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.

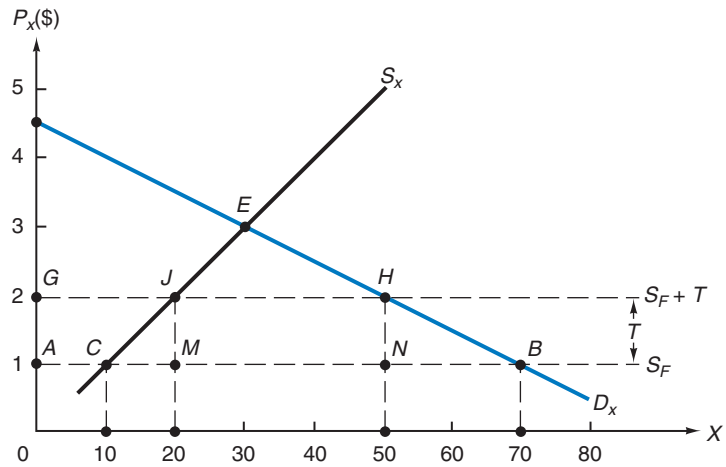

FIGURE 8.1. Partial Equilibrium Effects of a Tariff.
D_X and S_X represent Nation 2's demand and supply curves of commodity X. At the free trade price of $P_X = \$1$, Nation 2 consumes 70X (AB), of which 10X (AC) is produced domestically and 60X (CB) is imported. With a 100 percent import tariff on commodity 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 ($OABW = \$70$).

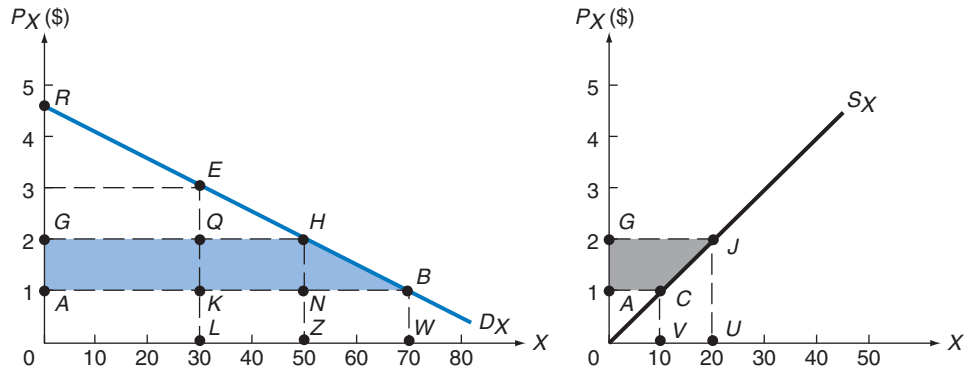

FIGURE 8.2. Effect of Tariff on Consumer and Producer Surplus.
The left panel shows that a tariff that increases the price of commodity X from $P_X = \$1$ to $P_X = \$2$ results in a reduction in consumer surplus from $ARB = \$122.50$ to $GRH = \$62.50$, or by shaded area $AGHB = \$60$. The right panel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

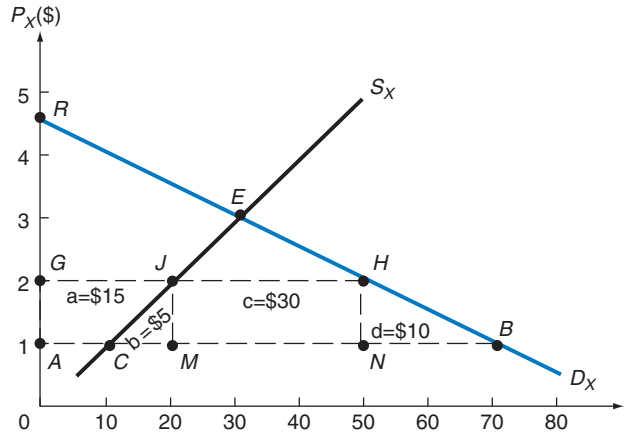

FIGURE 8.3. Partial Equilibrium Costs and Benefits of a Tariff.
The figure shows that with a 100 percent import tariff on commodity X, P_X rises from \$1 to \$2 in Nation 2. This reduces the consumer surplus by $AGHB = a + b + c + d = \$15 + \$5 + \$30 + \$10 = \$60$. Of this, $MJHN = c = \$30$ is collected 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.

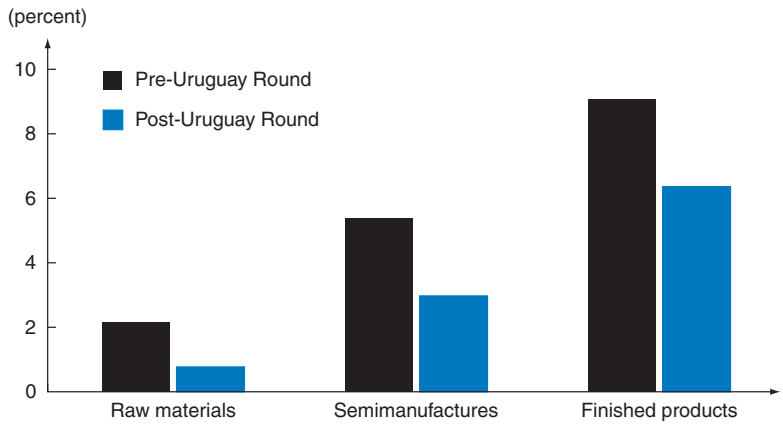

FIGURE 8.4. Pre- and Post-Uruguay Round Cascading Tariff Structure in Industrial Countries.
Source: W. Martin and L. A. Winters, *The Uruguay Round* (Washington, D.C.: World Bank, 1995), p. 11.

