Trade Restrictions: Tariffs

chapter 8

LEARNING GOALS:

After reading this chapter, you should be able to:

- Describe the effect of a tariff on consumers and producers
- Identify the costs and benefits of a tariff on a small and a large nation
- Describe an optimum tariff and retaliation
- Understand the meaning and importance of tariff structure

8.1 Introduction

We have seen in Part One that free trade maximizes world output and benefits all nations. However, practically all nations impose some restrictions on the free flow of international trade. Since these restrictions and regulations deal with the nation's trade or commerce, they are generally known as trade or commercial policies. While trade restrictions are invariably rationalized in terms of national welfare, in reality they are usually advocated by those special groups in the nation that stand to benefit from such restrictions.

The most important type of trade restriction has historically been the tariff. A tariff is a tax or duty levied on the traded commodity as it crosses a national boundary. In this chapter we deal with tariffs, and in the next chapter we discuss other trade restrictions. An import tariff is a duty on the imported commodity, while an export tariff is a duty on the exported commodity. Import tariffs are more important than export tariffs, and most of our discussion will deal with import tariffs. Export tariffs are prohibited by the U.S. Constitution but are often applied by developing countries on their traditional exports (such as Ghana on its cocoa and Brazil on its coffee) to get better prices and raise revenues. Developing nations rely heavily on export tariffs to raise revenues because of their ease of collection. Conversely, industrial countries invariably impose tariffs or other trade restrictions to protect some (usually labor-intensive) industry, while using mostly income taxes to raise revenues.

Tariffs can be ad valorem, specific, or compound. The ad valorem tariff is expressed as a fixed *percentage* of the value of the traded commodity. The specific tariff is expressed as a fixed *sum* per physical unit of the traded commodity. Finally, a compound tariff is a combination of an ad valorem and a specific tariff. For example, a 10 percent ad valorem tariff on bicycles would result in the payment to customs officials of the sum of $10 on each $100 imported bicycle and the sum of $20 on each $200 imported bicycle. On the other hand, a specific tariff of $10 on imported bicycles means that customs officials collect the fixed sum of $10 on each imported bicycle regardless of its price. Finally, a compound duty of 5 percent ad valorem and a specific duty of $10 on imported bicycles would result in the collection by customs officials of the sum of $15 on each $100 bicycle and $20 on each $200 imported bicycle. The United States uses the ad valorem and the specific tariff with about equal frequency, whereas European countries rely mainly on the ad valorem tariff. Most of our presentation in this chapter will be in terms of ad valorem import tariffs.

Tariffs have been sharply reduced since the end of World War II and now average 3 percent on industrial products in developed nations (see Case Study 8-1), but they are much higher in developing nations (see Case Study 8-2). Trade in agricultural commodities is still subject to relatively high trade barriers. These are discussed in the next chapter.

CASE STUDY 8-1 Average Tariff on Nonagricultural Products in Major Developed Countries

Table 8.1 gives the average tariff imposed by the United States, the European Union, Japan, and Canada (i.e., by the leading developed countries and the European Union) on various nonagricultural products in 2010. The table shows that the highest tariff is invariably imposed on imports of clothing, textiles, and leather products (also on fish and fish products in the European Union and Japan, and on transport equipment in the European Union and Canada). But the average tariff level on all nonagricultural products is less than 4 percent. It is even less in some of the smaller developed countries.

TABLE 8.1. Tariffs on Nonagricultural Products in the United States, the European Union, Japan, and Canada in 2010 (Percentages)

	United States	European Union	Japan	Canada
Fish and fish products	1.0	10.5	5.5	0.9
Minerals and metals	1.7	2.0	1.0	1.0
Petroleum	1.4	2.0	0.6	0.5
Chemicals	2.8	4.6	2.2	1.0
Wood, paper, etc.	0.5	0.9	0.8	1.1
Textiles	7.9	6.6	5.5	4.3
Clothing	11.7	11.5	9.2	16.9
Leather, footwear, etc.	3.9	4.2	9.0	4.3
Nonelectric machinery	1.2	1.9	0.0	0.5
Electric machinery	1.7	2.8	0.2	1.1
Transport equipment	3.0	4.3	0.0	5.8
Other manufactures	2.4	2.7	1.2	2.9
Average	3.3	4.0	2.5	2.6

Source: World Trade Organization, *World Trade Report 2011, Part 2* (Geneva: WTO, 2011).

CASE STUDY 8-2 Average Tariffs on Nonagricultural Products in Some Major Developing Countries

Table 8.2 gives the tariff imposed by China, India, Russia, Brazil, Korea, and Mexico on various nonagricultural products in 2010. The table shows that the lowest average tariff (6.6 percent) is imposed by Korea, with the others having average tariffs between 7.7 (Mexico) and 14.2 (Brazil). All six countries, however, have much higher tariffs than developed countries.

TABLE 8.2. Tariffs on Nonagricultural Products in China, India, Russia, Brazil, Korea, and Mexico in 2010 (Percentages)

	China	India	Brazil	Russia	Korea	Mexico
Fish and fish products	10.9	29.8	10.0	12.2	16.1	16.6
Minerals and metals	7.4	7.5	10.1	10.0	4.6	3.8
Petroleum	4.8	3.8	0.2	5.0	4.1	0.1
Chemicals	6.6	7.9	8.3	6.4	5.7	2.6
Wood, paper, etc.	4.4	9.1	10.7	13.2	2.2	5.5
Textiles	9.6	14.7	23.2	11.0	9.1	13.9
Clothing	16.0	13.4	35.0	11.8	12.6	30.0
Leather, footwear, etc.	13.2	10.2	15.7	8.6	7.9	8.8
Nonelectric machinery	8.0	7.3	12.7	3.4	6.0	3.1
Electric machinery	8.3	7.2	14.1	7.4	6.2	4.0
Transport equipment	11.5	20.7	18.1	11.1	5.5	9.6
Other manufactures	11.9	8.9	15.3	11.3	6.7	5.7
Average	8.7	10.1	14.2	8.9	6.6	7.1

Source: World Trade Organization, *World Trade Report 2011*, Part 2 (Geneva: WTO, 2011).

In this chapter, we analyze the effects of a tariff on production, consumption, trade, and welfare in the nation imposing the tariff and on its trade partner(s). We will first do this with partial equilibrium analysis (i.e., by utilizing demand and supply curves) and then by the more complex general equilibrium analysis, which makes use of production possibility frontiers and community indifference curves, or offer curves.

In Section 8.2, we analyze the partial equilibrium effects of a tariff in a country that is too small to affect world prices by its trading. In Section 8.3, we examine the theory of tariff structure. We then shift to the more complex general equilibrium analysis and examine the effects of a tariff in a small nation in Section 8.4 and in a large nation in Section 8.5. Finally, in Section 8.6 we examine the concept of the optimum tariff. The appendix examines the partial equilibrium effects of a tariff in a large nation and derives the formula for the rate of effective protection. It then analyzes graphically the Stolper–Samuelson theorem and its exception, examines the short-run effect of a tariff on factors' income, and shows the measurement of the optimum tariff.

8.2 Partial Equilibrium Analysis of a Tariff

The partial equilibrium analysis of a tariff is most appropriate when a small nation imposes a tariff on imports competing with the output of a small domestic industry. Then the tariff will affect neither world prices (because the nation is small) nor the rest of the economy (because the industry is small).

