply curve by exactly the amount *s* in Figure 10-1. In contrast, with a production subsidy, exports rise only because Home quantity supplied increases so that export supply shifts down by an amount less than *s* in Figure 10-4.

If we drew a downward-sloping Foreign import demand curve in panel (b), then the increase in supply as a result of the production subsidy would lower the world price. But that drop in world price would be *less than* the drop that occurred with the export subsidy because the increase in exports under the production subsidy is less.

Summary

Production subsidies in agriculture still lower world prices, but they lower prices by less than export subsidies. For this reason, the WTO is less concerned with eliminating production subsidies and other forms of domestic support for agriculture. These policies have a smaller impact on world prices and, as we have also shown, a smaller deadweight loss as compared with that of export subsidies.

5 Export Tariffs

Export and production subsidies are not the only policies that countries use to influence trade in certain products. Some countries apply export tariffs—which are taxes applied by the exporting country when a good leaves the country. As we saw in the introduction to this chapter, Argentina applies export tariffs on many of its agricultural products. Mozambique charges a tariff on exports of diamonds and Thailand charges a tariff on exports of teak wood. The main purpose of these export tariffs is to raise revenue for the government; farmers and other companies do not benefit from the export tariffs because they pay the tax.

In this section we look at how export tariffs affect the overall welfare of the exporting country, taking into account the effects on consumers, producers, and government revenue. We start with the case of a small exporting country facing fixed world prices. Following that, we look at how the outcome differs when the country is large enough to affect world prices.

Impact of an Export Tariff in a Small Country

Consider a small country (like Argentina) that exports soybeans. The Home no-trade equilibrium is shown at point A in panel (a) of Figure 10-5. With free trade, Home faces a world price of soybeans of P^W pesos (we are using the currency of Argentina). At that price, the quantity supplied in Home is S_1 and the quantity demanded is D_1 in panel (a), so Home will export soybeans. The quantity of exports is $X_1 = S_1 - D_1$, which is shown by point B in panel (b). So far, the free trade equilibrium in Figure 10-5 is the same as that in Figure 10-1, which showed the impact of an export subsidy. But the two figures will change when we consider the effects of an export tariff.

Now suppose that the government applies a tariff of t pesos to the exports of soybeans. Instead of receiving the world price of P^W, producers will instead receive the price of $P^W - t$ for their exports, because the government collects t pesos. If the price they receive in Home is any higher than this amount, then producers will sell only in the Home market and not export at all. As a result there would be an oversupply in Home and the local price would fall. Thus, in equilibrium, the Home price must also fall to equal the export price of $P^W - t$.

With the price falling to $P^W - t$, the quantity supplied in Home falls to S_2, and the quantity demanded increases to D_2 in panel (a). Therefore, Home exports fall to $X_2 = S_2 - D_2$. The change in the quantity of exports can be thought of as a leftward, or upward, shift of the export supply curve in panel (b), where we measure the world price rather than the Home price on the vertical axis. The export supply curve shifts up by the amount of the tariff t. This result is analogous to what happened when we introduced a subsidy in Figure 10-1. In that case, the export supply curve fell by the amount of the subsidy s.

The new intersection of supply and demand in the world market is at point C in panel (b), with exports of X_2. Alternatively, on the original export supply curve X, exports of X_2 occur at the point C' and the domestic price of $P^W - t$.

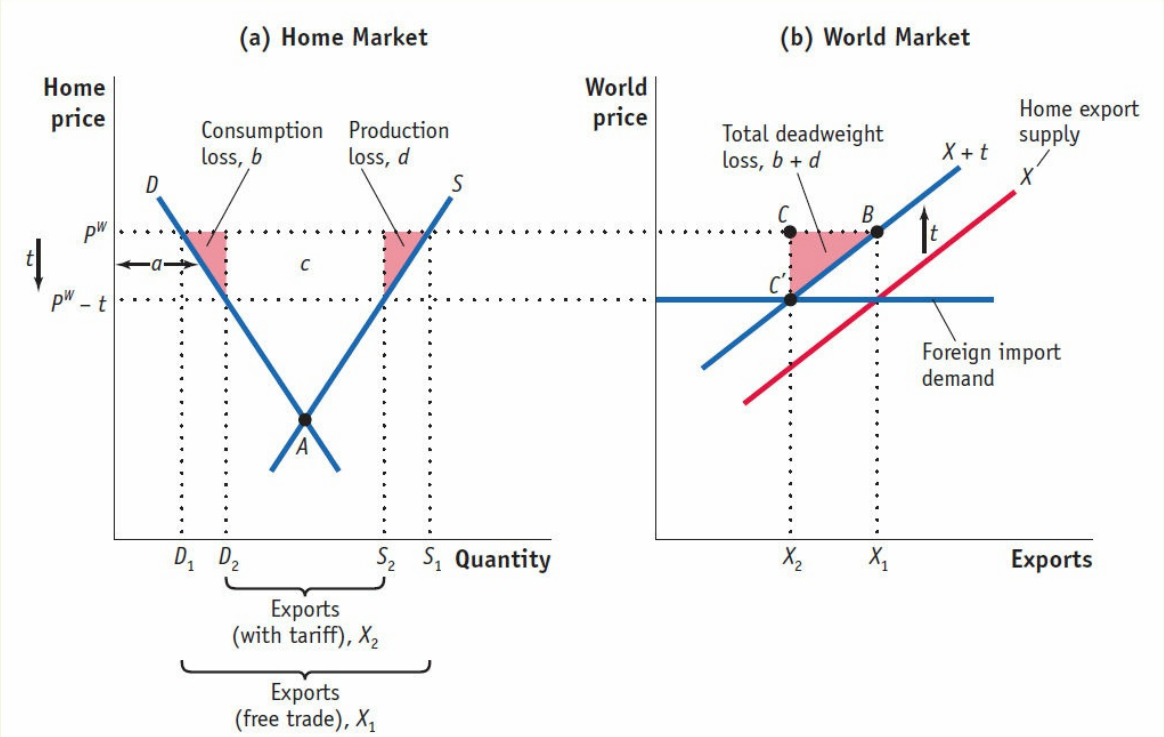


FIGURE 10-5

Export Tariff for a Small Country Panel (a): Applying an export tariff of t pesos per unit exported decreases the price that Home exporters receive from P^W to $P^W - t$. As a result, the domestic price of the similar good also falls by that amount. This price fall leads to a decrease in Home quantity supplied from S_1 to S_2, and an increase in Home quantity demanded from D_1 to D_2, in panel (a). Exports fall due to the tariff, from X_1 to X_2. Panel (b): The Home export supply curve shifts up by the amount of the tariff because the marginal cost of a unit of exports increases by exactly t. The deadweight loss due to the subsidy is the triangle $(b + d)$, the sum of the consumption loss b and production loss d.

Impact of the Export Tariff on Small Country Welfare

We can now determine the impact of the tariff on the welfare of the small exporting country. Since the Home price falls because of the export tariff, consumers benefit. The rise in consumer surplus is shown by area a in panel (a). Producers are worse off, however, and the fall in producer surplus is shown the amount $(a + b + c + d)$. The government collects revenue from the export tariff, and the amount of revenue equals the amount of the tariff t times exports of X_2, area c.

Adding up the impact on consumers, producers, and government revenue, the overall impact of the export tariff on the welfare of a small exporting country is:

Rise in consumer surplus:	$+a$
Fall in producer surplus:	$-(a + b + c + d)$
Rise in government revenue:	$+c$

Net effect on Home welfare: $-(b + d)$

To sum up, the export tariff for a small country has a deadweight loss of $(b + d)$. (This outcome is similar to the results of the import tariff that we studied in Chapter 8 and the export subsidy we studied earlier in this chapter.) That loss can be broken up into two components. The triangle b in panel (a) is the consumption loss for the economy. It occurs because as consumers increase their quantity from D_1 to D_2, the amount that they value these extra units varies between P^W and $P^W - t$, along their demand curve. The true cost to the economy of these extra units consumed is always P^W. Therefore, the value of the extra units is less than their cost to the economy, indicating that there is a deadweight loss.

Triangle d is the production loss to the economy. It occurs because as producers reduce their quantity from S_1 to S_2, the marginal cost of supplying those units varies between P^W and $P^W - t$, along their supply curve. But the true value to the economy of these extra units consumed is always P^W, because that is the price at which they could be exported without the tariff. Therefore, the value of the forgone units exceeds their cost to the economy, indicating again that there is a deadweight loss.

Impact of an Export Tariff in a Large Country

We have shown that the export tariff in a small country leads to a decline in overall welfare. Despite that, some governments—especially in developing countries—find that export tariffs are a convenient way to raise revenue, because it is very easy to apply the tax at border stations as goods leave the country. The fact that the economy overall suffers a loss does not prevent governments from using this policy.

What happens in a large exporting country? Does an export tariff still produce an overall loss? Recall from Chapter 8 that an import tariff in a large country would lead to an overall *gain* rather than a loss, provided that the tariff is not too high. This gain arises because the import tariff reduces demand for the imported product, and therefore lowers its price, which leads to a terms-of-trade gain. In this section, we see that an export tariff also leads to a terms-of-trade gain. That result occurs because an export tariff reduces the amount supplied to the world market, and therefore increases the price of the export product, which is a terms-of-trade gain.

Figure 10-6 illustrates the effect of an export tariff for a large country. Under free trade the price of soybeans is P^W, which is at the intersection of Home export supply X and Foreign import demand M^* in panel (b). When the government applies a tariff of t pesos to soybean exports, the Home export supply curve shifts up by exactly the amount of the tariff from X to $X + t$. The new intersection of the Home export supply curve and the Foreign import demand curve occurs at point C, and the world price has risen from P^W to P^*.

The price P^* is paid by Foreign buyers of soybeans and includes the export tariff. The Foreign import demand curve M^* is downward sloping rather than horizontal as it was in Figure 10-5 for a small country. Because the Foreign import demand curve slopes downward, the price P^* is greater than P^W but not by as much as the tariff t, which equals the upward shift in the export supply curve. Home receives price $P^* - t$, which is measured net of the export tariff. Because P^* has risen above P^W by less than the amount t, it follows

that $P^* - t$ falls below P^W, as shown in panel (a).

Impact of the Export Tariff on Large Country Welfare

We can now determine the impact of the tariff on the welfare of the large exporting country. Home consumer and producers faced the free trade price of P^W under free trade, but face the lower price of $P^* - t$ once the tariff is applied. The rise in consumer surplus is shown by area a in panel (a) and the fall in producer surplus is shown by area $(a + b + c + d)$. The revenue the government collects from the export tariff equals the amount of the tariff t times exports of X_2, by area $(c + e)$.