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

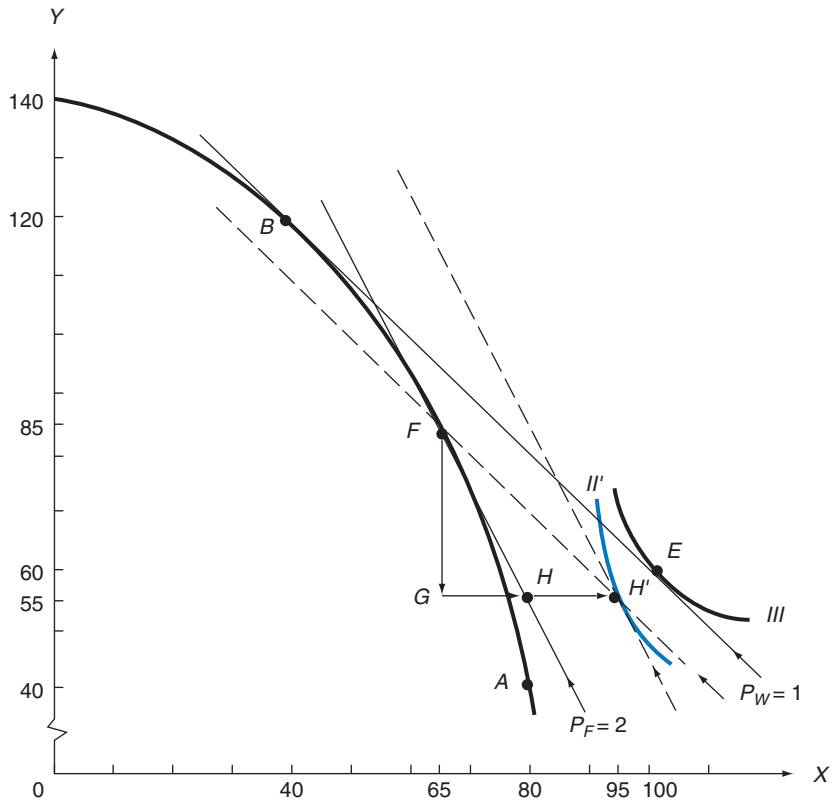

FIGURE 8.5. General Equilibrium Effects of a Tariff in a Small Country.
At $P_X/P_Y = 1$ on the world market, the small nation produces at point B and consumes at point E (as in the right panel of Figure 3.4). With a 100 percent ad valorem tariff on imports of commodity X, $P_X/P_Y = 2$ for individuals 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

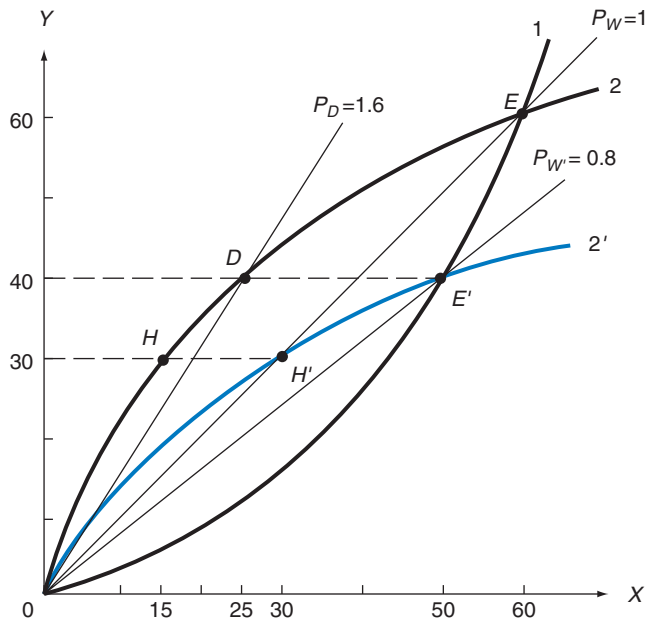

FIGURE 8.6. General Equilibrium Effects of a Tariff in a Large Country.
Free trade offer curves 1 and 2 define equilibrium point E and $P_X/P_Y = 1$ in both nations. A 100 percent ad valorem import tariff on commodity X by Nation 2 rotates its offer curve to 2′, defining the new equilibrium point E'. 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*

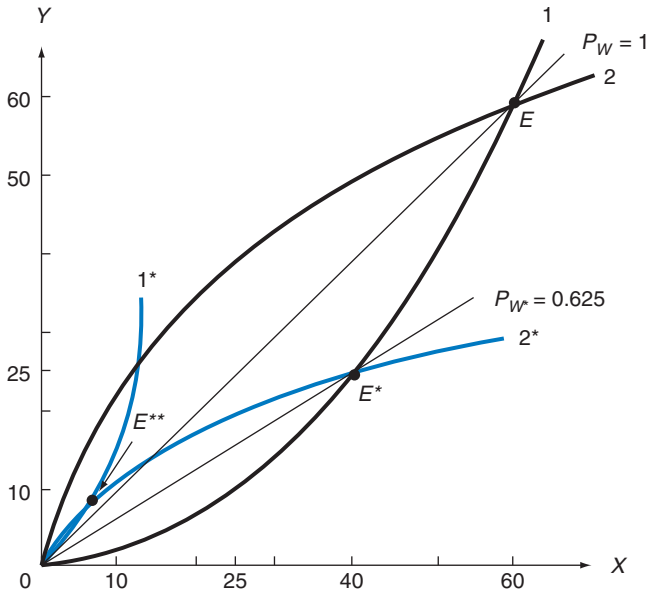

FIGURE 8.7. The Optimum Tariff and Retaliation.
Offer curves 1 and 2 define free trade equilibrium point E and $P_X/P_Y = 1$, as in Figure 8.6. If the optimum tariff for Nation 2 rotates its offer curve to 2^*, Nation 2's terms of trade improve to $P_X/P_Y = 1/P'_W = 1/0.625 = 1.6$. At equilibrium point E^*, Nation 2 is at its highest possible welfare and is better off than at the free trade equilibrium point E. However, since Nation 1's welfare is reduced, it is likely to retaliate with an optimum tariff of its own, shown by offer curve 1^* and equilibrium at point E^{**}. Nation 2 may then itself retaliate so that in the end both nations are likely to lose all or most of the benefits from trade.

tariff. Finally, note that the optimum tariff for a small country is zero, since a tariff will not affect its terms of trade and will only cause the volume of trade to decline (see points E and H' in Figure 8.6). Thus, no tariff can increase the small nation's welfare over its free trade position even if the trade partner does not retaliate. Finally, recent empirical research by *Broda, Limao, and Weinstein* (2008) indicates that nations do indeed impose higher tariffs on goods with lower export elasticity (i.e., in which the nations have more market power).