8.2A Partial Equilibrium Effects of a Tariff

The partial equilibrium effects of a tariff can be analyzed with Figure 8.1, in which D_X is the demand curve and S_X is the supply curve of commodity X in Nation 2. The same type of analysis for Nation 1 is left as an end-of-chapter problem. Nation 2 is now assumed to be small and so is industry X. In the absence of trade, the intersection of D_X and S_X defines equilibrium point E, at which 30X is demanded and supplied at $P_X = \$3$ in Nation 2. With free trade at the world price of $P_X = \$1$, Nation 2 will consume 70X (AB), of which 10X (AC) is produced domestically and the remainder of 60X (CB) is imported (as in the right panel of Figure 3.4). The horizontal dashed line S_F represents the infinitely elastic free trade foreign supply curve of commodity X to Nation 2.

If Nation 2 now imposes a 100 percent ad valorem tariff on the imports of commodity X, P_X in Nation 2 will rise to \$2. At $P_X = \$2$, Nation 2 will consume 50X (GH), of which 20X (GJ) is produced domestically and the remainder of 30X (JH) is imported. The horizontal dashed line $S_F + T$ represents the new tariff-inclusive foreign supply curve of commodity X to Nation 2. Thus, the consumption effect of a tariff (i.e., the reduction in domestic consumption) equals 20X (BN); the production effect (i.e., the expansion of domestic production resulting from the tariff) equals 10X (CM); the trade effect (i.e., the decline in imports) equals 30X ($BN + CM$); and the revenue effect (i.e., the revenue collected by the government) equals \$30 (\$1 on each of the 30X imported, or $MJHN$).

Note that for the same \$1 increase in P_X in Nation 2 as a result of the tariff, the more elastic and flatter D_X is, the greater is the consumption effect (see the figure). Similarly, the more elastic S_X is, the greater is the production effect. Thus, the more elastic D_X and S_X are in Nation 2, the greater is the trade effect of the tariff (i.e., the greater is the reduction in Nation 2's imports of commodity X) and the smaller is the revenue effect of the tariff.

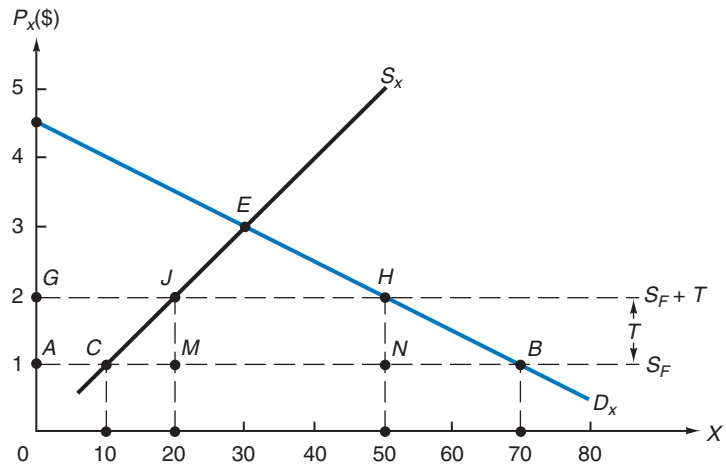

FIGURE 8.1. Partial Equilibrium Effects of a Tariff.
D_X and S_X represent Nation 2's demand and supply curves of commodity X. At the free trade price of $P_X = \$1$, Nation 2 consumes 70X (AB), of which 10X (AC) is produced domestically and 60X (CB) is imported. With a 100 percent import tariff on commodity X, P_X rises to \$2 for individuals in Nation 2. At $P_X = \$2$, Nation 2 consumes 50X (GH), of which 20X (GJ) is produced domestically and 30X (JH) is imported. Thus, the consumption effect of the tariff is (–) 20X (BN); the production effect is 10X (CM); the trade effect equals (–) 30X ($BN + CM$); and the revenue effect is \$30 ($MJHN$).

8.2B Effect of a Tariff on Consumer and Producer Surplus

The increase in the price of commodity X from $P_X = \$1$ to $P_X = \$2$ as a result of the 100 percent tariff that Nation 2 imposes on the importation of commodity X leads to a *reduction in consumer surplus and an increase in producer surplus*. These are examined in Figure 8.2 and used in Section 8.2C to measure the costs and benefits of the tariff.

The left panel of Figure 8.2 shows that the loss of consumer surplus that results from the tariff is equal to shaded area $AGHB = \$60$. The reason for this is as follows. Before the imposition of the tariff, consumers in Nation 2 consume 70X at $P_X = \$1$. Consumers pay for each unit as much as they are willing to pay for the last, or 70th, unit of commodity X (given by point B on D_X). Consumers, however, receive more satisfaction and would therefore be willing to pay higher prices for earlier units of commodity X that they purchase. In fact, the height of the demand curve shows the maximum price that consumers would be *willing* to pay for each unit of the commodity rather than go without it. The difference between what consumers would be willing to pay for each unit of the commodity (indicated by the height of D_X at that point) and what they actually pay for that unit (the same as for the last unit that they purchase) is called consumer surplus. Thus, consumer surplus is the difference between what consumers would be willing to pay for each unit of the commodity and what they actually pay. Graphically, consumer surplus is measured by the area under the demand curve above the going price.

For example, the left panel of Figure 8.2 shows that consumers in Nation 2 would be willing to pay $LE = \$3$ for the 30th unit of commodity X. Since they only pay \$1, they receive a consumer surplus of $KE = \$2$ on the 30th unit of commodity X that they purchase. Similarly, for the 50th unit of commodity X, consumers would be willing to pay $ZH = \$2$. Since they only pay $ZN = \$1$, they receive a consumer surplus of $NH = \$1$ on the 50th unit of X. For the 70th unit of commodity X, consumers would be willing to pay $WB = \$1$. Since this is equal to the price that they actually pay, the consumer surplus for the 70th unit of X is zero. With the total of 70X being purchased at $P_X = \$1$ in the absence of the import tariff, the total consumer surplus in Nation 2 is equal to $ARB = \$122.50$ (\$3.50 times 70 divided by 2). This is the difference between what consumers would have been willing to pay ($ORBW = \$192.50$) and what they actually pay for 70X ($OABW = \$70$).

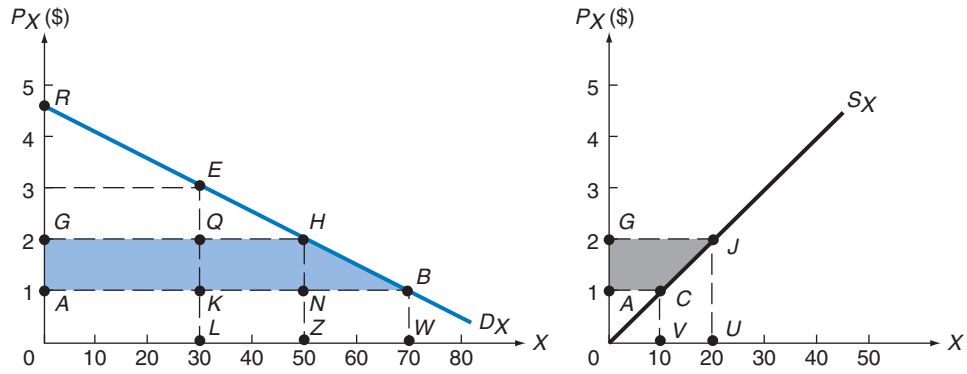

FIGURE 8.2. Effect of Tariff on Consumer and Producer Surplus.
The left panel shows that a tariff that increases the price of commodity X from $P_X = \$1$ to $P_X = \$2$ results in a reduction in consumer surplus from $ARB = \$122.50$ to $GRH = \$62.50$, or by shaded area $AGHB = \$60$. The right panel shows that the tariff increases producer surplus by shaded area $AGJC = \$15$.