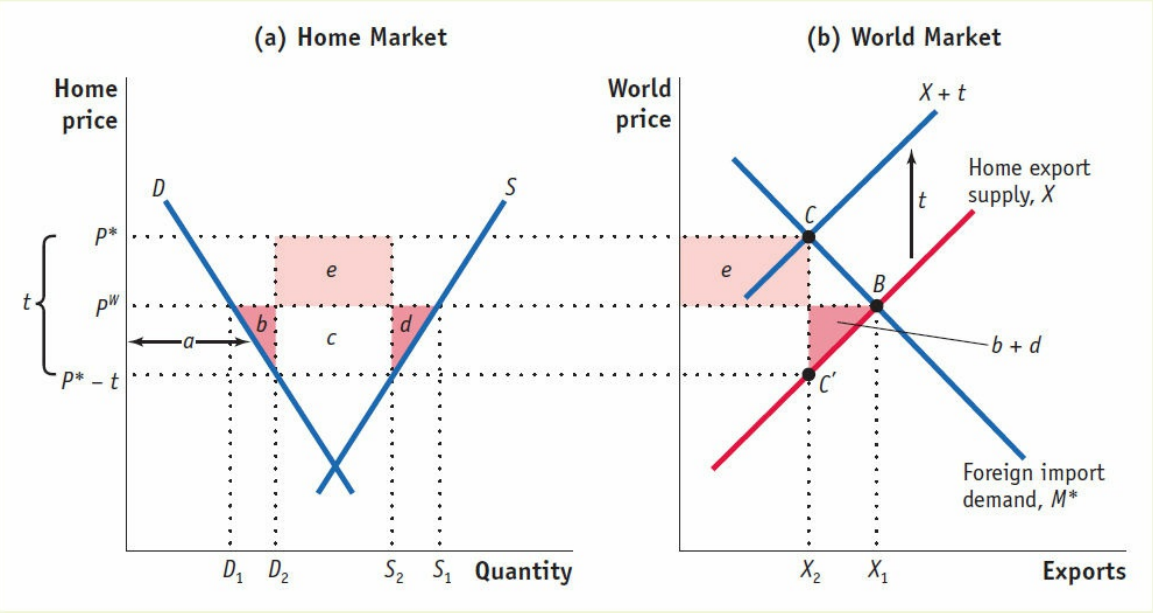


FIGURE 10-6

Export Tariff for a Large Country The tariff shifts up the export supply curve from X to $X + t$, in panel (b). As a result, the world price increases from P^W to P^*. But this increase in the world price is less than the upward shift in export supply of t. It follows that the Home price decreases from P^W to $P^* - t$, in panel (a). Home quantity demanded increases from D_1 to D_2, and Home quantity supplied decreases from S_1 to S_2. The deadweight loss for Home is the area of triangle $(b + d)$. Because world price rises from P^W to P^*, Home also has a terms-of-trade gain of area e.

Adding up the impacts on consumers, producers, and government revenue, the overall impact of the export tariff on the welfare of a large exporting country is:

Rise in consumer surplus:	$+a$
Fall in producer surplus:	$-(a + b + c + d)$
Rise in government revenue:	$+(c + e)$

Net effect on Home welfare: $e - (b + d)$

Compared with the effect of an export tariff for a small country, we find that the net effect on large-country Home welfare can be positive rather than negative, as long as $e > (b + d)$. The amount $(b + d)$ is still the deadweight loss; area e is the *terms-of-trade gain* due to the export tariff. In either panel of Figure 10-6, this terms-of-trade gain is measured by the rise in the price paid by Foreign purchasers of soybeans, from P^W to P^*, multiplied by the amount of exports X_2. This terms-of-trade gain is the "extra" money that Home receives from exporting soybeans at a higher price. If the terms-of-trade gain exceeds the deadweight loss, then the Home country gains overall from applying the tariff.

To sum up, the effect of an export tariff is most similar to that of an import tariff because it leads to a terms-of-trade gain. In Chapter 8 we argued that for an import tariff that is not too high, the terms-of-trade gain e would always exceed the deadweight loss $(b + d)$. That argument applies here, too, so that for export tariffs that are not too high, the terms-of-trade gain e exceeds the deadweight loss and Home country gains. In Chapter 8 we stressed that this terms-of-trade gain came at the expense of the Foreign country, which earns a lower price for the product it sells under an import tariff. Similarly, the Foreign country loses under an export tariff because it is paying a higher price for the product it is buying. So, just as we called an import tariff a "beggar thy neighbor" policy, the same idea applies to export tariffs because they harm the Foreign country. These results are the opposite of those we found for an export subsidy, which for a large Home country always leads to a terms-of-trade loss for Home and a benefit for Foreign buyers.

6 Export Quotas

The finding that a large country can gain from an export tariff gives a government an added reason to use this policy, in addition to earning the tariff revenue. There is one other export policy that also benefits the large country applying it: an export quota, which is a limit on the amount that firms are allowed to export. The most well-known system of export quotas in the world today is the system used by the Organization of Petroleum Exporting Countries (OPEC), which includes six countries in the Middle East, four in Africa, and two in South America. OPEC sets limits on the amount of oil that can be exported by each country, and by limiting oil exports in this way, it keeps world petroleum prices high. Those high prices benefit not only OPEC's member countries, but also other oil-exporting countries that do not belong to OPEC. (At the same time, the high prices clearly harm oil-importing countries). The oil companies themselves benefit from the export quotas because they earn the higher prices. Thus, the export quota is different from an export tariff (which is, in effect, a tax on firms that lowers their producer surplus).

We can use Figure 10-7 to illustrate the effect of an export quota. This figure is similar to Figure 10-6 because it deals with a large exporting country. Initially under free trade, the world trade price occurs at the intersection of Home export supply X and Foreign import demand M^*, at point B in panel (b) with exports of X_1. Now suppose that the Home country imposes a quota that limits its exports to the quantity $\bar{X}$, with $\bar{X} < X_1$. We can think of the export supply curve as a vertical line at the amount $\bar{X}$. A vertical line at $\bar{X}$ would intersect Foreign import demand at the point C, leading to a higher world price of $P^*_2 > P^W$.

That higher world price is earned by the Home producers. But because they export less ($\bar{X}$ rather than the free trade amount X_1), they sell more locally. Local sales can be found by subtracting exports of $\bar{X}$ from the Home supply curve in panel (a), shifting the remaining Home supply left to the curve labeled $S - \bar{X}$. The intersection of this remaining Home supply with Home demand occurs at the price P_2 in panel (a), which is lower than the initial world price of P^W. As we found for the export tariff in Figure 10-6, the fall in the Home price leads to an increase in Home demand from D_1 to D_2. That quantity is the amount that Home firms supply to the local market. The *total* amount supplied by Home firms is $D_2 + \bar{X} = S_2$, which has fallen in relation to the free-trade supply of S_1. So we see that a side-effect of the export quota is to limit the total sales of Home firms.

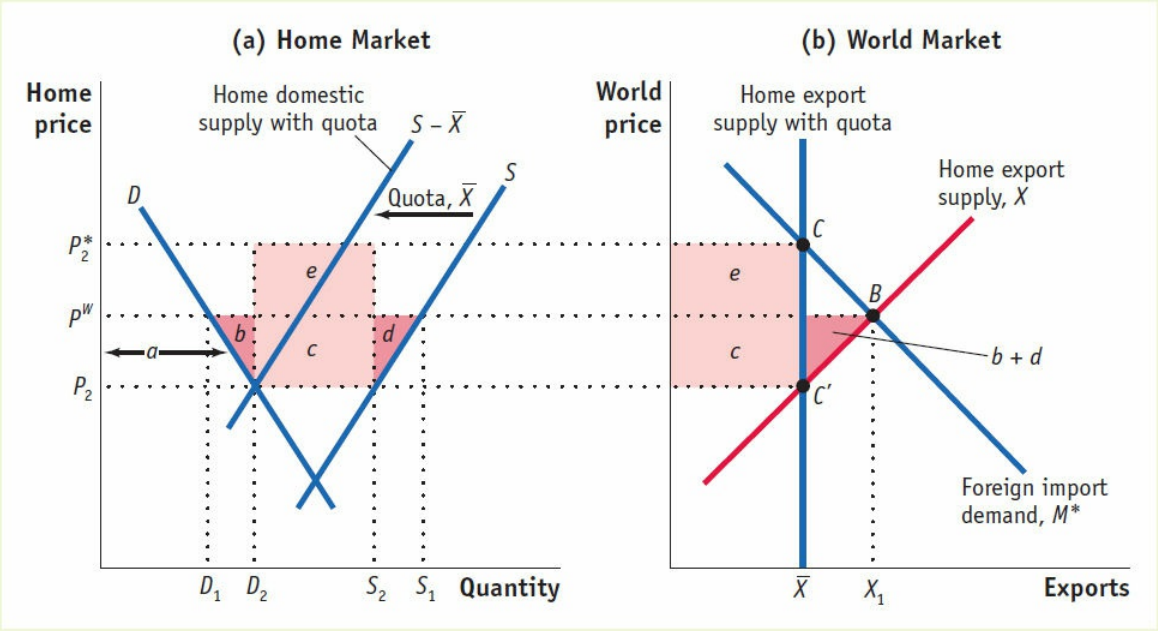


FIGURE 10-7

Export Quota for a Large Country The export quota leads to a vertical export supply curve above the quantity $\bar{X}$ in panel (b). As a result, the world price increases from P^W to P_2^*. Because Home firms can export only the amount $\bar{X}$, the remaining home supply curve shifts left by that amount, as shown by $S - \bar{X}$. This remaining Home supply intersects Home demand at the price P_2 in panel (a), which is lower than the initial world price of P^W. This increase in the world price is less than the upward shift in export supply of t. The deadweight loss for Home is the area of triangle $(b + d)$, while Home firms earn the quota rents of area $c + e$.

Let's compare the welfare effects of the export quota with those of the export tariff. Home consumers gain the same amount of consumer surplus a due to lower domestic prices. The change in producer surplus is more complicated. If producers earned the lower price of P_2 on *all* their quantity sold, as they do with the export tariff, then they would lose $(a + b + c + d)$ in producer surplus. But under the export quota they also earn rents of $(c + e)$ on their export sales, which offsets the loss in producer surplus. These rents equal the difference between the Home and world prices, $P^*_2 - P_2$, times the amount exported $\bar{X}$. A portion of these rents—the area e—is the rise in the world price times the amount exported, or the terms-of-trade gain for the exporter; the remaining amount of rents—the area c—offsets some of the loss in producer surplus. The government does not collect any revenue under the export quota, because the firms themselves earn rents from the higher export prices.

The overall impact of the export quota is:

Rise in consumer surplus:	$+a$
Fall in producer surplus	$-(a + b + c + d)$
Rise in rents earned by producers:	$+(c + e)$

Rise in government revenue	0
Net effect on Home welfare:	$e - (b + d)$

To summarize, the overall effect of the export quota on the Home country welfare is the same as the export tariff, with a net effect on welfare of $e - (b + d)$. If this amount is positive, then Home gains from the export quota. The effects of the quota on Home firms and the government differ from those of the tariff. Under the export tariff the Home government earns revenue of $(c + e)$, while under the export quota that amount is earned instead as quota rents by Home firms.