SUMMARY

1. Although free trade maximizes world welfare, most nations impose some trade restrictions that benefit special groups in the nation. The most important type of trade restriction historically is the tariff. This is a tax or duty on imports or exports. The *ad valorem tariff* is expressed as a percentage of the value of the traded commodity, whereas the specific tariff is a fixed sum per unit. The two are sometimes combined into a compound tariff. The most common is the ad valorem import tariff. These have generally declined over the past 50 years and today average only about 3 percent on manufactured goods in industrial nations.

2. Partial equilibrium analysis of a tariff utilizes the nation's demand and supply curves of the importable commodity and assumes that the domestic price of the importable commodity rises by the full amount of the tariff. It measures the reduction in domestic

consumption, increase in domestic production, reduction in imports, the revenue collected, and redistribution of income from domestic consumers (who pay a higher price for the commodity) to domestic producers (who receive a higher price) as a result of the tariff. A tariff leads to inefficiencies referred to as protection cost or deadweight loss.

3. The appropriate measure of the degree of protection actually provided to domestic producers is given by the rate of effective protection *(g)*. This usually differs widely from the nominal tariff rate *(t)*, and *g* can even be negative for a positive value of *t*. The two rates are equal only when the nominal rate on imported inputs equals the nominal rate on the final commodity or if there are no imported inputs. Rates of effective protection in industrial nations are generally much higher than the corresponding nominal rates and are higher the more processed the product. These calculations, however, must be used cautiously because of their partial equilibrium nature.

4. When a small nation imposes an import tariff, the domestic price of the importable commodity rises by the full amount of the tariff for individuals in the nation. As a result, domestic production of the importable commodity expands while domestic consumption and imports fall. However, the nation as a whole faces the unchanged world price since the nation itself collects the tariff. These general equilibrium effects of a tariff can be analyzed with the trade models developed in Part One and by assuming that the nation redistributes the tariff revenue fully to its citizens in the form of subsidized public consumption and/or general income tax relief.

5. According to the Stolper–Samuelson theorem, 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 its production. For example, if a capital-abundant nation imposes an import tariff on the labor-intensive commodity, wages in the nation will rise.

6. When a large nation imposes an import tariff, its offer curve rotates toward the axis measuring its importable commodity by the amount of the tariff, reducing the volume of trade but improving the nation's terms of trade. The optimum tariff is one that maximizes the net benefit resulting from improvement in the nation's terms of trade against the negative effect resulting from reduction in the volume of trade. However, since the nation's benefit comes at the expense of other nations, the latter are likely to retaliate, so that in the end all nations usually lose.

A LOOK AHEAD

Chapter 9 extends our discussion to nontariff trade restrictions, such as quotas and new forms of protection, that have increased substantially during the past three decades. The chapter then goes on to examine the political economy of protectionism and strategic trade and industrial policies. Finally, the chapter reviews the history of U.S. commercial policies and presents an overview of the provisions of the Uruguay Round and of the outstanding trade problems remaining in the world today.

KEY TERMS

Ad valorem tariff, p. 222
Compound tariff, p. 222
Consumer surplus, p. 225
Consumption effect of a tariff, p. 224
Domestic value added, p. 230
Export tariff, p. 221
Import tariff, p. 221
Metzler paradox, p. 239
Nominal tariff, p. 229
Optimum tariff, p. 240
Production effect of a tariff, p. 224
Prohibitive tariff, p. 236
Protection cost or deadweight loss of a tariff, p. 227
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QUESTIONS FOR REVIEW

1. What is meant by an ad valorem, a specific, and a compound tariff? Are import or export tariffs more common in industrial nations? in developing nations?
2. What is the primary function of tariffs in industrial nations? in developing nations?
3. When is partial equilibrium analysis of a tariff justified? How is this performed?
4. What is meant by the consumption, production, trade, revenue, and redistribution effects of a tariff?
5. What is meant by the protection cost, or deadweight loss, of a tariff? How is this measured?
6. What is the difference between a nominal tariff and an effective tariff? What is the usefulness of the concept of effective protection? How is the rate of effective protection measured?
7. What is the tariff structure of developed nations? Why is this of special concern to developing nations? What is the most serious shortcoming of the concept and measure of effective protection?
8. Using general equilibrium analysis, indicate the effect of an import tariff imposed by a small nation on the relative commodity price of the importable commodity for individuals in the nation and for the nation as a whole.
9. What is the effect of the tariff on the degree of specialization in production in a small nation? the volume of trade? the welfare of the nation? the distribution of income between the nation's relatively abundant and scarce factors?
10. Using general equilibrium analysis and assuming that a nation is large, indicate the effect of an import tariff on the nation's offer curve, the nation's terms of trade, the volume of trade, the nation's welfare, and the distribution of income between the nation's relatively abundant and scarce factors.
11. What is meant by the optimum tariff? What is its relationship to changes in the nation's terms of trade and volume of trade?
12. Why are other nations likely to retaliate when a nation imposes an optimum tariff (or, for that matter, any import tariff)? What is likely to be the final outcome resulting from the process of retaliation?