When Nation 2 imposes a 100 percent import tariff, the price of commodity X rises from $P_X = \$1$ to $P_X = \$2$ and purchases of commodity X fall from 70X to 50X. With the tariff, consumers pay $OGHZ = \$100$ for 50X. The consumer surplus thus shrinks from $ARB = \$122.50$ (with $P_X = \$1$ before the tariff) to $GRH = \$62.50$ (when $P_X = \$2$ with the tariff), or by $AGHB = \$60$ (the shaded area in the left panel of Figure 8.2). The imposition of the 100 percent import tariff by Nation 2 thus leads to a reduction in consumer surplus.

In the right panel of Figure 8.2, the increase in rent or producer surplus that results from the tariff is given by shaded area $AGJC = \$15$. The reason for this is as follows. At free trade $P_X = \$1$, domestic producers produce 10X and receive $OACV = \$10$ in revenues. With the tariff and $P_X = \$2$, they produce 20X and receive $OGJU = \$40$. Of the \$30 increase ($AGJC + VCJU$) in the revenue of producers, $VCJU = \$15$ (the unshaded area under the S_X curve between 10X and 20X) represents the increase in their costs of production, while the remainder (shaded area $AGJC = \$15$) represents the increase in rent or producer surplus. This is defined as a payment that need not be made in the long run in order to induce domestic producers to supply the additional 10X with the tariff. The increase in rent or producer surplus resulting from the tariff is sometimes referred to as the subsidy effect of the tariff.

8.2c Costs and Benefits of a Tariff

The concept and measure of consumer and producer surplus can now be used to measure the costs and benefits of the tariff. These are shown in Figure 8.3, which summarizes and extends the information provided by Figures 8.1 and 8.2.

Figure 8.3 shows that when Nation 2 imposes a 100 percent import tariff, the price of commodity X increases from $P_X = \$1$ to $P_X = \$2$, consumption falls from $AB = 70X$ to

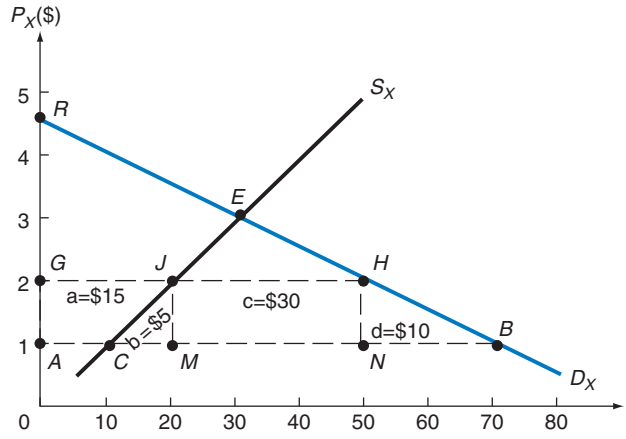

FIGURE 8.3. Partial Equilibrium Costs and Benefits of a Tariff.
The figure shows that with a 100 percent import tariff on commodity X, P_X rises from \$1 to \$2 in Nation 2. This reduces the consumer surplus by $AGHB = a + b + c + d = \$15 + \$5 + \$30 + \$10 = \$60$. Of this, $MJHN = c = \$30$ is collected by the government as tariff revenue, $AGJC = a = \$15$ is redistributed to domestic producers of commodity X in the form of increased rent or producer surplus, while the remaining \$15 (the sum of the areas of triangles $CJM = b = \$5$ and $BHN = d = \$10$) represents the protection cost, or deadweight loss, to the economy.

$GH = 50X$, production increases from $AC = 10X$ to $GJ = 20X$, imports decline from $CB = 60X$ to $JH = 30X$, and the government of Nation 2 collects $MJHN = \$30$ in import duties (as in Figure 8.1). Furthermore, consumer surplus declines by $AGHB = \$60$ (as in the left panel of Figure 8.2), and producer surplus increases by $AGJC = \$15$ (as in the right panel of Figure 8.2).

Figure 8.3 shows that of the reduction of the consumer surplus of $AGHB = a + b + c + d = \$60$, $MJHN = c = \$30$ is collected by the government as tariff revenue, $AGJC = a = \$15$ is redistributed to domestic producers of commodity X in the form of increased producer surplus or rent, while the remaining \$15 (the sum of the areas of triangles $CJM = b = \$5$ and $BHN = d = \$10$) represents the protection cost, or deadweight loss, to the economy.

The production component ($CJM = b = \$5$) of the protection cost, or deadweight loss, arises because, with the tariff, some domestic resources are transferred from the more efficient production of exportable commodity Y to the less efficient production of importable commodity X in Nation 2. The consumption component ($BHN = d = \$10$) of the protection cost, or deadweight loss, arises because the tariff artificially increases P_X in relation to P_Y and distorts the pattern of consumption in Nation 2.

Thus, the tariff redistributes income from domestic consumers (who pay a higher price for the commodity) to domestic producers of the commodity (who receive the higher price) and from the nation's abundant factor (producing exportables) to the nation's scarce factor (producing importables). This leads to inefficiencies, referred to as the protection cost, or deadweight loss, of the tariff. By dividing the loss of consumer surplus by the number of jobs "saved" in the industry because of the tariff (or equivalent rate of protection), we can calculate the cost per domestic job saved (see Case Studies 8-3 and 8-4). (A tariff also has

CASE STUDY 8-3 The Welfare Effect of Liberalizing Trade on Some U.S. Products

Table 8.3 shows the welfare effect of removing trade protection (the tariff or its equivalent, as a percentage of the world price of the product) in 1990 on some specific products on which U.S. protection remained high (despite very low overall average tariff rates). The consumer cost refers to the reduction in consumer surplus resulting from the tariff ($AGHB = a + b + c + d$ in Figure 8.3). The tariff revenue is the revenue collected from the tariff by the U.S. government ($MJHN = c$ in Figure 8.3). Producer gain refers to the increase in the producer surplus resulting from the tariff ($AGJC = a$ in Figure 8.3). The deadweight loss is the protection cost of the tariff ($CJM + BHN$ in Figure 8.3). The table also shows the cost per domestic job "saved" by the tariff. This is obtained by dividing the consumer cost (i.e., reduction in consumer surplus) of the tariff by the number of domestic jobs saved as a result of the tariff.

For example, Table 8.3 shows that the tariff of 20 percent that the United States imposed on imports of rubber footwear (the third line from the bottom in Table 8.3) resulted in a \$208 million cost to U.S. consumers, \$141 million in tariff revenues collected by the U.S. government, \$55 million in producer gain, and \$12 million of deadweight loss. The table also shows that the cost of each job saved in the production of rubber footwear in the United States (as compared with the free trade situation) was about \$122,000 (\$208 million divided by the 1,705 jobs saved). Note the high cost of tariff protection to U.S. consumers even for relatively unimportant products and the very high cost of preserving each job in U.S. import-competing industries.