This conclusion is the same as the one we reached in Chapter 8, when we examined the ways that import quotas can be allocated. One of those ways was by using a "voluntary" export restraint (VER), which is put in place by the exporting country rather than the importing country. The VER and the export quota are the same idea with different names. In both cases, the restriction on exports raises the world price. Firms in the exporting country can sell at that higher world price, so they earn the quota rents, with no effect on government revenue. In the following application, we look at how China used export quotas to limit its export of some mineral products.

APPLICATION

Chinese Export Policies in Mineral Products

Like many developing countries, China uses a wide variety of export policies. Export tariffs ranging from 10% to 40% are applied to steel products, for example, which create a source of revenue for the government. In addition, China has applied both tariffs and quotas to its exports of mineral products. The policies that China has applied to mineral exports have attracted international attention recently, since some of these minerals are essential to the production of goods in other countries. As we saw in Figures 10-6 and 10-7, export tariffs and export quotas both increase the world price, making it more expensive for other countries to obtain a product and at the same time benefiting the exporting country with a terms-of-trade gain.

In 2009, the United States, the European Union, and Mexico filed a case against China at the World Trade Organization (WTO), charging that the export tariffs and export quotas that China applied on bauxite, zinc, yellow phosphorus, and six other industrial minerals, distorted the pattern of international trade.[5] Export restrictions of this type are banned under Article XI of the General Agreement on Tariffs and Trade (see Side Bar: Key Provisions of the GATT, Chapter 8). When China joined the WTO in 2001, it was required to eliminate its export restrictions, including those on minerals. But an exception to Article XI states that this rule does not apply to "export prohibitions or restrictions temporarily applied to prevent or relieve critical shortages of foodstuffs or other products essential to the exporting contracting party." For example, a country facing a food shortage can restrict its food exports to keep the food at home. In its response to this 2009 case, China claimed that this exception applied to its exports of industrial minerals; China was restricting its exports of the minerals because they were needed by Chinese industries using these products (such as the solar panel industry), and also because the export quota would limit the total amount sold of these precious resources and leave more in the ground for future use. But in July 2011, the WTO ruled that this exception did not apply to China's exports of these products, and that it must remove its export restrictions on industrial minerals. China filed an appeal, but the WTO reaffirmed the ruling again in January 2012.

This legal battle at the WTO was closely watched around the world, because shortly after the case was filed in 2009, China also started applying export quotas to other mineral products: rare earth minerals, such as lanthanum (used in batteries and lighting) and neodymium (used in making permanent magnets, which are found in high-tech products ranging from smartphones to hybrid cars to wind turbines). At that time, China controlled more than 95% of the world production and exports of these minerals. The export quotas applied by China contributed to a rise in the world prices

of these products. For example, the price of lanthanum went from $6 per kilogram in 2009 to $60 in 2010, to $151 in 2011, and then back down to $36 in 2012.

In Figure 10-8, we show the value, the average price, and the quantity of Chinese exports in three categories of rare earth minerals over the period from 2007 to 2015. Panel (a) shows the value of exports in billions of dollars, panel (b) shows the average price in dollars per kilogram, and panel (c) shows the quantity exported in millions of kilograms. For all three categories of rare earth minerals, the average export price rose dramatically in 2011, while the quantity exported fell in 2011 and 2012 because of the limits imposed by the Chinese export quota. For two of the categories (scandium and yttrium, and cerium compounds), the price rise was enough to lead to much greater export value despite the lower quantity, indicating the demand is highly inelastic, at least in the short run (within a year). Figure 10-8 shows how a country can gain by applying an export quota: the export value went up, so Chinese firms earned more despite the reduced quantity of exports.

In Figure 10-8, the price and export value fell in 2012 even though the quantity exported remained low (because of the continued export quota). That price fall was caused by mines being opened in other countries: the high world prices in 2011 made it profitable for Australia to open a new mine, and the United States reopened a mine in the Mojave Desert that had closed a decade earlier for environmental reasons. The U.S. mine includes deposits of light rare earth elements, such as neodymium (needed to make permanent magnets in hard drives) and europium (needed for fluorescent light bulbs and TV screens), as well as the heavy rare elements terbium, yttrium, and dysprosium (which are needed to manufacture wind turbines and solar cells).[6] These new sources of supply led to the price drop in 2012.

In March 2012, the United States, the European Union, and Japan filed another WTO case against China, charging that it applied unfair export restrictions on its rare earth minerals, as well as tungsten and molybdenum. The first step in such a case is for the parties involved (the United States, Europe, and Japan on one side; China on the other) to see whether the charges can be resolved through consultations at the WTO. Those consultations failed to satisfy either side, and in September 2012, the case went to a dispute settlement panel at the WTO. The Chinese government appealed to Article XX of the GATT, which allows for an exception to GATT rules in cases "relating to the conservation of exhaustible natural resources." In 2014, however, China lost that case at the WTO and was required to eliminate the quotas used on its exports of rare earth minerals, as described in Headlines: China Ends Rare-Earth Minerals Export Quotas.

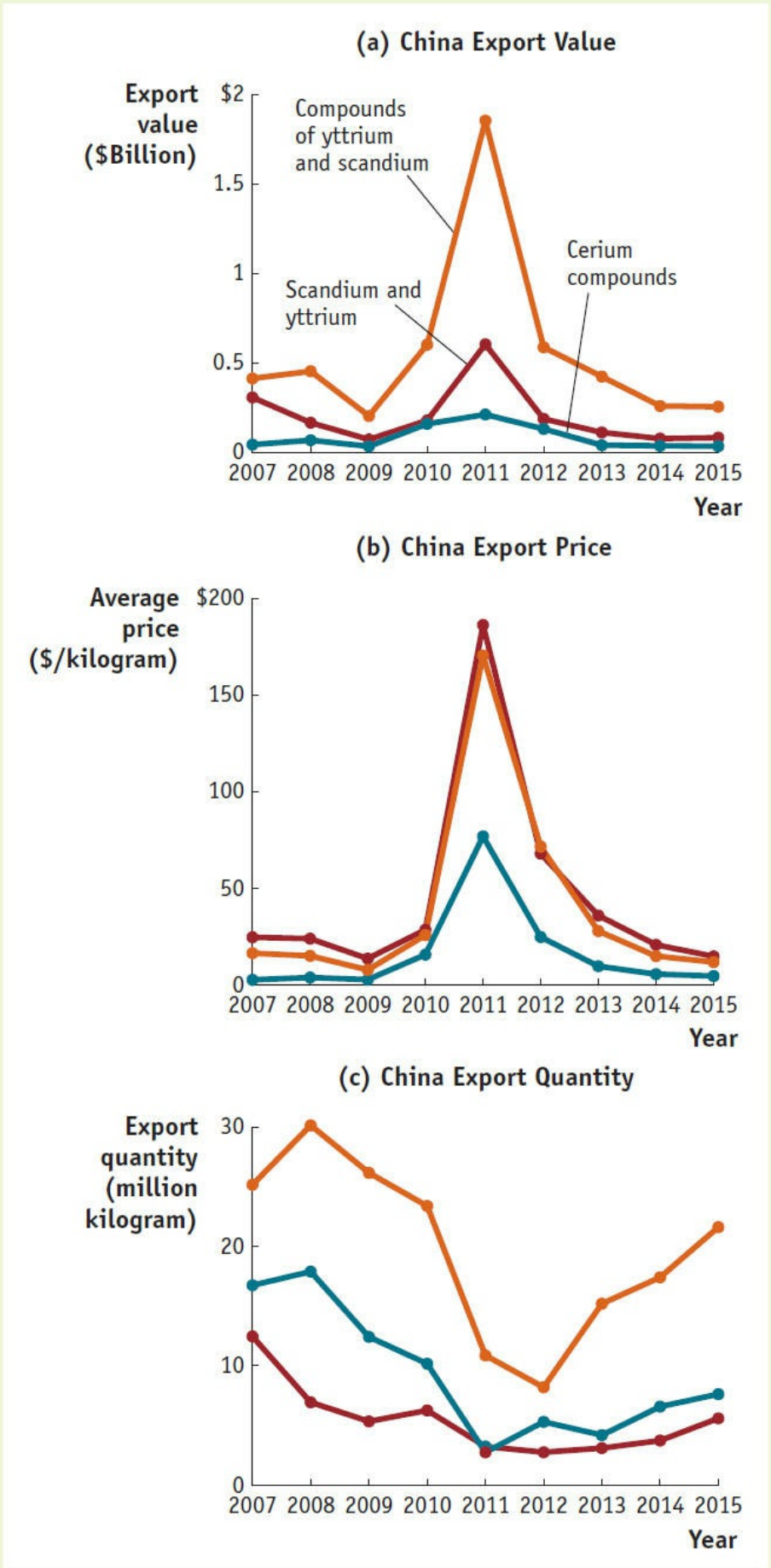

(a) China Export Value
Export value ($Billion)
$2
1.5
1
0.5
0
Compounds of yttrium and scandium
Cerium compounds
Scandium and yttrium
2007 2008 2009 2010 2011 2012 2013 2014 2015
Year
(b) China Export Price
Average price ($/kilogram)
$200
150
100
50
0
2007 2008 2009 2010 2011 2012 2013 2014 2015
Year
(c) China Export Quantity
Export quantity (million kilogram)
30
20
10
0
2007 2008 2009 2010 2011 2012 2013 2014 2015
Year

FIGURE 10-8

China Exports of Rare Earth Minerals, 2007–15 Panel (a) shows the value of Chinese exports (in $ billion) for three categories of rare earth minerals over the period 2007–15. Panel (b) shows the average price for each category (in dollars per kilogram), and panel (c) shows the quantity exported (in millions of kilograms). For all three categories of rare earth minerals, the average export price rose dramatically in 2011 while the quantity fell in 2011 and 2012 because of the Chinese export quota. For two of the categories (scandium and yttrium, and cerium compounds), the price rise was enough to lead to much greater export value despite the lower quantity.

Data from: China Customs Statistics, 2007–15.

Protesters from the Save Malaysia! Stop Lynas! group demonstrating outside a hotel in Sydney, Australia.

A final feature of international trade in rare earth minerals is important to recognize: the mining and processing of these minerals poses an environmental risk, because rare earth minerals are frequently found with radioactive ores like thorium or uranium. Processing these minerals therefore leads to low-grade radioactive waste as a by-product. That aspect of rare earth minerals leads to protests against the establishment of new mines. The Lynas Corporation mine in Australia processes its minerals in Malaysia. The Malaysian processing facility was targeted by protesters in Malaysia led by a retired math teacher named Tan Bun Teet. Although Mr. Tan and the other protestors did not succeed in preventing the processing facility from being opened, they delayed it and also put pressure on the company to ensure that the radioactive waste would be exported from Malaysia, in accordance with that country's laws. But where will this waste go? This environmental dilemma arises because of the exploding worldwide demand for high-tech products (including your own cell phone), manufacturing of which involves environmental risks. This case illustrates the potential interaction between international

trade and the environment, a topic we examine in more detail in Chapter 11.