PROBLEMS

1. Draw a figure similar to Figure 8.1 for Nation 1 but with the quantity of commodity Y on the horizontal axis and the dollar price of Y on the vertical axis. Draw S_Y for Nation 1, identical to S_X for Nation 2 in Figure 8.1, but draw D_Y for Nation 1 crossing the vertical axis at $P_Y = \$8$ and the horizontal axis at 80Y. Finally, assume that $P_Y = \$1$ under free trade and that Nation 1 then imposes a 100 percent ad valorem import tariff on commodity Y. With regard to your figure, indicate the following for Nation 1:

   (a) The level of consumption, production, and imports of commodity Y at the free trade price of $P_Y = \$1$.

   (b) The level of consumption, production, and imports of commodity Y after Nation 1 imposes the 100 percent ad valorem tariff on commodity Y.

   (c) What are the consumption, production, trade, and revenue effects of the tariff?

2. For the statement of Problem 1:

   (a) Determine the dollar value of the consumer surplus before and after the imposition of the tariff.

   (b) Of the increase in the revenue of producers with the tariff (as compared with their revenues under free trade), how much represents increased production costs? increased rent, or producer surplus?

   (c) What is the dollar value of the protection cost, or deadweight loss, of the tariff?

3. Suppose that a nation reduces import tariffs on raw materials and intermediate products but not on finished products. What effect will this have on the rate of effective protection in the nation?

***4.** Calculate the rate of effective protection when t (the nominal tariff on the final commodity) is 40 percent, a_i (the ratio of the cost of the imported input to the price of the final commodity in the absence of tariffs) is 0.5, and t_i (the nominal tariff on the imported input) is 40 percent.

5. For the given in Problem 4, recalculate g with the following values of t_i:

(a) $t_i = 20$ percent.

(b) $t_i = 0$.

(c) $t_i = 80$ percent.

(d) $t_i = 100$ percent.

6. For the given in Problem 4,

(a) Recalculate g if $t_i = 20$ percent and $a_i = 0.6$.

(b) What general conclusion can you reach about the relationship between g and t from your answer to Problem 4 in Chapter 3 and Problem 6(a) above?

***7.** Starting with the trade model of Figure 3.4 for Nation 1 and assuming that Nation 1 is small, draw a figure analogous to Figure 8.5 showing the general equilibrium effects resulting when Nation 1 imposes a 100 percent ad valorem import tariff on commodity Y, starting from its free trade position. (*Hint*: See Figure 4.3 but assume that, with the tariff, individuals exchange 30X for 15Y, instead of the 40X for 20Y in Figure 4.3.)

***8.** Using the Stolper–Samuelson theorem, indicate the effect on the distribution of income between labor and capital in Nation 1 (assumed to be a small nation) when it imposes an import tariff on commodity Y.

9. Explain the forces at work that lead to the redistribution of income in your answer to Problem 8, in a way analogous to the explanation given in Section 8.4C for the redistribution of income in Nation 2 when that nation imposed an import tariff on commodity X.

10. How would the result in Problem 8 be affected if Nation 1 were instead assumed to be a large nation?

11. Is India more likely to restrict its imports of L-intensive or K-intensive commodities? Why? What effect is this likely to have on the distribution of income between labor and capital in India?

12. Starting with the free trade offer curves of Nation 1 and Nation 2 in Figure 8.6 and building on your figure in Problem 1, draw a figure analogous to Figure 8.6 showing the general equilibrium effects of the 100 percent ad valorem import tariff on commodity Y imposed by Nation 1, now assumed to be a large nation.

13. Draw a figure analogous to Figure 8.7 for Nation 1 showing that with the optimum tariff Nation 1 will trade 25X for 40Y and also showing the effect of Nation 2 retaliating with an optimum tariff of its own.

14. What happens if the two nations retaliate against each other's optimum tariff several times?

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

APPENDIX

This appendix examines the partial equilibrium effects of a tariff in a large nation, derives the formula for the rate of effective protection, 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.

A8.1 Partial Equilibrium Effects of a Tariff in a Large Nation

In Section 8.2, we examined the partial equilibrium effects of a tariff in a small nation (i.e., one that does not affect commodity prices by its trading). We now extend the analysis to