(continued)

CASE STUDY 8-3 Continued

TABLE 8.3. Economic Effect of U.S. Import Tariffs on Selected Products

Product	Tariff (%)	Consumer Cost (million $)	Tariff Revenue (million $)	Producer Gain (million $)	Dead-weight Cost (million $)	Consumer Costs per Job (thousand $)
Ceramic tiles	19.0	139	92	45	2	401
Costume jewelry	9.0	103	51	46	5	97
Frozen concentrated orange juice	30.0	281	145	101	35	57
Glassware	11.0	266	95	162	9	180
Luggage	16.5	211	169	16	26	934
Rubber footwear	20.0	208	141	55	12	122
Women's footwear	10.0	376	295	70	11	102
Women's handbags	13.5	148	119	16	13	191

Source: G. C. Hufbauer and K. A. Elliott, *Measuring the Cost of Protection in the United States* (Washington, D.C.: Institute for International Economics, 1994), pp. 8–13.

CASE STUDY 8-4 The Welfare Effect of Liberalizing Trade on Some EU Products

Table 8.4 shows the welfare effect of removing trade protection (the tariff or its equivalent, as a percentage of the world price of the product) in 1990 on some specific products on which EU protection remained high (despite very low overall average tariff rates). The interpretation of the table is identical to the U.S. case. The only difference is that benefits and costs are here measured in euros (€), the new currency of 12 of the 15 members of the European Union in 1990 (this is discussed in the finance part of the text). Since at the time of this writing, the value of €1 was approximately $1.30, the equivalent dollar values would be about 30 percent higher than the euro values shown in Table 8.4.

For example, Table 8.4 shows that the tariff (or its equivalent) of 22.9 percent that the European Union imposed on imports of chemical fibers (the first line in Table 8.4) resulted in a €580 (about $754) million cost to EU consumers, €362 ($471) million in tariff revenues collected by the EU governments, €139 ($181) million in producer gain, and €79 ($103) million of deadweight loss. The table also shows that the cost of each job saved in the production of chemical fibers in the European Union (as compared with the free trade situation) was about €526,000 or about $683,800 (€580 million divided by the 1,103 jobs saved). Note the high cost of tariff protection to EU consumers even for relatively unimportant products and the very high cost of preserving each job in EU import-competing industries.

(continued)

■ CASE STUDY 8-4 Continued

■ TABLE 8.4. Economic Effect of EU Protection on Selected Products

Product	Tariff Equivalent (%)	Consumer Cost (million €)	Tariff Revenue (million €)	Producer Gain (million €)	Dead-weight Cost (million €)	Consumer Costs per Job (thousand €)
Chemical fibers	22.9	580	362	139	79	526
Videocassettes	30.2	313	165	82	67	420
Integrated circuits	47.6	2,187	548	139	564	366
Photocopiers	33.7	314	242	5	66	3,483
Steel	21.9	1,626	229	397	333	316
Passenger cars	17.1	2,101	979	278	276	569
Textiles	21.4	7,096	1,742	2,678	668	180
Clothing	31.3	7,103	1,696	1,712	1,079	214

Source: P. A. Messerlin, *Measuring the Cost of Protection in Europe* (Washington, D.C.: Institute for International Economics, 2001), pp. 46–47, 54–55.

a balance-of-payments effect, but this is discussed in Section 18.6, after we have examined the concept and measurement of the balance of payments.)

The above are the partial equilibrium effects of a tariff in a small nation (i.e., a nation that does not affect commodity prices by its trading). The partial equilibrium effects of a tariff imposed by a large nation are more complex to analyze and are presented for the more advanced student in Section A8.1 of the appendix.

8.3 The Theory of Tariff Structure

So far, we have discussed the nominal tariff on imports of a final commodity. We now extend the partial equilibrium analysis of the previous section to define, measure, and examine the importance of the rate of effective protection. This is a relatively new concept developed only since the 1960s but widely used today.

8.3A The Rate of Effective Protection

Very often, a nation imports a raw material duty free or imposes a lower tariff rate on the importation of the input than on the importation of the final commodity produced with the imported input. The nation usually does this in order to encourage domestic processing and employment. For example, a nation may import wool duty free but impose a tariff on the importation of cloth in order to stimulate the domestic production of cloth and domestic employment.

When this is the case, the rate of effective protection (calculated on the domestic value added, or processing, that takes place in the nation) exceeds the nominal tariff rate (calculated

on the value of the final commodity). Domestic value added equals the price of the final commodity minus the cost of the imported inputs going into the production of the commodity. While the nominal tariff rate is important to consumers (because it indicates by how much the price of the final commodity increases as a result of the tariff), the effective tariff rate is important to producers because it indicates how much protection is actually provided to the domestic processing of the import-competing commodity. An example will clarify the distinction between the nominal and effective tariff rates.

Suppose that \$80 of imported wool goes into the domestic production of a suit. Suppose also that the free trade price of the suit is \$100 but the nation imposes a 10 percent nominal tariff on each imported suit. The price of suits to domestic consumers would then be \$110. Of this, \$80 represents imported wool, \$20 is domestic value added, and \$10 is the tariff. The \$10 tariff collected on each imported suit represents a 10 percent nominal tariff rate since the nominal tariff is calculated on the price of the final commodity (i.e., \$10/\$100 = 10 percent) but corresponds to a 50 percent effective tariff rate because the effective tariff is calculated on the value added domestically to the suit (i.e., \$10/\$20 = 50 percent).

While consumers are only concerned with the fact that the \$10 tariff increases the price of the suits they purchase by \$10 or 10 percent, producers view this \$10 tariff as being 50 percent of the \$20 portion of the suit produced domestically. To them, the \$10 tariff provides 50 percent of the value of domestic processing. This represents a much greater degree of protection (five times more) than the 10 percent nominal tariff rate seems to indicate. It is this effective rate of tariff protection that is important to producers in stimulating the domestic production of suits in competition with imported suits. Whenever the imported input is admitted duty free or a lower tariff rate is imposed on the imported input than on the final commodity produced with the imported input, the effective rate of protection will exceed the nominal tariff rate.