HEADLINES

China Ends Rare-Earth Minerals Export Quotas

China has dropped decade-old quotas limiting exports of strategically important minerals that sparked a global trade dispute and led some countries to reduce their reliance on Chinese supplies. The shift comes after Beijing lost a dispute at the World Trade Organization in 2013. But the policy also proved to be of little value for Beijing as many countries found other sources for the materials known as rare earths, which are widely used in high-technology industries such as smartphones and missile systems. "The change is likely because of the pressure from the WTO decision," said Frank Tang, an analyst at investment bank North Square Blue Oak. "China is saying that as a WTO member, it'll have to abide by WTO rules."

The quota system was once a major global trade issue. In 2010, China pushed global rare-earth prices sharply higher—in some cases tenfold—when it slashed its export quota on the 17 elements by 40% from the preceding year. China has said it was an effort to clean up a highly polluting domestic rare-earth mining industry. The Obama administration described the move as a "wake-up call." Trade complaints followed, adding rare earths to a raft of items—including car parts and solar panels—that have been the subject of friction between China and its trading partners in recent years. The U.S., European Union and Japan in 2012 complained that China was using the quota to push up global rare-earth prices in violation of WTO rules.

But since then the world has reduced its reliance on the minerals from China, which until recent years produced about 93% of the world's rare earths. China's share of global rare-earth output has fallen to around 86% as other producers amped up supply. China's exports now frequently fall short of maximum levels under the quota system. In 2012, it eased quota restrictions. But after it lost the WTO case, government officials said the quota's days were numbered.

Source: Excerpted from Chuin-Wei Yap "China Ends Rare-Earth Minerals Export Quotas," The Wall Street Journal, *January 5, 2015, online edition.*

7 High-Technology Export Subsidies

We turn now from rare earth minerals, which are used in the production of high-tech products, to consider high-technology products themselves. The high-tech sector of an economy also receives substantial assistance from government, and an important example is the subsidies to the aircraft industries in both the United States and Europe. In the United States, subsidies take the form of low-interest loans provided by the Export-Import Bank to foreign firms or governments that want to purchase aircraft from Seattle-based Boeing. (The Export-Import Bank is a U.S. government agency that finances export-related projects.) In the European Union, government support for research and development and other subsidies are given to Airbus, which produces parts and assembles its finished products in a number of European countries. In Japan and South Korea, direct subsidies have been given to high-tech manufacturing firms that achieve certain targets for increasing their export sales. High-tech subsidies are given by many other countries, too.

Why do governments support their high-technology industries? In the case of agricultural products, subsidies are instituted primarily because of the political clout of those industries. Although politics plays a role in subsidies for high-tech industries, governments also subsidize these industries because they may create benefits that spill over to other firms in the economy. That is, governments believe that high-tech industry produces a positive externality. This argument for a subsidy is similar to the infant industry argument used to justify protective tariffs (see Chapter 9), except that the protection is applied to an export industry rather than an import-competing industry.

"Strategic" Use of High-Tech Export Subsidies

In addition to the spillover argument for export subsidies, governments and industries also argue that export subsidies might give a strategic advantage to export firms that are competing with a small number of rivals in international markets. By a strategic advantage, we mean that the subsidized industry can compete more effectively with its rivals on the world market. Think of the aircraft industry, which currently has just two producers of large, wide-bodied airplanes: Boeing in the United States and Airbus in Europe. Each of these firms receives some type of subsidy from its government. If high-tech subsidies allow firms to compete more effectively and earn more profits in international markets, and if the extra profits are more than the amount of the subsidy, then the exporting country will obtain an overall benefit from the export subsidy, similar to the benefit that comes from a large country applying a tariff.

To examine whether countries can use their subsidies strategically, we use the assumption of imperfect competition. We already used this assumption in Chapter 9, in which we considered the cases of Home monopoly and Foreign monopoly. Now we allow for two firms in the market, which is called a duopoly. In that case, each firm can set the price and quantity of its output (and hence maximize its profits) based on the price and quantity decisions of the other firm. When a government uses subsidies to affect this interaction between firms and to increase the profits of its own domestic firm, the government is said to be acting strategically. In this section, we examine the effects of strategic export subsidies to determine whether profits of the exporting firm will rise

enough to offset the cost of the subsidy to the government.

Because we now assume that certain high-tech industries operate in imperfectly competitive markets, we need to use a different set of tools to model their supply decisions than we have used thus far in this chapter. To capture the strategic decision making of two firms, we use game theory, the modeling of strategic interactions (games) between firms as they choose actions that will maximize their returns. The main goal in this section is to model the strategic interaction of high-tech firms in Home and Foreign, and then to see the impact of export subsidies on their respective decisions and payoffs.

To examine the effect of an export subsidy, we start with the free-trade situation, before any subsidies are in place. Suppose there are two firms that are competing for sales of a new type of aircraft. For example, one of the newest aircraft that Airbus sells is the double-decker A380, which Boeing has no plans to copy. One of the newest aircraft that Boeing sells is the smaller 787 Dreamliner, and Airbus has developed a similar model called the A350 (discussed later in the chapter). For convenience, we focus on the decision of each firm to produce a relatively new aircraft that competes with the other firm for sales to the rest of the world. By ignoring sales to firms in their own countries, we will not have to keep track of consumer surplus in the United States or Europe. Instead, the measure of welfare for these countries will depend only on the profits earned by Boeing or Airbus from their sales to the rest of the world.

Payoff Matrix

In Figure 10-9, we show a payoff matrix for Boeing and Airbus, each of which has to decide whether to produce the new aircraft. Each quadrant of the matrix shows the profits earned by Boeing in the lower-left corner and the profits of Airbus in the upper-right corner. When both firms produce (upper-left quadrant), their prices are reduced through competition, and they both end up making negative profits (i.e., losses) of $5 million.[7]

If Airbus produces the new aircraft and Boeing does not (lower-left quadrant), then Boeing earns nothing, whereas Airbus, the only supplier, earns high profits of $100 million. Conversely, if Boeing produces and Airbus does not (upper-right quadrant), Airbus earns nothing, and Boeing, now the only supplier, earns high profits of $100 million. Finally, if both firms choose to not produce (lower-right quadrant), then they both earn profits of 0.

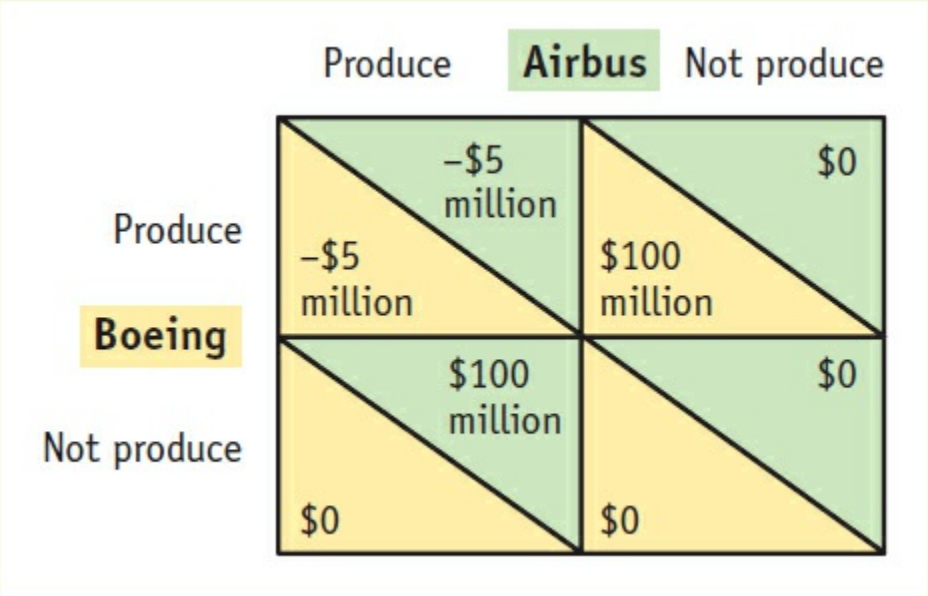


FIGURE 10-9

Payoff Matrix Between Two Firms The lower-left number in each quadrant shows the profits of Boeing, and the upper-right number shows the profits of Airbus. Each firm must decide whether to produce a new type of aircraft. A Nash equilibrium occurs when each firm is making its best decision, given the action of the other. For this pattern of payoffs, there are two Nash equilibria, in the upper-right and lower-left quadrants, where one firm produces and the other does not.

Nash Equilibrium

With the pattern of payoffs shown in Figure 10-9, we want to determine what the outcome of this game between the two firms will be. At first glance, this seems like a difficult problem. It is hard for each firm to decide what to do without knowing whether the other firm is going to produce. To solve this problem, we use the concept of the Nash equilibrium, named after John Nash, a winner of the Nobel Prize in economics.[8]

The idea of a Nash equilibrium is that each firm must make its own best decision, taking as given each possible action of the rival firm. When each firm is acting that way, the outcome of the game is a Nash equilibrium. That is, the action of each player is the best possible response to the action of the other player.

Best Strategy for Boeing

To determine the Nash equilibrium, we proceed by checking each quadrant of the payoff matrix. Let us look at Boeing's possible strategies, starting with the case in which its rival, Airbus, chooses to produce. If Boeing knows that Airbus will produce, then Boeing needs to decide whether to produce. If Boeing produces, then it earns –$5 million (in the upper-left quadrant); if Boeing does not produce, then it earns 0 (in the lower-left quadrant).

Therefore, if Airbus produces, then Boeing is better off *not* producing. This finding proves that having both firms produce is not a Nash equilibrium. Boeing would never stay in production, since it prefers to drop out of the market whenever Airbus produces.

Best Strategy for Airbus

Let's continue with the case in which Boeing does not produce but Airbus does (lower-left quadrant of Figure 10-9). Is this the best strategy for Airbus? To check this, suppose that Airbus chooses instead to not produce. That would move us from the lower-left quadrant to the lower-right quadrant in Figure 10-9, meaning that Airbus's profits fall from $100 million to 0. This outcome is worse for Airbus, so it would not change its decision: it would still choose to produce. We conclude that the decision illustrated in the lower-left quadrant, with Airbus producing and Boeing not producing, is a Nash equilibrium because each firm is making its best decision given what the other is doing. When Airbus produces, then Boeing's best response is to not produce, and when Boeing does not produce, then Airbus's best response is to produce. There is no reason for either firm to change its behavior from the Nash equilibrium.

Multiple Equilibria

Is it possible to find more than one Nash equilibrium? To check for this, we need to check the other quadrants in Figure 10-9. Let us try the case in the upper-right quadrant, where Boeing produces but Airbus does not. Consider Airbus making the decision to produce or not, given that Boeing produces, or Boeing making the decision to produce or not, given that Airbus does not produce. Using the same logic we have already gone through, you can confirm that neither firm would want to change the decision it has made as seen in the upper-right quadrant: if either firm changed its choice, its profits would fall. If Boeing decides not to produce, then its profits fall to 0 (from the upper-right to the lower-right quadrant), whereas if Airbus decides to produce, its profits fall to –$5 million (from the upper-right to the upper-left quadrant). So we conclude that the upper-right quadrant, with Boeing producing and Airbus not producing, is *also* a Nash equilibrium. When Boeing produces, then Airbus's best response is to not produce, and when Airbus does not produce, then Boeing's best response is to produce. Finally, by applying the same logic to the other quadrants, we can confirm that there are no more Nash equilibria.