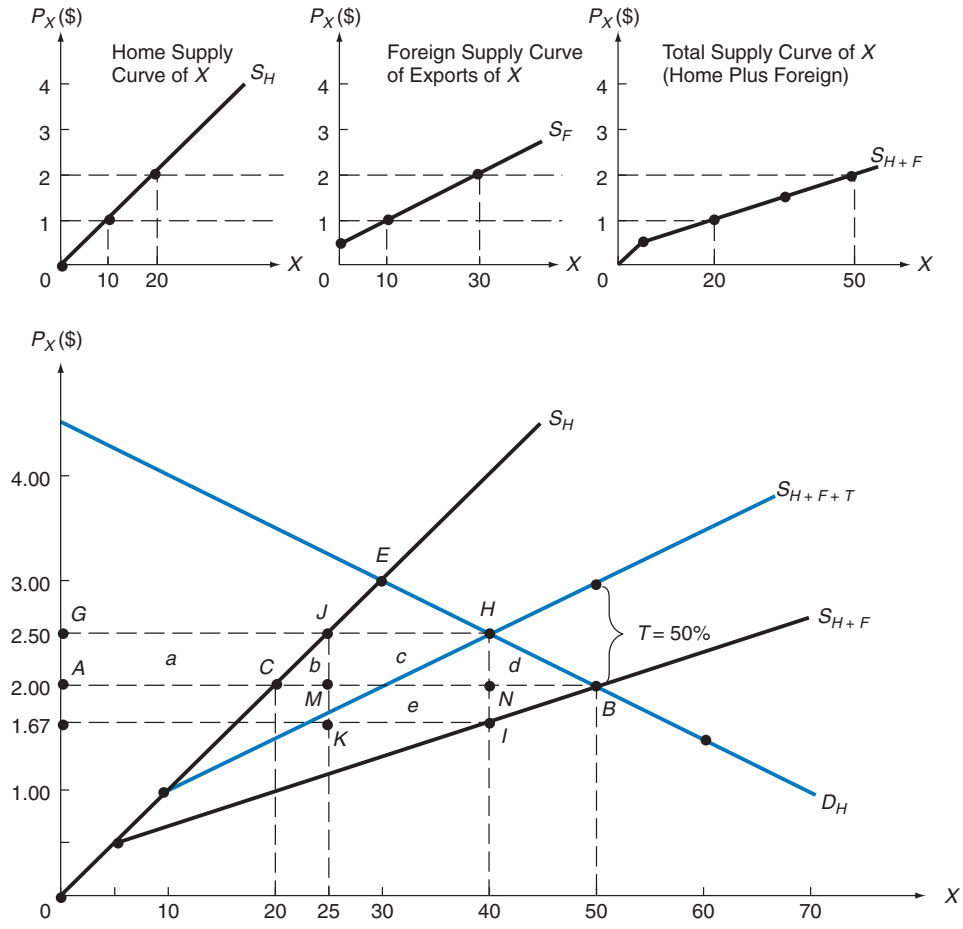

FIGURE 8.8. Partial Equilibrium Effects of a Tariff in a Large Nation.
In the top panel, S_H is the *domestic* supply, S_F is the *foreign* supply, and S_{H+F} is the *total* supply of X to the nation. With free trade, D_H (the home demand for X) intersects S_{H+F} at B (in the bottom panel) so that $P_X = \$2$ and $Q_X = AB = 50$ ($AC = 20$X supplied domestically and $CB = 30$X by foreigners). With a 50 percent ad valorem import tariff, S_{H+F} shifts up to S_{H+F+T}. D_H intersects S_{H+F+T} at H and $P_X = \$2.50$ and $Q_X = GH = 40$ ($GJ = 25$X supplied domestically and $JH = 15$X by foreigners). The loss of consumer surplus is area $a + b + c + d = \$22.50$, of which $a = \$11.25$ is the higher rent of domestic producers, $c = \$7.50$ is the tariff revenue collected from domestic consumers, and $b + d = \$3.75$ is the protection cost or deadweight loss to the nation. Since the nation also collects $MNIK = e = \$4.95$ from exporters, the nation receives a net gain of \$1.20 from the tariff.

examine the partial equilibrium effects of a tariff imposed by a large nation. This is done by using Figure 8.8, which is similar to but more complex than Figure 8.3.

In the top panel of Figure 8.8, S_H is the home or *domestic* supply curve of commodity X in the *large* nation, S_F is the *foreign* supply curve of exports of commodity X to the nation, and S_{H+F} is the total supply curve of commodity X to the nation. S_{H+F} is obtained as the (lateral) summation of the home supply curve, S_H, and S_F, the foreign supply curve

of exports of commodity X to the nation. For example, at $P_X = \$1$, 10X will be supplied domestically and 10X from abroad, for a total of 20X. At $P_X = \$2$, 20X will be supplied domestically and 30X from abroad, for a total of 50X. The S_F curve is positively sloped (rather than horizontal, as in the small-nation case in Figure 8.1) because the large nation must pay higher prices to induce foreigners to supply more exports of commodity X to the nation.

In the bottom panel of Figure 8.8, we see that *with free trade*, D_H (the home demand curve for commodity X in the nation) intersects S_{H+F} (the same as in the top panel, except for being drawn on a larger scale) at point B, so that $P_X = \$2$ and $Q_X = AB = 50$ (of which $AC = 20$X are supplied by domestic producers and $CB = 30$X by foreigners). If the nation now imposes a 50 percent ad valorem import tariff *(T)* on commodity X, the total supply curve will shift up by 50 percent and becomes S_{H+F+T}. Now D_H intersects S_{H+F+T} at point H, so that $P_X = \$2.50$ and $Q_X = GH = 40$ (of which $GJ = 25$X are supplied by domestic producers and $JH = 15$X by foreigners).

The loss of consumer surplus resulting from the tariff is equal to area $a + b + c + d = \$22.50$, of which $a = \$11.25$ is the higher rent received by domestic producers, $c = \$7.50$ is the tariff revenue collected by the nation's government from domestic consumers, and the remainder (the sum of triangles $b + d = \$3.75$) is the protection cost or deadweight loss to the nation.

The nation's government, however, also collects $IKMN = e = (\$0.33)(15) = \$4.95$ from foreign exporters. The reason for this is that by increasing P_X, the tariff reduces consumption and imports of commodity X in the nation, and since the nation is large, the smaller quantity of exports will be supplied at a lower price. Specifically, with the tariff domestic consumers pay \$2.50 (as compared with $P_X = \$2.00$ under free trade), whereas foreign exporters receive only $P_X = \$1.67$ (instead of \$2.00 under free trade). Thus, foreign exporters share the burden of the tariff with domestic consumers. Now that the nation is large, the tariff will lower the price of imports to the nation as a whole (i.e., the nation receives a terms-of-trade benefit from the tariff).

The protection cost or deadweight loss to the nation from the tariff must now be balanced against the terms-of-trade benefit that the nation receives. Since in this case the terms-of-trade benefit to the nation of \$4.95 (e) exceeds the protection cost of the tariff of \$3.75 ($b + d$), the nation receives a net benefit of \$1.20 ($e - b - d$) from the tariff. If the terms-of-trade benefit equaled the protection cost, the nation would neither gain nor lose from the tariff. Finally, if the terms-of-trade benefit were smaller than the protection cost, the nation would lose. Note that a small nation always incurs a net loss from a tariff equal to the protection cost or deadweight loss because the small nation does not affect foreign export or world prices (so that $e = 0$).