The rate of effective protection is usually calculated by the following formula (derived in the appendix):

$$g = \frac{t - a_i t_i}{1 - a_i} \tag{8-1}$$

where g = the rate of effective protection to producers of the final commodity
t = the nominal tariff rate on consumers of the final commodity
a_i = the ratio of the cost of the imported input to the price of the final commodity in the absence of tariffs
t_i = the nominal tariff rate on the imported input

In the preceding suit example, t = 10 percent or 0.1, a_i = \$80/\$100 = 0.8, and t_i = 0. Thus,

$$g = \frac{0.1 - (0.8)(0)}{1.0 - 0.8} = \frac{0.1 - 0}{0.2} = \frac{0.1}{0.2} = 0.5 \text{ or } 50\% \text{ (as found above)}$$

If a 5 percent nominal tariff is imposed on the imported input (i.e., with t_i = 0.05), then

$$g = \frac{0.1 - (0.8)(0.05)}{1.0 - 0.8} = \frac{0.1 - 0.04}{0.2} = \frac{0.06}{0.2} = 0.3 \text{ or } 30\%$$

If $t_i = 10$ percent instead,

$$g = \frac{0.1 - (0.8)(0.1)}{1.0 - 0.8} = \frac{0.1 - 0.08}{0.2} = \frac{0.02}{0.2} = 0.1 \text{ or } 10\% \text{ (and equals } t)$$

With $t_i = 20$ percent,

$$g = \frac{0.1 - (0.8)(0.2)}{1.0 - 0.8} = \frac{0.1 - 0.16}{0.2} = \frac{-0.06}{0.2} = -0.3 \text{ or } -30\%$$

8.3B Generalization and Evaluation of the Theory of Effective Protection

From examining Equation (8-1) and the results obtained with it, we can reach the following important conclusions on the relationship between the rate of effective protection *(g)* and the nominal tariff rate *(t)* on the final commodity:

1. If $a_i = 0$, $g = t$.
2. For given values of a_i and t_i, g is larger the greater is the value of t.
3. For given values of t and t_i, g is larger the greater is the value of a_i.
4. The value of g exceeds, is equal to, or is smaller than t, as t_i is smaller than, equal to, or larger than t (see the first three examples above).
5. When $a_i t_i$ exceeds t, the rate of effective protection is negative (see the last example above).

Note that a tariff on imported inputs is a tax on domestic producers that increases their costs of production, reduces the rate of effective protection provided by a given nominal tariff on the final commodity, and therefore discourages domestic production. In some cases (see conclusion 5 above), even with a positive nominal tariff on the final commodity, less of the commodity is produced domestically than would be under free trade.

Clearly, the nominal tariff rate can be very deceptive and does not give even a rough idea of the degree of protection actually provided to domestic producers of the import-competing product. Furthermore, most industrial nations have a "cascading" tariff structure with very low or zero nominal tariffs on raw materials and higher and higher rates the greater is the degree of processing (see Case Study 8-5). This "tariff escalation" makes the rate of effective protection on a final commodity with imported inputs much greater than the nominal tariff rate would indicate. Case Study 8-6 shows that the highest rates in developed nations are often found on simple labor-intensive commodities, such as textiles, in which developing nations have a comparative advantage and, as such, are of crucial importance to their development. (These questions will be analyzed in detail in Chapter 11).

The concept of effective protection must be used cautiously, however, because of its partial equilibrium nature. Specifically, the theory assumes that the international prices of the commodity and of imported inputs are not affected by tariffs and that inputs are used in fixed proportions in production. Both assumptions are of doubtful validity. For example, when the price of an imported input rises for domestic producers as a result of an import

CASE STUDY 8-5 Rising Tariff Rates with Degree of Domestic Processing

Figure 8.4 shows that industrial countries imposed an average import tariff of about 2.1 percent on raw materials, 5.3 percent on semimanufactures, and 9.1 percent on finished products before the completion of the Uruguay Round in 1993. Although average tariff rates on imports at all stages of processing have fallen during the past decade as a result of the implementation of the Uruguay Round, the figure shows that the cascading tariff structure or the tariff escalation with the stage of processing remains. Thus, the effective rate of protection exceeds the nominal tariff rate by larger percentages, the greater the degree of domestic processing.

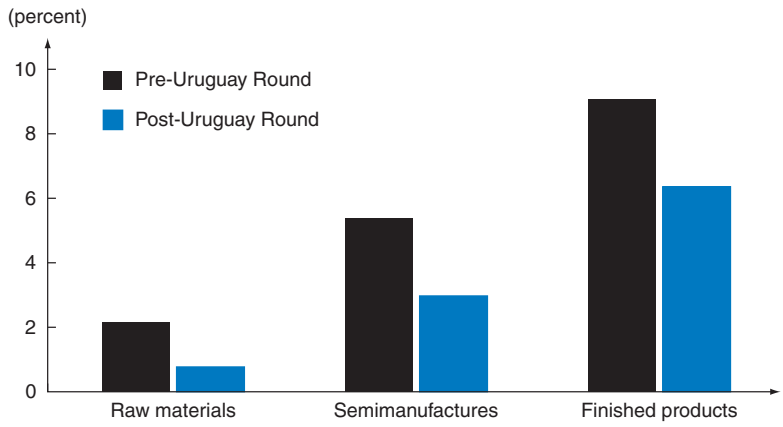

FIGURE 8.4. Pre- and Post-Uruguay Round Cascading Tariff Structure in Industrial Countries.
Source: W. Martin and L. A. Winters, *The Uruguay Round* (Washington, D.C.: World Bank, 1995), p. 11.

CASE STUDY 8-6 Structure of Tariffs on Industrial Products in the United States, the European Union, Japan, and Canada

Table 8.5 gives the post-Uruguay Round tariff levels on imports of raw materials, semimanufactures, and finished products in the United States, the European Union, Japan, and Canada. Transport equipment, nonelectrical machinery, electrical machinery, and other manufactured goods have the single tariff levels indicated in Table 8.1 (independently of the stage of processing), and so they are not included in Table 8.5. The table shows the cascading tariff structure on many industrial products imported in the leading developed countries. The increase in the tariff with the stage of processing is greatest on imports of textiles and clothing, leather, rubber, and travel goods. It is also prevalent in metals, fish, and fish products (except for Japan), and in mineral products (except for Canada). For chemicals, wood, pulp, paper, and furniture, the situation is mixed. The tariff structure in other developed countries is similar.

(continued)

CASE STUDY 8-6 Continued

TABLE 8.5. Cascading Tariff Structure on Imports of Industrial Products in the United States, European Union, Japan, and Canada in 2000 (percentages)

	United States			European Union		
Product	Raw Materials	Semi-manu-factures	Finished Products	Raw Materials	Semi-manu-factures	Finished Products
Wood, pulp, paper, and furniture	0.0	0.7	0.7	0.0	1.0	0.5
Textiles and clothing	2.8	9.1	9.1	2.6	6.6	9.7
Leather, rubber, and travel goods	0.0	2.3	11.7	0.1	2.4	7.0
Metals	0.8	1.1	2.9	0.0	1.2	2.8
Chemicals and photo supplies	0.0	4.1	2.3	0.0	5.2	3.4
Mineral products	0.6	1.3	5.3	0.0	2.4	3.7
Fish and fish products	0.7	1.7	4.0	11.2	13.3	14.1

	Japan			Canada		
Product	Raw Materials	Semi-manu-factures	Finished Products	Raw Materials	Semi-manu-factures	Finished Products
Wood, pulp, paper, and furniture	0.1	1.9	0.6	0.2	0.9	1.9
Textiles and clothing	2.6	5.9	8.3	2.5	11.1	14.5
Leather, rubber, and travel goods	0.1	10.4	20.7	0.3	5.7	10.3
Metals	0.0	1.0	0.9	0.1	1.7	5.2
Chemicals and photo supplies	0.0	2.9	1.0	0.0	4.7	3.9
Mineral products	0.2	0.5	1.8	2.7	1.0	4.4
Fish and fish products	5.2	10.4	7.9	0.6	0.3	4.6

Source: World Trade Organization, *Market Access: Unfinished Business* (Geneva: WTO, 2001), pp. 36–39.

tariff, they are likely to substitute cheaper domestic or imported inputs in production. Despite these shortcomings, the rate of effective protection is definitely superior to the nominal tariff rate in estimating the degree of protection actually granted to domestic producers of the import-competing product and played a crucial role during the Uruguay Round trade negotiations (discussed in Section 9.6B).