When there are two Nash equilibria, there must be some force from outside the model that determines in which equilibrium we are. An example of one such force is the first mover advantage, which means that one firm is able to decide whether to produce before the other firm. If Boeing had this advantage, it would choose to produce, and Airbus, as the second mover, would not produce, so we would be in the upper-right quadrant. Let us suppose that is the Nash equilibrium from which we start. Because Airbus is not producing, it is making zero profits. In this situation, the government in Europe might want to try to change the Nash equilibrium so that Airbus would instead earn positive profits. That is, by providing subsidies to Airbus, we want to determine whether the payoffs in the matrix change such that the Nash equilibrium also changes.

The type of subsidy we consider in our model is a cash payment to Airbus. In practice,

however, subsidies are of many kinds: Boeing has benefited from U.S. military contracts, where the research and development (R&D) done for those contracts has been used in its civilian aircraft, too. Airbus, on the other hand, has benefited from direct R&D subsidies to defray the "launch costs" of getting a new aircraft off the ground. Both companies have benefited from low-cost loans provided by their governments to purchasers of aircraft. Later in the chapter, we examine in more detail actual export subsidies that are used in the aircraft industry.

Effect of a Subsidy to Airbus

Suppose the European governments provide a subsidy of $25 million to Airbus. With this subsidy in place, Airbus's profits will increase by $25 million when it produces. In Figure 10-10, we add that amount to the payoffs for Airbus and check to see whether the Nash equilibria have changed. Recall that the free-trade Nash equilibria occur when one firm produces and the other does not.

Best Strategy for Airbus

Let us start with the free-trade Nash equilibrium in which Boeing produces but Airbus does not (upper-right quadrant) and see whether it changes when Airbus receives a government subsidy. After the subsidy, that option is no longer a Nash equilibrium: if Boeing is producing, then Airbus is now better off by *also* producing because then it receives a $25 million subsidy from the government. With the subsidy, it will now earn $20 million ($5 million in negative profits plus the $25 million subsidy) even when Boeing produces. Recall that in the original situation, if Boeing produced, then Airbus would not choose to produce because otherwise it would lose $5 million. With the subsidy, Airbus now earns $20 million by producing instead of losing $5 million.

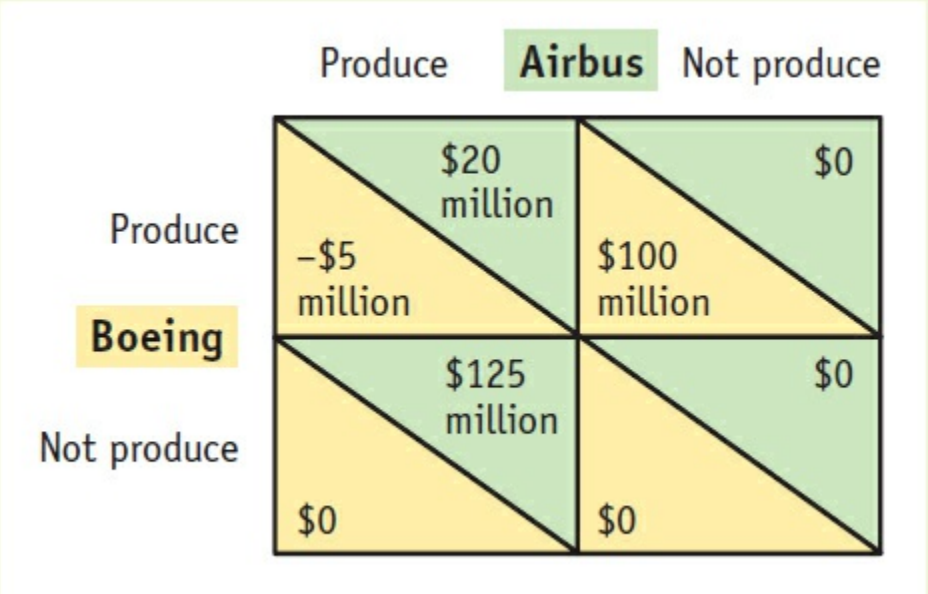


FIGURE 10-10

Payoff Matrix with Foreign Subsidy When the European governments provide a subsidy of $25 million to Airbus, its profits increase by that much when it produces a new aircraft. Now there is only one Nash equilibrium, in the lower-left quadrant, with Airbus producing but Boeing not producing. The profits for Airbus have increased from 0 to $125 million, while the subsidy cost only $25 million, so there is a net gain of $100 million in European welfare.

Best Strategy for Boeing

Is this new position a Nash equilibrium? To answer that, we need to see whether Boeing would still be making the right decision given that Airbus is producing. When Airbus produces, Boeing loses $5 million when it produces (upper-left quadrant) but loses nothing when it does not produce (lower-left quadrant). Therefore, Boeing will want to drop out of the market. Once Boeing makes the decision not to produce, Airbus's decision doesn't change. It still chooses to produce, but its payoff increases dramatically from $20 million to $125 million, and we move to the lower-left quadrant, with Airbus producing and Boeing not.

Nash Equilibrium

You can readily check that the lower-left quadrant is a unique Nash equilibrium: each firm is making its best decision, given the action of the other. Furthermore, it is the *only* Nash equilibrium. The effect of the European governments' subsidy has been to shift the equilibrium from having Boeing as the only producer (where we started, in the upper-right quadrant) to having Airbus as the only producer (in the lower-left quadrant).

European Welfare

The European subsidy has had a big impact on the equilibrium of the game being played between the two firms. But can we necessarily conclude that Europe is better off? To evaluate that, we need to add up the welfare of the various parties involved, much as we did earlier in the chapter.

The calculation of European welfare is simplified, however, because of our assumption that production is for export to the rest of the world. From Europe's point of view, we do not need to worry about the effect of the subsidy on consumer surplus in its own market. The only two items left to evaluate, then, are the profits for Airbus from its sales to the rest of the world and the cost of the subsidy to the European government.

Airbus's profits have increased from 0 (when it was not producing but Boeing was) to $125 million (now that Airbus is producing but Boeing is not). The revenue cost of the subsidy to Europe is $25 million. Therefore, the net effect of the subsidy on European welfare is

Rise in producer surplus:	+125

Fall in government revenue:	–25
Net effect on European welfare:	+100

In this case, the subsidy led to a net gain in European welfare because the increase in profits for Airbus is more than the cost of the subsidy.[9]

Subsidy with Cost Advantage for Boeing

Our finding that the subsidy can raise European welfare depends, however, on the numbers we assumed so far. Let us now consider another case in which Boeing has a cost advantage over Airbus. In this case, we assume that the cost advantage is the result not of U.S. subsidies but of U.S. comparative advantage in aircraft production.

When Boeing has a cost advantage in aircraft production, the payoff matrix is as shown in Figure 10-11. Boeing earns profits of $5 million when both firms produce and profits of $125 million when Airbus does not produce. There is now only one Nash equilibrium, and it is in the upper-right quadrant in which Boeing produces and Airbus does not. The alternative free-trade Nash equilibrium in Figure 10-9 (in which Airbus produces and Boeing does not) is no longer a Nash equilibrium because, with the cost advantage we are now assuming Boeing has, even if Airbus chooses to produce, it is better for Boeing to produce and earn profits of $5 million than not produce and earn 0 profits.

Now suppose, once again, that the European governments provide a $25 million subsidy to Airbus. We add that amount to the payoffs of Airbus when it produces (still assuming that Boeing has a cost advantage over Airbus), as shown in Figure 10-12.

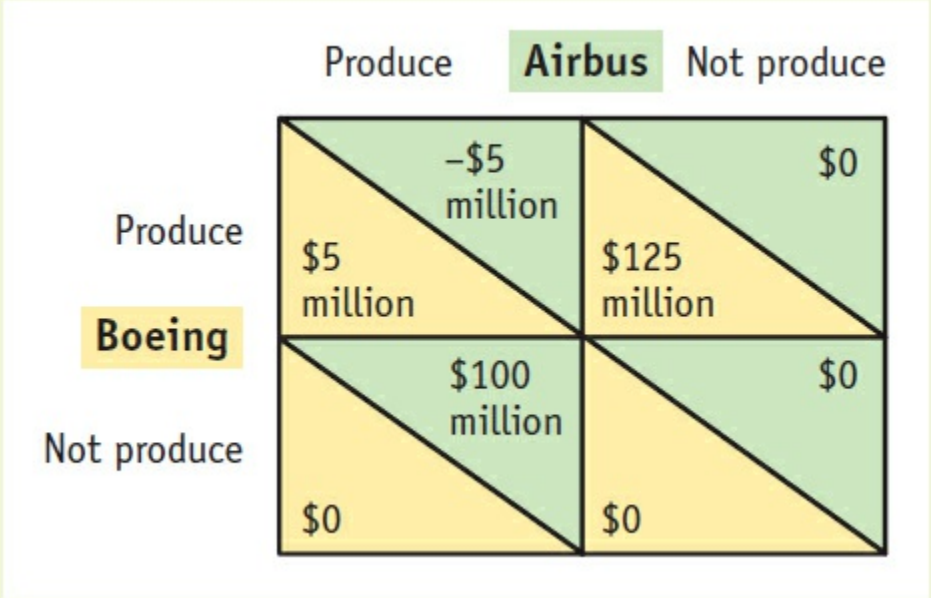


FIGURE 10-11

Another Payoff Matrix, with Boeing Cost Advantage If Boeing has a cost advantage in the production of

aircraft, the payoffs are as shown here. Boeing earns profits of $5 million when both firms are producing, and profits of $125 million when Airbus does not produce. Now there is only one Nash equilibrium, in the upper-right quadrant, where Boeing produces and Airbus does not.

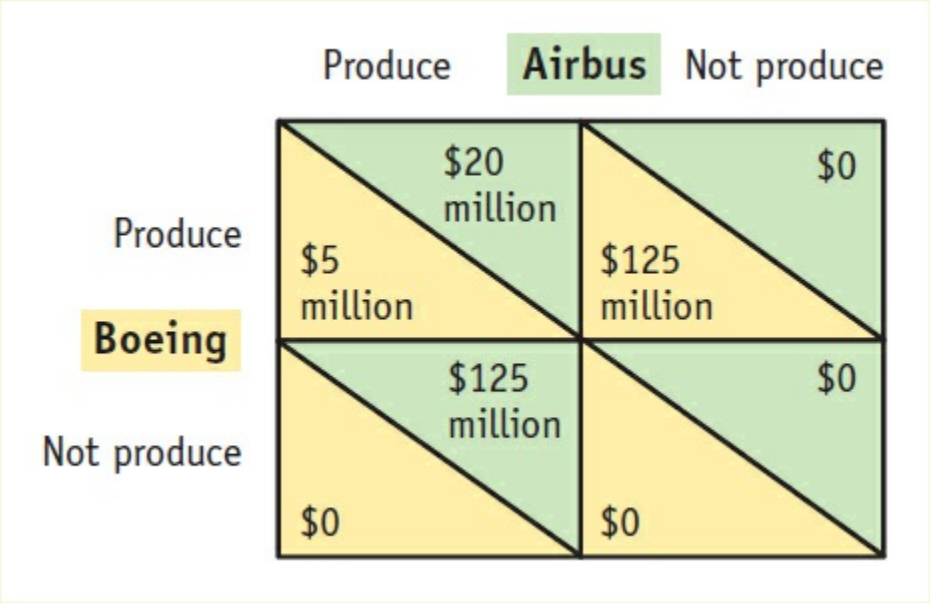


FIGURE 10-12

Another Payoff Matrix with Foreign Subsidy When the European governments provide a subsidy of $25 million to Airbus, its profits increase by that much when it produces. Now the only Nash equilibrium is in the upper-left quadrant, where both firms produce. The profits for Airbus have increased from 0 to $20 million, but the subsidy costs $25 million, so there is a net loss of $5 million in European welfare.