Even if, as in the above example, the nation gains from the tariff, the terms-of-trade benefit to the nation represents a loss to foreigners. As a result, foreigners are likely to retaliate with a tariff of their own, so that in the end both nations are likely to lose from the reduced level of trade and international specialization (see the discussion of the optimum tariff in Section 8.6).

Problem What is the relationship between the price elasticity of S_H and S_F and the price of the commodity under free trade and with the specific tariff?

A8.2 Derivation of the Formula for the Rate of Effective Protection

The rate of effective protection measures the percentage increase in domestic value added as a result of tariffs and is given by

$$g = \frac{V' - V}{V} \tag{8A-1}$$

where g is the rate of effective protection, V is the domestic value added under free trade, and V' equals the domestic value added with a tariff on imports of the final commodity and/or on imported inputs used in the domestic production of the commodity.

We now want to derive Equation (8-1) in Section 8.3A from Equation (8A-1). This is accomplished by defining V and V' in terms of the international price of the final commodity under free trade and with tariffs, substituting these values into Equation (8A-1), and simplifying to get Equation (8-1).

Suppose that the fixed international free trade price of a commodity (for example, a suit) is p (so that we are dealing with a small nation). Suppose also that a number of imported inputs (such as wool, buttons, etc.), also fixed in price on the world market, go into the domestic production of suits. The sum of the costs of these imported inputs going into the domestic production of a suit under free trade is

$$a_1p + a_2p + \ldots a_np = \sum a_ip \tag{8A-2}$$

where i refers to any of the n imported inputs and a_ip is the cost of imported input i going into the domestic production of a suit.

Thus, the domestic value added in a suit produced in the nation under free trade equals the international fixed price of the suit under free trade minus the cost of all imported inputs at their fixed international free trade price. That is,

$$V = p - p\sum a_i = p(1 - \sum a_i) \tag{8A-3}$$

With a tariff on suit imports and on imported inputs going into the domestic production of suits, the domestic value added (V') is

$$V' = p(1 + t) - p\sum a_i(1 + t_i) \tag{8A-4}$$

where t is the nominal ad valorem tariff rate on suit imports and t_i is the nominal ad valorem tariff rate on the imported input i going into the domestic production of suits. Note that t_i may differ for different imported inputs.

Substituting the values from Equation (8A-3) and Equation (8A-4) into Equation (8A-1), we get

$$g = \frac{V' - V}{V} = \frac{p(1 + t) - p\sum a_i(1 + t_i) - p(1 - \sum a_i)}{p(1 - \sum a_i)}$$

Since there is a p in each term in the numerator and denominator, we can cancel them out, and by also removing the parentheses, we get

$$g = \frac{1 + t - \sum a_i - \sum a_i t_i - 1 + \sum a_i}{1 - \sum a_i}$$

Canceling out equal terms in the numerator, we get Equation (8A-5):

$$g = \frac{t - \sum a_i t_i}{1 - \sum a_i} \tag{8A-5}$$

If there is only one imported input going into the production of the commodity, the "$\sum$" sign is removed from the numerator and the denominator of Equation (8A-5) and we end up with Equation (8-1) given in Section 8.3.

A shortcoming of the theory of effective protection is that it assumes technologically fixed coefficients of production (i.e., no factor substitution is possible) and that the international prices of the imported commodity and imported inputs are not affected by tariffs (i.e., the nation is a small nation).

Problem (a) What effect will the imposition of a tariff on imported inputs going into the domestic production of a commodity have on the size of the consumption, production, trade, revenue, and redistribution effects of the tariff on the final commodity? (b) What effect will it have on the size of the protection cost, or deadweight loss, of the tariff? (*Hint*: Determine which curve shifts and in which direction in Figure 8.1 as a result of the tariff on imported inputs.)

A8.3 The Stolper–Samuelson Theorem Graphically

According to the Stolper–Samuelson theorem (see Section 8.4C), 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 rise in P_X/P_Y and the resulting expansion of the output of commodity X and contraction of the output of commodity Y when Nation 2 imposes an import tariff on commodity X are clearly shown in Figure 8.5. Here we want to show that the tariff also results in an increase in K/L in the production of both commodities and thus increases the wage of labor (the nation's scarce factor), as postulated by the Stolper–Samuelson theorem.

To do this, we utilize the Edgeworth box diagram for Nation 2 in Figure 8.9 (from Figures 3.10 and 5.6, but omitting the prime on the letters). In Figure 8.9, point A is the autarky production point, point B is the free trade production point, and point F is the production point with 100 percent import tariff on commodity X. Note that point F is farther away from origin O_X and closer to origin O_Y than point B, indicating that with the rise in P_X/P_Y as a result of the import tariff on commodity X, Nation 2 produces more of commodity X and less of commodity Y.

The slope of the *solid* line from origin O_X to point B measures K/L in the production of commodity X, and the slope of the *solid* line from origin O_Y to point B measures K/L in the production of commodity Y under *free trade*. With production at point F (after the