Equation (8-1) can easily be extended to the case of more than one imported input subject to different nominal tariffs. This is done by using the sum of $a_i t_i$ for each imported input in the numerator and the sum of a_i for each imported input in the denominator of the formula. (It is this more general formula that is actually derived in the appendix; the case of a single imported input is a simpler special case.)

8.4 General Equilibrium Analysis of a Tariff in a Small Country

In this section, we use general equilibrium analysis to study the effects of a tariff on production, consumption, trade, and welfare when the nation is too small to affect world prices by its trading. In the next section, we relax this assumption and deal with the more realistic and complex case where the nation is large enough to affect world prices by its trading.

8.4A General Equilibrium Effects of a Tariff in a Small Country

When a very small nation imposes a tariff, it will not affect prices on the world market. However, the domestic price of the importable commodity will rise by the full amount of the tariff for individual producers and consumers in the small nation.

Although the price of the importable commodity rises by the full amount of the tariff for *individual* producers and consumers in the small nation, its price remains constant for the *small nation as a whole* since the nation itself collects the tariff. For example, if the international price of importable commodity X is $1 per unit and the nation imposes a 100 percent ad valorem tariff on imports of commodity X, domestic producers can compete with imports as long as they can produce and sell commodity X at a price no higher than $2. Consumers will have to pay $2 per unit of commodity X, whether imported or domestically produced. (We assume throughout that the imported commodity and the domestically produced commodity are identical.) However, since the nation itself collects the $1 tariff on each unit of commodity X imported, the price of commodity X remains $1 as far as the nation as a whole is concerned.

The divergency between the price of the importable commodity for individual producers and consumers (which includes the tariff) and the price for the nation as a whole (which excludes the tariff and remains the same as the world price) is crucial for the graphical analysis in Section 8.4B. We further assume that the government of the small tariff-imposing nation uses the tariff revenue to subsidize public consumption (such as schools, police, etc.) and/or for general income tax relief. That is, the government of the small nation will need to collect less taxes internally to provide basic services by using the tariff revenue.

8.4B Illustration of the Effects of a Tariff in a Small Country

We will illustrate the general equilibrium effects of a tariff by continuing to utilize our familiar Nation 1 and Nation 2 from previous chapters. We start by using Nation 2's production frontier because it is somewhat more convenient for the type of analysis that we need to perform now. The same analysis for Nation 1 is left as an end-of-chapter problem. The only conclusion that we need to remember from previous chapters is that Nation 2 is the capital-abundant nation specializing in the production of commodity Y (the capital-intensive commodity), which it exports in exchange for imports of commodity X.

From Figure 8.5, we see that if $P_X/P_Y = 1$ on the world market and Nation 2 is too small to affect world prices, it produces at point B, exchanges 60Y for 60X with the rest

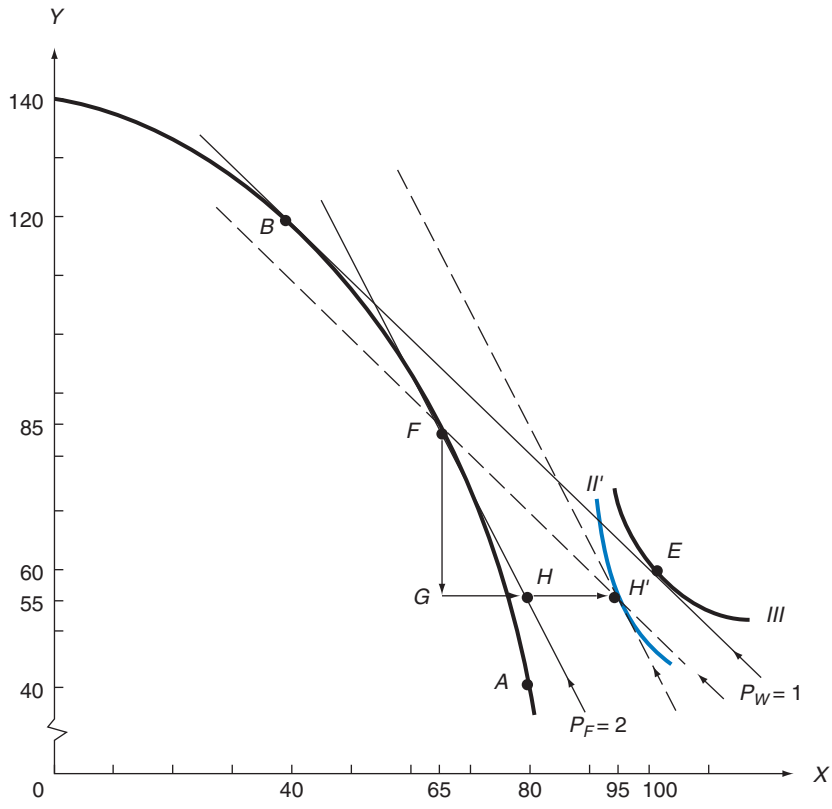

FIGURE 8.5. General Equilibrium Effects of a Tariff in a Small Country.
At $P_X/P_Y = 1$ on the world market, the small nation produces at point B and consumes at point E (as in the right panel of Figure 3.4). With a 100 percent ad valorem tariff on imports of commodity X, $P_X/P_Y = 2$ for individuals in the nation, production takes place at point F, and the nation exports 30Y (FG) for 30X, of which 15X (HH') is collected by the government as a tariff. Since we assume that the government redistributes the tariff revenue in full to its citizens, consumption with the tariff takes place on indifference curve II′ at point H', where the two dashed lines cross. Thus, free trade consumption and welfare (point E) are superior to consumption and welfare with the tariff (point H').

of the world, and consumes at point E on its indifference curve III with free trade. (For convenience, we now omit the prime that we attached to all letters on the graphs for Nation 2 in previous chapters.)

If the nation now imposes a 100 percent ad valorem tariff on imports of commodity X, the relative price of X rises to $P_X/P_Y = 2$ for domestic producers and consumers but remains at $P_X/P_Y = 1$ on the world market and for the nation as a whole (since the nation itself collects the tariff). Facing $P_X/P_Y = 2$, domestic producers will produce at point F, where price line $P_F = 2$ is tangent to the nation's production frontier. Thus, the nation produces more of importable commodity X and less of exportable commodity Y after imposition of the tariff than under free trade (compare point F to point B). The figure also shows that for exports of FG, or 30Y, the nation demands imports of GH', or 30X, of which GH, or 15X, goes directly to the nation's consumers and HH' (i.e., the remaining 15X) is collected in kind by the government in the form of the 100 percent import tariff on commodity X.

Note that indifference curve II′ is tangent to the dashed line parallel to $P_F = 2$ because individual consumers in the nation face the tariff-inclusive price of $P_X/P_Y = 2$. However, since the government collects and *redistributes* the tariff in the form of public consumption and/or tax relief, indifference curve II′ must also be on the dashed line parallel to $P_W = 1$ (since the nation as a whole still faces the world price of $P_X/P_Y = 1$). Thus, the new consumption point H' is defined by the intersection of the two dashed lines (and therefore is on both). The angle between the two dashed lines (which is equal to the angle between price lines $P_W = 1$ and $P_F = 2$) is equal to the tariff *rate* of 100 percent. With production at point F and consumption at point H', the nation exports 30Y for 30X after imposition of the tariff (as opposed to 60Y for 60X before imposition of the tariff).