Best Strategy for Airbus

Let's see how the subsidy has affected the previous Nash equilibrium in which Boeing produces and Airbus does not (upper-right quadrant). Given that Boeing produces, the decision to not produce is no longer the best one for Airbus: with the subsidy now in place and Boeing producing, Airbus's best decision is to produce and to earn profits of $20 million (upper-left quadrant) rather than 0.

Best Strategy for Boeing

Is this new position a Nash equilibrium? Once again, we need to check to see whether, given Airbus's new postsubsidy decision to produce, Boeing is still making the right decision. Given that Airbus produces, then Boeing earns profits of $5 million when it produces and 0 when it does not. Therefore, Boeing will stay in the market, and we have proved that having both firms produce is a Nash equilibrium.

European Welfare Once Again

When Boeing has a cost advantage, the European subsidy allows Airbus to enter the market, but it *has not* resulted in the exit of Boeing as it did in the earlier no-cost-advantage scenario. Let us evaluate the effect on European welfare under these circumstances.

Airbus's profits have increased from 0 (when it was not producing, but Boeing was) to 20 (now that both firms are producing). The revenue cost of the subsidy to Europe is still 25. Therefore, the net effect of the subsidy on European welfare is

Rise in producer profits:	+20
Fall in government revenue:	−25
Net effect on European welfare:	−5

When Boeing has a cost advantage, then, the subsidy leads to a *net loss* in European welfare because the increase in profits for Airbus is less than the cost of the subsidy.

Summary

The lessons that we should draw from these various examples is that under conditions of imperfect competition, a subsidy by one government to its exporting firm might increase welfare for its nation, but it might not. Although profits for the exporting firm certainly rise, there is an increase in welfare only if profits rise by more than the cost of the subsidy. This condition is more likely to be satisfied if the subsidy leads to the *exit* of the other firm from the market. In that case, the profits earned by the single firm could very well exceed the cost of the subsidy. When both firms remain in the market after the subsidy, however, it is unlikely that the increase in profits for the subsidized firm will exceed the subsidy cost. In the following application, we are especially interested in whether subsidies in the aircraft industry have kept one firm out of a market segment in which another produces.

APPLICATION

Subsidies to Commercial Aircraft

In the large passenger aircraft industry, there have been just three competitors: Boeing and McDonnell-Douglas in the United States and Airbus in Europe. The former two companies merged on August 1, 1997, so the industry effectively became a duopoly. The United States and Europe have used various types of subsidies to support their respective firms. First, there are indirect subsidies that arise because in the production of civilian and military aircraft, the research and development (R&D) for the military versions effectively subsidize R&D for the civilian aircraft. These indirect subsidies have benefited both McDonnell-Douglas and Boeing in the United States. Second, the government might directly subsidize the R&D costs of a new aircraft, as Europe subsidizes R&D at Airbus. Third, the government can subsidize the interest rates that aircraft buyers pay when they borrow money to purchase aircraft. Europe and the United States both provide such low-interest loans, for instance, through the Export-Import Bank in the United States, as mentioned previously.

1992 Agreement

Recognizing that these subsidies are ultimately costly, in 1992 the United States and the European Community reached an agreement to limit them. The main features of this agreement are summarized in Table 10-2. Development subsidies are limited to 33% of the total development costs of a new aircraft, and it is expected that the aircraft manufacturers will repay these subsidies at the government interest rate. In addition, the agreement limits indirect (military) subsidies to not more than 4% of any firm's annual sales, prohibits production subsidies, and limits the ability of government agencies to subsidize the interest rate on purchases of aircraft. According to one estimate, this agreement reduced subsidies by between 7.5% and 12.5% of the costs of production. As a result of the reduction in subsidies, prices for aircraft rose by somewhere between 3.1% and 8.8%. This agreement between the United States and Europe benefited the countries' governments because they no longer had to spend the money on the subsidies, and most likely also benefited the aircraft companies because prices rose, but the higher prices led to welfare losses for the purchasing countries.

TABLE 10-2

Provisions of the 1992 Agreement Between the United States and the European Community on Trade in Civil Aircraft This table shows the major provisions of a 1992 agreement between the United States and

Europe that limited the subsidies provided to the development and production of civilian aircraft.

Aircraft Covered

- All aircraft of 100 seats or larger are subject to the provisions of the agreement.

Direct Support Levels

- Funds advanced by governments for aircraft development may not exceed 33% of total development costs and are to be provided only to programs in which there is a reasonable expectation of recoupment within 17 years.

Interest Rates

- Airbus will repay the first 25% of total development costs at the government cost of borrowing within 17 years of first disbursement; the remaining 8% will be repaid at the government cost of borrowing plus 1% within 17 years of first disbursement.

Indirect Supports

- Both sides agree that indirect (i.e., military) supports should neither confer unfair advantage on manufacturers of civil aircraft nor lead to distortions in international trade in such aircraft.
- Identifiable benefits from indirect support are limited to 3% of the value of industry-wide turnover in each signatory and 4% of the value of each firm's annual sales. Benefits will primarily be calculated as cost reductions in the development of a civil aircraft program realized from technology acquired through government R&D programs.

Escape Clause on Emergency Aid

- Either side can temporarily derogate from the agreement, with the exception of the development support provisions, if survival and financial viability of an aircraft manufacturer are in jeopardy. Any such withdrawal would require consultations with representatives of the other side, full disclosure of information to justify the withdrawal, and full explanation of the remedy to be used.

Production Supports

- No further production subsidies are allowed.

Dispute Settlement Mechanisms

- Both sides will consult at least twice a year to ensure the functioning of the agreement. Either side may request consultations related to the agreement at any time. Such consultations must be held no later than 30 days after they are requested.

Excerpted from: Laura D'Andrea Tyson, 1992, Who's Bashing Whom? Trade Conflict in High Technology Industries (Washington, D.C.: Peterson Institute for International Economics).

The Superjumbo

There are claims that the terms of the 1992 agreement were violated by Airbus in the production of the double-decker A380, which is even larger than the Boeing 747 and will compete directly with the 747 in long flights. This "superjumbo" aircraft carries up to 555 passengers and consists of two passenger decks for its entire length. Its first test flight in Europe took place in April 2005, and its first commercial flight to the United States was in March 2007. The expenditures to develop the A380 are estimated to have been $12 billion, one-third of which the governments of France, Germany, the Netherlands, Belgium, Spain, Finland, and the United Kingdom are expected to pay. The European governments provided some $3.5 billion in low-interest loans to cover development costs. In 2005 both the United States and the European Union filed countercomplaints at the World Trade Organization (WTO) regarding illegal subsidies by the other party to their respective aircraft producers. Europe was accused of

"illegally" subsidizing the A380, while the United States was accused of subsidizing the development of Boeing's 787 Dreamliner commercial jet. The complaints at the WTO have been going on since 2004.

Both Airbus and Boeing have filed cases against each other at the WTO, claiming that the subsidies given for the A380 and the 787 aircraft violated the terms of the 1992 Agreement on Trade in Civil Aircraft. In bringing the initial case to the WTO in 2004, the United States declared that it would no longer abide by the 1992 agreement, which the United States felt had outlived its usefulness. Over the years, the WTO has ruled in favor of both companies, finding that the European Union gave up to $18 billion in subsidized financing to Airbus, while the United States gave up to $4 billion in subsidized financing to Boeing. Both governments are now requesting that they be permitted to apply "countermeasures" against the other countries, which means that they can apply tariffs against products imported from those countries in retaliation for the subsidies. In the latest developments, Airbus has filed a new case against Boeing based on alleged subsidies given to a new aircraft, the 777X. Airbus claims that this new plane is subject to the same conditions to limit subsidies as in earlier WTO cases, whereas Boeing claims that it is an entirely new case.[10] It will probably be years before this complex case is ever resolved at the WTO.

National Welfare

Will the development subsidies provided by the European governments to the Airbus A380 increase their national welfare? From the theory presented previously, that outcome is more likely to happen if Airbus is the only firm producing in that market. And such is the case, because Boeing did not try to produce a double-decker aircraft to compete with the A380. Instead, it modified its 747 jumbo jet model to compete with the A380, and it focused its R&D on its new 787 Dreamliner, a midsized (250 passenger) wide-bodied aircraft.

AP Photo/Elaine Thompson

Dreamliner's first take-off on December 15, 2009.

AP Photo/Bob Edme

Airbus 350's first take-off on June 15, 2013.

Because Boeing did not enter the market with its own double-decker aircraft, it is possible that the profits earned by Airbus will be large enough to cover the subsidy costs, the criterion for an increase in national welfare. But that outcome is certainly not guaranteed. The profits earned by Airbus on the A380 will depend on how many aircraft are sold and at what price. Airbus has stated that it needs to produce at least 250 planes to cover its development costs but that it expects to sell 1,500 A380s over 20 years. As of February 2016, it had delivered 182 of 319 aircraft ordered. Boeing believes that market demand for the A380 superjumbo will not exceed 700 aircraft over 20 years. It remains to be seen whether the subsidies provided by the European Union for the A380 will ultimately pay off.

As of February 2016, Boeing has delivered 380 of the 787 Dreamliner aircraft, with 1,143 orders. This midsized aircraft has a larger market than the double-decker A380. Greater sales make it more likely that the United States will ultimately benefit from subsidies given to Boeing, but again, that outcome is not guaranteed. As we have noted, Airbus has produced a competitor for the 787 Dreamliner, the A350 wide-bodied jet, which had its maiden take-off on June 14, 2013. France, Germany, and Britain pledged $4.1 billion in launch funding for the A350. As of February 2016, Airbus had delivered 16 of this aircraft, with 777 ordered. The fact that both firms are producing a new midsized wide-bodied aircraft makes it less likely that either country will recoup the subsidies provided and experience a rise in national welfare from the subsidies.

8 Conclusions

Countries use export subsidies in a wide range of industries, including agriculture, mining, and high technology. For agriculture, the underlying motivation for the export subsidies is to prop up food prices, thereby raising the real incomes of farmers. This motivation was also discussed at the end of Chapter 3 using the specific-factors model. In this chapter, we use supply and demand curves to analyze the effect of export subsidies, but obtain the same result as in the specific-factors model: export subsidies raise prices for producers, thereby increasing their real income (in the specific-factors model) and their producer surplus (using supply curves).