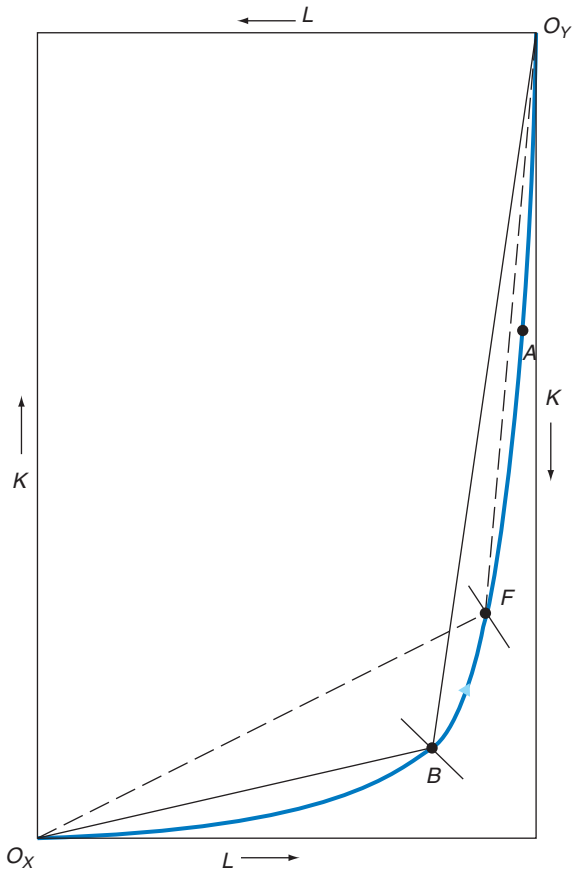

FIGURE 8.9. The Stolper–Samuelson Theorem Graphically.
When Nation 2 imposes an import tariff on commodity X, P_X/P_Y rises and the nation moves from free trade point *B* to point *F* on its production contract curve and produces more of commodity X but less of commodity Y. Since both *dashed* lines from the origins to point *F* are steeper than both *solid* lines from the origins to point *B*, *K/L* is higher in the production of both commodities with the tariff than under free trade. As more capital is used per unit of labor, the productivity of labor rises, and therefore the income of labor is higher after the tariff is levied, as postulated by the theorem.

import tariff on commodity X), *K/L* in the production of commodity X and commodity Y is measured by the slope of the *dashed* lines from origins O_X and O_Y, respectively, to point F. Since the dashed line from each origin is steeper than the solid line (see the figure), *K/L* is higher in the production of both commodities after the imposition of the import tariff on commodity X than under free trade.

As each unit of labor is combined with more capital in the production of both commodities after the tariff on commodity X, the productivity of labor increases, and therefore the wage rate rises in the production of both commodities. This is reflected in the fact that the absolute slope of the short solid line through point F (measuring w/r) is greater than the absolute slope of the short solid line through point B. With the assumption of perfect competition in factor markets, wages will be equalized in the production of both commodities.

Problem Utilizing the Edgeworth box diagram for *Nation 1* in the top panel of Figure 3.9 and in Figure 5.6, show that a 100 percent import tariff on commodity Y alters production from point B to point F, reduces K/L in the production of both commodities, and thus increases the productivity and income of capital in Nation 1.

A8.4 Exception to the Stolper–Samuelson Theorem—The Metzler Paradox

In the unusual case where a tariff lowers rather than raises the relative price of the importable commodity to individuals in the nation, the income of the nation's scarce factor also falls, and the Stolper–Samuelson theorem no longer holds. To examine this case (discovered by Metzler), we first look at the left panel of Figure 8.10, where the theorem *does* hold. This is identical to Figure 8.6 except that now we deal with an *export* rather than an import tariff because this makes the graphical analysis more straightforward.

The left panel of Figure 8.10 shows that *individual* exporters in Nation 2 must export 55Y, of which 15Y ($D'E'$) is collected in kind by their government in the form of an *export* tariff and the remaining 40Y goes to foreigners in exchange for 50X. As a result, $P_X/P_Y = P'_D = 1.1$ for individuals in Nation 2 with the tariff, as opposed to $P_X/P_Y = P_W = 1$ under free trade.

Note that the rise in P_X/P_Y for individuals in Nation 2 would be greater if the shift from offer curve 2 to 2′ was due to an import rather than an export tariff (see $P_D = 1.6$ in

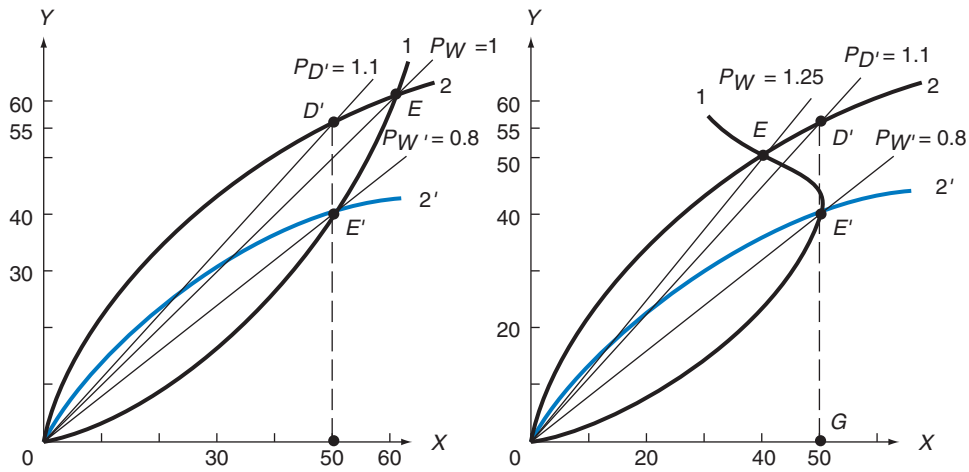

FIGURE 8.10. The Metzler Paradox.
The left panel shows that when Nation 2 imposes an export tariff, the relative price of commodity X falls to $P_X/P_Y = 0.8$ for the nation as a whole but rises to $P_X/P_Y = 1.1$ for individuals (because of the tariff) as compared with free trade $P_X/P_Y = 1$. Since P_X/P_Y rises for individuals in Nation 2, Nation 2 produces more of commodity X (the L-intensive commodity) and the income of labor rises, so that the Stolper–Samuelson theorem holds. In the right panel, free trade $P_X/P_Y = 1.25$ (at point E) and the same export tariff by Nation 2 results in $P_X/P_Y = 1.1$ for individuals in Nation 2. Since P_X/P_Y falls for individuals when Nation 2 imposes a tariff, the income of labor falls. Thus, the Stolper–Samuelson theorem no longer holds, and we have the Metzler paradox. This results because Nation 1's offer curve bends backward or is inelastic past point E, in the right panel.