To summarize, the nation produces at point B with free trade and exports 60Y for 60X at $P_W = 1$. With the 100 percent import tariff on commodity X, $P_X/P_Y = 2$ for individual producers and consumers in the nation but remains at $P_W = 1$ on the world market and for the nation as a whole. Production then takes place at point F; thus, more of importable commodity X is produced in the nation with the tariff than under free trade. 30Y is exchanged for 30X, of which 15X is collected in kind by the government of the nation in the form of a 100 percent import tariff on commodity X. Consumption takes place at point H' on indifference curve II′ after imposition of the tariff. This is below the free trade consumption point E on indifference curve III because, with the tariff, specialization in production is less and so are the gains from trade.

With a 300 percent import tariff on commodity X, $P_X/P_Y = 4$ for domestic producers and consumers, and the nation would return to its autarky point A in production and consumption (see Figure 8.5). Such an import tariff is called a prohibitive tariff. The 300 percent import tariff on commodity X is the *minimum ad valorem rate* that would make the tariff prohibitive in this case. Higher tariffs remain prohibitive, and the nation would continue to produce and consume at point A.

8.4c The Stolper–Samuelson Theorem

The Stolper–Samuelson theorem postulates that an increase in the relative price of a commodity (for example, as a result of a tariff) raises the return or earnings of the factor used intensively in the production of the commodity. Thus, the real return to the nation's scarce factor of production will rise with the imposition of a tariff. For example, when

Nation 2 (the K-abundant nation) imposes an import tariff on commodity X (its L-intensive commodity), P_X/P_Y rises for domestic producers and consumers, and so will the real wage of labor (Nation 2's scarce factor).

The reason for this is that as P_X/P_Y rises as a result of the import tariff on commodity X, Nation 2 will produce more of commodity X and less of commodity Y (compare point F with point B in Figure 8.5). The expansion in the production of commodity X (the L-intensive commodity) requires L/K in a higher proportion than is released by reducing the output of commodity Y (the K-intensive commodity). As a result, w/r rises and K is substituted for L so that K/L rises in the production of both commodities. (This is shown graphically in Section A8.3 in the appendix.) As each unit of L is now combined with more K, the productivity of L rises, and therefore, w rises. Thus, imposition of an import tariff on commodity X by Nation 2 increases P_X/P_Y in the nation and increases the earnings of L (the nation's scarce factor of production).

Since the productivity of labor increases in the production of both commodities, not only the money wage but also the real wage rises in Nation 2. With labor fully employed before and after imposition of the tariff, this also means that the total earnings of labor and its share of the national income are now greater. Since national income is reduced by the tariff (compare point H' to point E in Figure 8.5), and the share of total income going to L is higher, the interest rate and the total earnings of K fall in Nation 2. Thus, while the small nation as a whole is harmed by the tariff, its scarce factor benefits at the expense of its abundant factor (refer to Section 5.5C).

For example, when a small industrial and K-abundant nation, such as Switzerland, imposes a tariff on the imports of an L-intensive commodity, w rises. That is why labor unions in industrial nations generally favor import tariffs. However, the reduction in the earnings of the owners of capital exceeds the gains of labor so that the nation as a whole loses. The Stolper–Samuelson theorem is always true for small nations and is usually true for large nations as well. However, for large nations the analysis is further complicated by the fact that they affect world prices by their trading.

8.5 General Equilibrium Analysis of a Tariff in a Large Country

In this section, we extend our general equilibrium analysis of the production, consumption, trade, and welfare effects of a tariff to the case of a nation large enough to affect international prices by its trading.

8.5A General Equilibrium Effects of a Tariff in a Large Country

To analyze the general equilibrium effects of a tariff in a large nation, it is more convenient to utilize offer curves. When a nation imposes a tariff, its offer curve shifts or rotates toward the axis measuring its importable commodity by the amount of the import tariff. The reason is that for any amount of the export commodity, importers now want sufficiently more of the import commodity to also cover (i.e., pay for) the tariff. The fact that the nation is large is reflected in the trade partner's (or rest of the world's) offer curve having some curvature rather than being a straight line.

Under these circumstances, imposition of a tariff by a large nation reduces the volume of trade but improves the nation's terms of trade. The reduction in the volume of trade, by itself, tends to reduce the nation's welfare, while the improvement in its terms of trade tends to increase the nation's welfare. Whether the nation's welfare actually rises or falls depends on the net effect of these two opposing forces. This is to be contrasted to the case of a small country imposing a tariff, where the volume of trade declines but the terms of trade remain unchanged so that the small nation's welfare always declines.

8.5B Illustration of the Effects of a Tariff in a Large Country

The imposition by Nation 2 of a 100 percent ad valorem tariff on its imports of commodity X is reflected in Nation 2's offer curve rotating to offer curve 2′ in Figure 8.6. Note that tariff-distorted offer curve 2′ is at every point 100 percent or twice as distant from the Y-axis as offer curve 2. (Compare, for example, point H' to point H and point E' to point D in the figure.)

Before imposition of the tariff, the intersection of offer curve 2 and offer curve 1 defined equilibrium point E, at which Nation 2 exchanged 60Y for 60X at $P_X/P_Y = P_W = 1$. After imposition of the tariff, the intersection of offer curve 2′ and offer curve 1 defines the new equilibrium point E', at which Nation 2 exchanges 40Y for 50X at the new world price of $P_X/P_Y = P'_W = 0.8$. Thus, the terms of trade of Nation 1 (the rest of the world) deteriorated

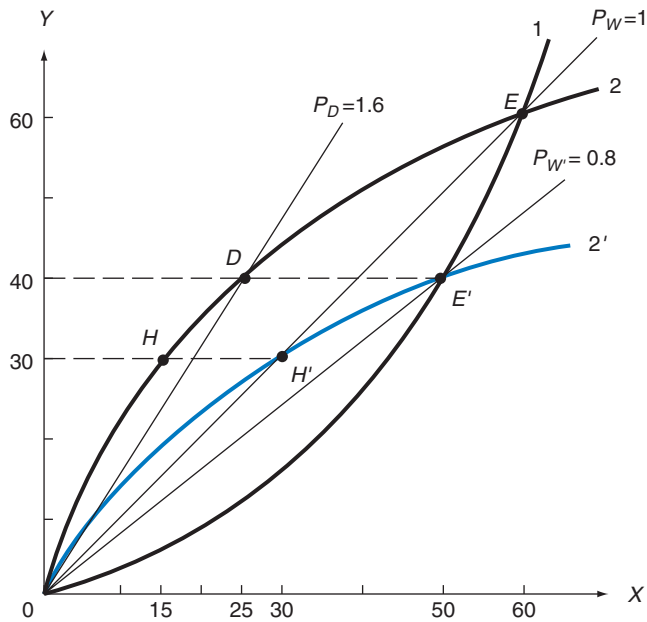

FIGURE 8.6. General Equilibrium Effects of a Tariff in a Large Country.
Free trade offer curves 1 and 2 define equilibrium point E and $P_X/P_Y = 1$ in both nations. A 100 percent ad valorem import tariff on commodity X by Nation 2 rotates its offer curve to 2′, defining the new equilibrium point E'. At point E' the volume of trade is less than under free trade and $P_X/P_Y = 0.8$. This means that Nation 2's terms of trade improved to $P_Y/P_X = 1.25$. The change in Nation 2's welfare depends on the net effect from the higher terms of trade but lower volume of trade. However, since the government collects half of the imports of commodity X as tariff, P_X/P_Y for individuals in Nation 2 rises from $P_X/P_Y = 1$ under free trade to $P_X/P_Y = P_D = 1.6$ with the tariff.

from $P_X/P_Y = P_W = 1$ to $P_X/P_Y = P'_W = 0.8$. On the other hand, Nation 2's terms of trade improved from $P_Y/P_X = 1/P_W = 1$ to $P_Y/P_X = 1/P'_W = 1/0.8 = 1.25$. Note that for any tariff *rate*, the steeper or less elastic Nation 1's (or the rest of the world's) offer curve is, the more its terms of trade deteriorate and Nation 2's improve.