Shifting income toward farmers comes with a cost to consumers, however, because of the higher food prices in the exporting country. When we add up the loss in consumer surplus, the gain in producer surplus, and the revenue cost of the subsidy, we obtain a net loss for the exporting country as a result of the subsidy. This deadweight loss is similar to that from a tariff in a small country. On the other hand, for a large country, an import tariff and an export subsidy have different welfare implications. Both policies lead to a rise in domestic prices (of either the import good or the export good) and a fall in world prices. For an export subsidy, however, the fall in world prices is a terms-of-trade loss for the exporting country. This means that applying an export subsidy in a large exporting country leads to even greater losses than applying it to a small country: there is no possibility of gain, as we found for a large-country import tariff.

The losses arising from an export subsidy, for either a small or a large country, are less severe when we instead consider production subsidies. A production subsidy provides a farmer with an extra payment for every unit produced, regardless of whether it is sold at home or abroad. So consumer prices do not change from their world level. Since consumer prices are not affected, exports increase only because domestic supply increases. In other words, the excess supply in response to production subsidies will indirectly spill over into international markets but production subsidies do not exclusively subsidize those exports (as export subsidies do). For these reasons, the losses arising from production subsidies in an exporting country are less severe than the losses arising from export subsidies. At the Hong Kong meeting of the WTO in December 2005, countries set a goal to eliminate export subsidies in agriculture by 2013, though the goal was not achieved by that time. At a 2015 meeting of the WTO in Nairobi, Kenya, the member countries of the WTO agreed to eliminate export subsidies in the developed countries immediately, and to eliminate them in the developing countries by 2018.

The losses experienced by an exporting country due to subsidies are reversed when countries instead use export tariffs, as occurs for some natural resource products. With export tariffs in a large country, the exporter obtains a terms-of-trade gain through restricting supply of its exports and driving up the world price. This terms-of-trade gain comes at the expense of its trade partners who are buying the products, so like an import tariff, an export tariff is a "beggar thy neighbor" policy.

The losses experienced by an exporting country due to subsidies also change when we consider high-technology industries, operating under imperfect competition. In this chapter, we examined an international duopoly (two firms) producing a good for sale in the rest of the world: Boeing and Airbus, competing for sales of a new aircraft. We showed that

it is *possible* for an export subsidy to lead to gains for the exporting country, by increasing the profits earned by the exporting firms by more than the cost of the subsidy. But that result often requires the subsidy to force the other firm out of the market, which does not necessarily occur. In this case, if both firms stay in the market and are subsidized by their governments, then it is unlikely that the subsidies are in the national interest of either the United States or the European Union; instead, the countries purchasing the aircraft gain because of the lower price, while the United States and Europe lose as a result of the costs of the subsidies.

KEY POINTS

1. An export subsidy leads to a fall in welfare for a small exporting country facing a fixed world price. The drop in welfare is a deadweight loss and is composed of a consumption and production loss, similar to an import tariff for a small country.
2. In the large-country case, an export subsidy lowers the price of that product in the rest of the world. The decrease in the export price is a terms-of-trade loss for the exporting country. Therefore, the welfare of the exporters decreases because of both the deadweight loss of the subsidy and the terms-of-trade loss. This is in contrast to the effects of an import tariff in the large-country case, which generates a terms-of-trade gain for the importing country.
3. Export subsidies applied by a large country create a benefit for importing countries in the rest of the world, by lowering their import prices. Therefore, the removal of these subsidy programs has an adverse affect on those countries. In fact, many of the poorest countries are net food importers that will face higher prices as agricultural subsidies in the European Union and the United States are removed.
4. Production subsidies to domestic producers also have the effect of increasing domestic production. However, consumers are unaffected by these subsidies. As a result, the deadweight loss of a production subsidy is less than that for an equal export subsidy, and the terms-of-trade loss is also smaller.
5. An export tariff or quota applied by a large country creates a terms-of-trade gain for these countries, by raising the price of their export product. In addition, the export tariff or quota creates a deadweight loss. If the terms-of-trade gain exceeds the deadweight loss, then the exporting country gains overall.
6. It is common for countries to provide subsidies to their high-technology industries because governments believe that these subsidies can create a strategic advantage for their firms on international markets. Because these industries often have only a few global competitors, we use game theory (the study of strategic interactions) to determine how firms make their decisions under imperfect competition.
7. A Nash equilibrium is a situation in which each player is making the best response to the action of the other player. In a game with multiple Nash equilibria, the outcome can depend on an external factor, such as the ability of one player to make the first move.
8. Export subsidies can affect the Nash equilibrium of a game by altering the profits of

the firms. If a subsidy increases the profits to a firm by more than the subsidy cost, then it is worthwhile for a government to undertake the subsidy. As we have seen, though, subsidies are not always worthwhile unless they can induce the competing firm to exit the market altogether, which may not occur.

KEY TERMS

export subsidy

indirect subsidies

Common Agricultural Policy (CAP)

domestic farm supports

deadweight loss

production loss

consumption loss

terms of trade

production subsidy

targeting principle

export tariff

export quota

rare earths

externality

strategic advantage

imperfect competition

duopoly

game theory

payoff matrix

Nash equilibrium

first mover advantage

PROBLEMS

1.  Discovering Data In Figure 10-8 we showed the value of Chinese exports of rare earth minerals, along with their average price and quantity sold, in three categories of exports. The source for the data in Figure 10-8 is the *China Customs Statistics*. In this problem, you will check the value of imports of rare earth minerals for the United States. To answer this question, you can access the Trade Stats Express database at

the International Trade Administration, U.S. Department of Commerce. (If you are using this textbook in another country, you should try to answer this question using the customs statistics for your own country.)

a. Start at the webpage http://www.trade.gov/, and find Trade Stats Express under the Data & Analysis tab. Choose National Trade Data, and Product Profiles of U.S. Merchandise Trade with a Selected Market. Select China as a Trade Partner, and select Imports. On this page, categories of goods are identified by their Harmonized System (HS) codes. The HS codes for products can have 2 digits or 4 digits; you should choose 4 digits. Change the product from HS-total to the HS code 28, and display the U.S. imports from China within this HS code. You will find two 4-digit HS codes that include RARE_EARTH within their names. What are these codes? Graph the value of U.S. imports in each of these codes for 2007–15. What do you notice about the graphs during the key period 2010–12?

b. Subtract the U.S. imports for these two HS codes from the *total* imports within HS 28 (as shown at the top of the display), and call this the *remaining imports*. Then graph the remaining imports over 2007–15. How does the shape of this graph compare with those in part (a)?

c. Now inspect the value of imports for all other 4-digit HS codes within this category of HS 28. Are there any other codes that show a marked increase during 2011, with a reduction after that? What are these other codes? By inspection of their names, could these other codes include rare earth minerals?

2. Describe the impact of each of the following goals from the Hong Kong WTO meeting on (i) domestic prices and welfare of the country taking the action and (ii) world prices and welfare for the partner countries.

a. Elimination of agriculture export subsidies

b. Reduction of agricultural tariffs

c. Duty-free, quota-free access for 97% of goods originating in the world's least-developed countries

WORK IT OUT

Consider a large country with export subsidies in place for agriculture. Suppose the country changes its policy and decides to cut its subsidies in half.

a. Are there gains or losses to the large country, or is it ambiguous? What is the impact on domestic prices for agriculture and on the world price?

b. Suppose a small food-importing country abroad responds to the lowered subsidies by lowering its tariffs on agriculture by the same amount. Are there gains or losses to the small country, or is it ambiguous? Explain.

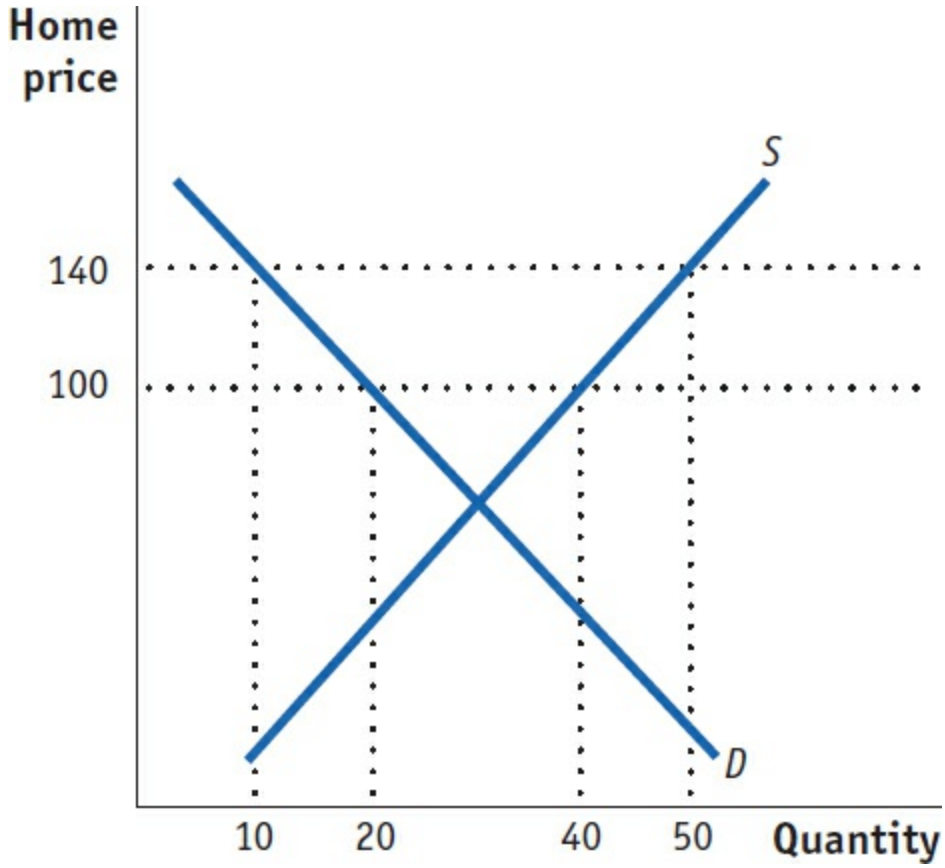
c. Suppose a large food-importing country abroad reciprocates by lowering its tariffs on agricultural goods by the same amount. Are there gains or losses to this large country, or is it ambiguous? Explain.

3. Suppose Home is a small exporter of wheat. At the world price of $100 per ton, Home growers export 20 tons. Now suppose the Home government decides to support its domestic producer with an export subsidy of $40 per ton. Use the following figure to answer these questions.