Thus, when large Nation 2 imposes a tariff, the volume of trade declines but its terms of trade improve. Depending on the net effect of these two opposing forces, Nation 2's welfare can increase, decrease, or remain unchanged. This is to be contrasted to the previous case where Nation 2 was assumed to be a small nation and did not affect world prices by its trading. In that case, Nation 1's (or the rest of the world's) offer curve would be represented by straight line $P_W = 1$ in Figure 8.6. Nation 2's imposition of the 100 percent import tariff on commodity X then reduces the volume of trade from 60Y for 60X under free trade to 30Y for 30X with the tariff, at unchanged $P_W = 1$ (compare point E to point H' in Figure 8.6 and Figure 8.5). As a result, the welfare of (small) Nation 2 always declines with a tariff.

Returning to our present case where Nation 2 is assumed to be large, we have seen in Figure 8.6 that with tariff-distorted offer curve $2'$, Nation 2 is in equilibrium at point E' by exchanging 40Y for 50X so that $P_Y/P_X = P'_W = 0.8$ on the world market and for Nation 2 as a whole. However, of the 50X imported by Nation 2 at equilibrium point E', 25X is collected in kind by the government of Nation 2 as the 100 percent import tariff on commodity X and only the remaining 25X goes directly to individual consumers. As a result, for individual consumers and producers in Nation 2, $P_X/P_Y = P_D = 1.6$, or twice as much as the price on the world market and for the nation as a whole (see the figure).

Since the relative price of importable commodity X rises for individual consumers and producers in Nation 2, the Stolper–Samuelson theorem also holds (and w rises) when we assume that Nation 2 is large. Only in the unusual case where P_X/P_Y falls for individual consumers and producers after the nation imposes a tariff will the theorem not hold and w fall in Nation 2. This is known as the Metzler paradox and is discussed in Section A8.4 in the appendix.

Also to be pointed out is that the Stolper–Samuelson theorem refers to the long run when all factors are mobile between the nation's industries. If one of the two factors (say, capital) is immobile (so that we are in the short run), the effect of a tariff on factors' income will differ from that postulated by the Stolper–Samuelson theorem and is examined in Section A8.5 of the appendix with the specific-factors model.

8.6 The Optimum Tariff

In this section, we examine how a *large* nation can increase its welfare over the free trade position by imposing a so-called optimum tariff. However, since the gains of the nation come at the expense of other nations, the latter are likely to retaliate, and in the end all nations usually lose.

8.6A The Meaning of the Concept of Optimum Tariff and Retaliation

As we saw in Section 8.5B and Figure 8.6, when a large nation imposes a tariff, the volume of trade declines but the nation's terms of trade improve. The decline in the volume of trade, by itself, tends to reduce the nation's welfare. On the other hand, the improvement in its terms of trade, by itself, tends to increase the nation's welfare.

The optimum tariff is that rate of tariff that maximizes the net benefit resulting from the improvement in the nation's terms of trade against the negative effect resulting from reduction in the volume of trade. That is, starting from the free trade position, as the nation increases its tariff rate, its welfare increases up to a maximum (the optimum tariff) and then declines as the tariff rate is raised past the optimum. Eventually the nation is pushed back toward the autarky point with a prohibitive tariff.

However, as the terms of trade of the nation imposing the tariff improve, those of the trade partner deteriorate, since they are the inverse, or reciprocal, of the terms of trade of the tariff-imposing nation. Facing both a lower volume of trade and deteriorating terms of trade, the trade partner's welfare definitely declines. As a result, the trade partner is likely to retaliate and impose an optimum tariff of its own. While recapturing most of its losses with the improvement in its terms of trade, retaliation by the trade partner will definitely reduce the volume of trade still further. The first nation may then itself retaliate. If the process continues, all nations usually end up losing all or most of the gains from trade.

Note that even when the trade partner does not retaliate when one nation imposes the optimum tariff, the gains of the tariff-imposing nation are less than the losses of the trade partner, so that the world as a whole is worse off than under free trade. It is in this sense that free trade maximizes world welfare.

8.6B Illustration of the Optimum Tariff and Retaliation

Figure 8.7 repeats free trade offer curves 1 and 2 from Figure 8.6, defining equilibrium point E at $P_W = 1$. Suppose that with the optimum tariff, Nation 2's offer curve rotates to 2^*. (Why the tariff associated with offer curve 2^* is an optimum tariff will be explained in Section A8.6 in the appendix.) If Nation 1 does not retaliate, the intersection of offer curve 2^* and offer curve 1 defines the new equilibrium point E^*, at which Nation 2 exchanges 25Y for 40X so that $P_X/P_Y = P_W^* = 0.625$ on the world market and for Nation 2 as a whole. As a result, Nation 1's (the rest of the world's) terms of trade deteriorate from $P_X/P_Y = P_W = 1$ to $P_X/P_Y = P_W^* = 0.625$, and Nation 2's terms of trade improve to $P_Y/P_X = 1/P_W^* = 1/0.625 = 1.6$.

With the tariff associated with offer curve 2^*, not only does the improvement in Nation 2's welfare resulting from its improved terms of trade exceed the reduction in welfare due to the decline in volume of trade, but it represents the highest welfare that Nation 2 can achieve with a tariff (and exceeds its free trade welfare). (Again, the reason why the tariff associated with offer curve 2^* is the optimum tariff will be explained in Section A8.6 in the appendix by utilizing the trade indifference curves derived in Section A4.1 in the appendix to Chapter 4. Here we simply examine the effect of the optimum tariff on the nation imposing it and on its trade partner.)

However, with deteriorated terms of trade and a smaller volume of trade, Nation 1 is definitely worse off than under free trade. As a result, Nation 1 is likely to retaliate and impose an optimum tariff of its own, shown by offer curve 1^*. With offer curves 1^* and 2^*, equilibrium moves to point E^{**}. Now Nation 1's terms of trade are higher and Nation 2's are lower than under free trade, but the volume of trade is much smaller. At this point, Nation 2 is itself likely to retaliate, and in the end both nations may end up at the origin of Figure 8.7, representing the autarky position for both nations. By so doing, all of the gains from trade are lost.

Note that we have been implicitly discussing the optimum *import* tariff. More advanced treaties show, however, that an optimum import tariff is equivalent to an optimum *export*