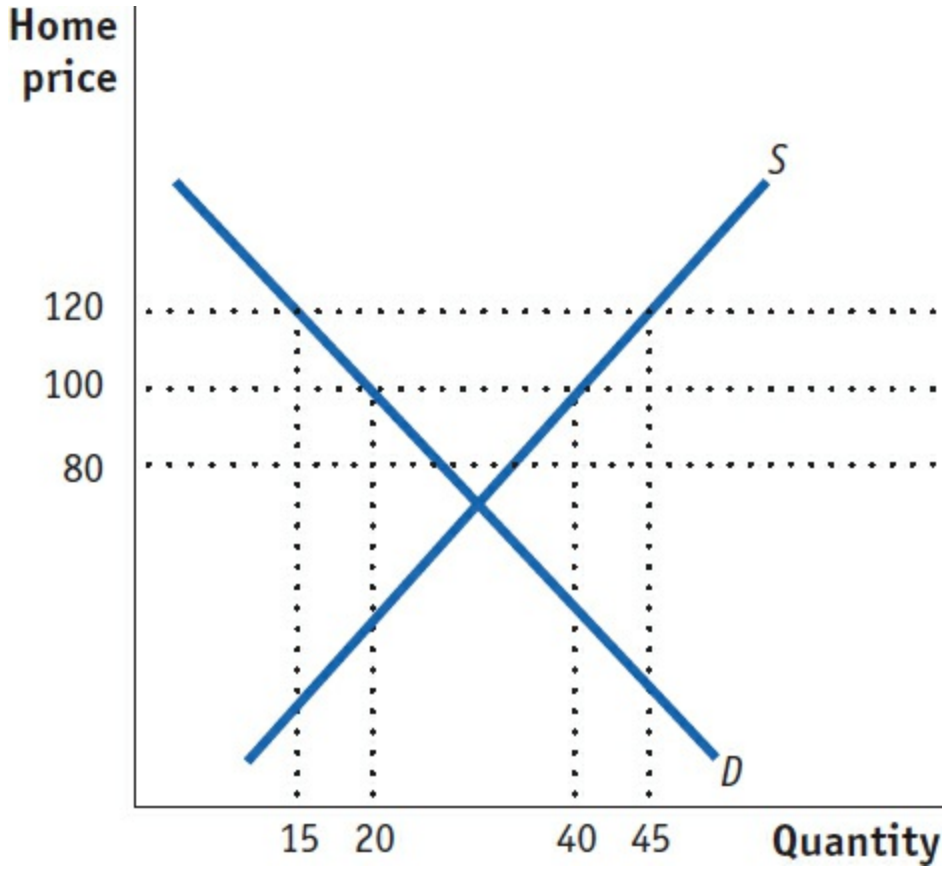
a. What is the quantity exported under free trade and with the export subsidy?

b. Calculate the effect of the export subsidy on consumer surplus, producer surplus, and government revenue.

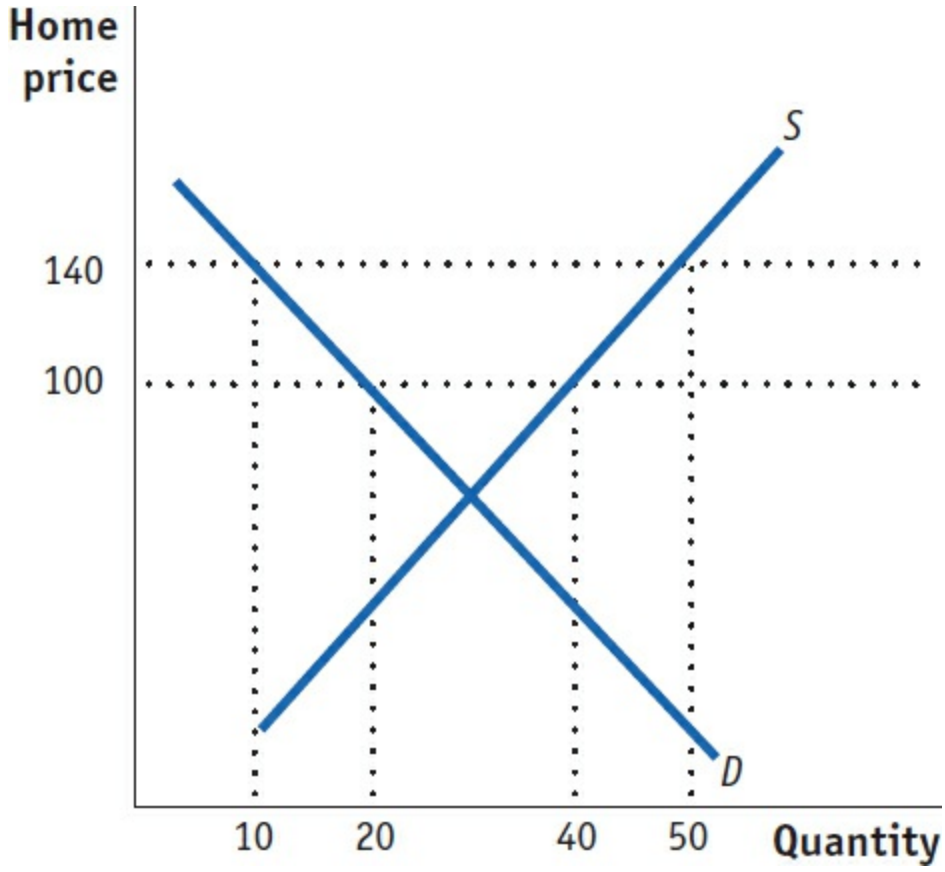
c. Calculate the overall net effect of the export subsidy on Home welfare.



4. Refer to Problem 3. Rather than a small exporter of wheat, suppose that Home is a large country. Continue to assume that the free-trade world price is $100 per ton and that the Home government provides the domestic producer with an export subsidy in the amount of $40 per ton. Because of the export subsidy, the local price increases to $120, while the foreign market price declines to $80 per ton. Use the following figure to answer these questions.
    a. Relative to the small-country case, why does the new domestic price increase by less than the amount of the subsidy?
    b. Calculate the effect of the export subsidy on consumer surplus, producer surplus, and government revenue.
    c. Calculate the overall net effect of the export subsidy on Home welfare. Is the large country better or worse off as compared to the small country with the export subsidy? Explain.



5. Refer to Problem 3. Suppose Home is a small exporter of wheat. At the world price of $100 per ton, Home growers export 20 tons. But rather than an export subsidy, suppose the Home government provides its domestic producer with a production subsidy of $40 per ton. Use the following figure to answer these questions.
    a. What is the quantity exported with the production subsidy?
    b. Calculate the effect of the production subsidy on consumer surplus, producer surplus, and government revenue.
    c. Calculate the overall net effect of the production subsidy on Home welfare. Is the cost of the production subsidy more or less than the cost of the export subsidy for the small country? Explain.



6. Explain why the WTO is more concerned with the use of direct export subsidies than production subsidies in achieving the same level of domestic support.
7. Boeing and Airbus are the world's only major producers of large wide-bodied aircrafts. But the increasing cost of fuel and the changing demand in the airline industry increases the need for smaller regional jets. Suppose that both firms must decide whether they will produce a smaller plane. We will assume that Boeing has a slight cost advantage over Airbus in both large and small planes, as shown in the payoff matrix that follows (in millions of U.S. dollars). Assume that each producer chooses to produce only large, only small, or no planes at all.
    a. What is the Nash equilibrium of this game?
    b. Are there multiple equilibria? If so, explain why. *Hint:* Guess at an equilibrium and then check whether either firm would want to change its action, given the action of the other firm. Remember that Boeing can change only its own action, which means moving up or down a column, and Airbus can change only its own action, which means moving back or forth on a row.

		Airbus		
		Large planes	Small planes	Not produce
Boeing	Large planes	−5 / 10	125 / 115	0 / 115
	Small planes	100 / 150	0 / 15	0 / 150
	Not produce	100 / 0	125 / 0	0 / 0

8. Refer to Problem 7. Now suppose the European government wants Airbus to be the sole producer in the lucrative small-aircraft market. Then answer the following:
    a. What is the minimum amount of subsidy that Airbus must receive when it produces small aircraft to ensure that outcome as the unique Nash equilibrium?
    b. Is it worthwhile for the European government to undertake this subsidy?
9. Here we examine the effects of domestic sales taxes on the market for exports, as an example of the "targeting principle." For example, in the domestic market, there are heavy taxes on the purchase of cigarettes. Meanwhile, the United States has several very large cigarette companies that export their products abroad.
    a. What is the effect of the sales tax on the quantity of cigarette exports from the United States? *Hint:* Your answer should parallel the case of production subsidies but for a consumption tax instead.
    b. How does the change in exports, if any, due to the sales tax compare with the effect of an export subsidy on cigarettes?
10. Refer to Problem 9. Based on your answer there, would foreign countries have a reason to object to the use of a sales tax on cigarettes by the United States? Based on your knowledge of the GATT/WTO provisions (see Side Bar: Key Provisions of the GATT in Chapter 8), are foreign countries entitled to object to the use of such a tax?
11. To improve national welfare, a large country would do better to implement an export subsidy rather than an import tariff. Is this true or false? Explain why.
12. Who gains and who loses when governments in Europe and the United States provide subsidies to Airbus and Boeing?
13. Provide reasons for countries to use export subsidies. Does your answer depend on whether firms compete under perfect or imperfect competition?

[1] In the United States, export tariffs are prohibited by Clause 5 of the U.S. Constitution.

[2] There are 17 rare earth minerals, consisting of the 15 lanthanides along with yttrium and scandium. Lanthanum, for example, is used in batteries and lighting, and neodymium is used in making permanent magnets, which are found in high-tech products ranging from smartphones to hybrid cars to wind turbines.

[3] Margaret McMillan, Alix Peterson Zwane, and Nava Ashraf, 2007, "My Policies or Yours: Have OECD Agricultural Policies Affected Incomes in Developing Countries?" In Ann Harrison, *Globalization and Poverty* [Chicago: University of Chicago Press and National Bureau of Economic Research (NBER)], pp. 183–232.

[4] More information on the Food for Peace program can be obtained at the USAID website: https://www.usaid.gov/foodaidreform.

[5] The six other minerals are coke, fluorspar, magnesium, manganese, silicon carbide, and silicon metal. The information in this paragraph and the next is drawn from Keith Bradsher, "In Victory for the West, W.T.O. Orders China to Stop Export Taxes on Minerals," *New York Times*, January 30, 2012, and "Rare Earth Trade Case Against China May Be Too Late," *New York Times*, March 13, 2012.

[6] See Kyle Wiens, "A Visit to the Only American Mine for Rare Earth Metals," *The Atlantic*, February 21, 2012, electronic edition.

[7] The numbers we are using in the payoff matrix are made up for convenience, but they illustrate the idea of competition between the firms for the sale of a new aircraft.

[8] The book and movie *A Beautiful Mind* describes the career of John Nash.

[9] Notice that if the initial equilibrium was one in which Airbus produced and Boeing did not, then the only effect of the subsidy would be to make this equilibrium unique; it would not change the decision of either firm. Moreover, the effect on total European welfare would be zero because the subsidy would be just a transfer from the European government to Airbus.

[10] See: "WTO Panel to Review EU-US Civil Aircraft Dispute," International Centre for Trade and Sustainable Development, *Bridges* 19(7), February 26, 2015, available at: http://www.ictsd.org/bridges-news/bridges/news/wto-panel-to-review-eu-us-civil-aircraft-dispute.