Figure 8.6), but what is important for the Stolper–Samuelson theorem to hold is only that P_X/P_Y rises for individuals in Nation 2. The reason for this is that when P_X/P_Y rises, *whether from an import or export tariff*, L and K are transferred from the production of commodity Y to the production of commodity X, K/L rises in the production of both commodities, and so will the productivity and the income of labor (exactly as described in Section A8.3).

Only in the unusual case where Nation 1's (or the rest of the world's) offer curve bends backward and becomes negatively inclined or inelastic after a point (as in the right panel in Figure 8.10) may P_X/P_Y fall rather than rise for individuals in Nation 2 (compared with the free trade equilibrium price). In that case, the Stolper–Samuelson theorem would no longer hold. Specifically, the right panel of Figure 8.10 shows that at the free trade equilibrium point E (given by the intersection of offer curves 1 and 2), $P_W = 1.25$. The imposition of the export tariff by Nation 2 rotates offer curve 2 to 2′, giving equilibrium point E' with $P'_W = 0.8$ for Nation 2 as a whole and the rest of the world. However, individuals in Nation 2 will have to pay the export tariff of 15Y ($D'E'$) so that $P_X/P_Y = P_{D'} = 1.1$ for individuals in Nation 2.

Since the imposition of the export tariff reduces P_X/P_Y for individuals in Nation 2 (from $P_X/P_Y = 1.25$ under free trade to $P_X/P_Y = 1.1$ with the export tariff), the Stolper–Samuelson theorem no longer holds. That is, the fall in P_X/P_Y as Nation 2 imposes a tariff causes Nation 2 to produce less of commodity X and more of commodity Y. Since commodity Y is the K-intensive commodity, K/L falls in the production of both commodities, and so will the productivity and income of labor (Nation 2's scarce factor). This is the opposite of what the Stolper–Samuelson theorem postulates and is known as the Metzler paradox.

The Metzler paradox, however, is unusual. A necessary and sufficient condition for its occurrence is that the other nation's (or the rest of the world's) offer curve bends backward or is inelastic over the range of the tariff and that all of the export tariff collected by the government is spent on consumption of the importable commodity.

Problem Draw a figure analogous to Figure 8.10 showing in the left panel that the Stolper–Samuelson theorem holds *when Nation 1 imposes an export tariff* and showing the Metzler paradox in the right panel.

A8.5 Short-Run Effect of a Tariff on Factors' Income

The Stolper–Samuelson theorem refers to the long run when all factors are mobile between the nation's industries. Suppose, however, that labor is mobile but some capital is specific to the production of commodity X and some capital is specific to the production of commodity Y, so that we are in the short run. The short-run effect of a tariff on factors' income differs from that postulated by the Stolper–Samuelson theorem for the long run and can be analyzed with the use of the specific-factors model developed in Section A5.4.

Suppose we examine the case of Nation 2 (the K-abundant nation), which exports commodity Y (the K-intensive commodity) and imports commodity X. In Figure 8.11, distance OO' refers to the total supply of labor available to Nation 2 and the vertical axes measure the wage rate. Under free trade, the equilibrium wage rate is ED in both industries of Nation 2 and is determined by the intersection of the $VMPL_X$ and $VMPL_Y$ curves. OD of labor is used in the production of commodity X and DO' in the production of Y.

If Nation 2 now imposes a tariff on the importation of commodity X so that P_X rises in Nation 2, the $VMPL_X$ curve shifts upward proportionately, say, to $VMPL'_X$. This increases the wage rate from ED to $E'D'$, and DD' units of labor are transferred from the production

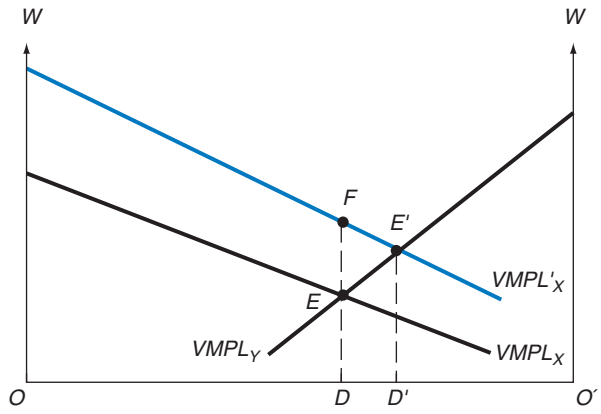

FIGURE 8.11. Short-Run Effect of Tariff on Factors' Income.
An import tariff imposed by Nation 2 (*K* abundant) usually increases P_X and shifts the $VMPL_X$ curve upward to $VMPL'_X$. The wage rate increases less than proportionately, and DD' of labor (the nation's mobile factor) is transferred from the production of Y to the production of X. The real wage falls in terms of X but rises in terms of Y. The real return of capital (the nation's immobile factor) rises in terms of X but falls in terms of Y.

of commodity Y to the production of commodity X. Since w increases by less than the increase in P_X, w falls in terms of X but rises in terms of Y (since P_Y is unchanged).

Since the specific capital in the production of commodity X has more labor to work with, the real $VMPK_X$ and r increase in terms of both commodities X and Y. On the other hand, since less labor is used with the fixed capital in the production of commodity Y, $VMPK_Y$ and r fall in terms of commodity X, and therefore in terms of commodity Y as well.

Thus, the imposition of an import tariff on commodity X by Nation 2 (the K-abundant nation) leads to the real income of labor (the mobile factor) falling in terms of X and rising in terms of Y in both industries of Nation 2, and to the real income and return to capital (the immobile factor) rising in the production of X and falling in the production of Y. These results are to be contrasted with those obtained by the Stolper–Samuelson theorem when both labor and capital are mobile, which postulates that an import tariff increases real w and reduces real r in the K-abundant nation (our Nation 2).

Problem What effect on real w and r will the imposition of an import tariff on commodity Y (the K-intensive commodity) have in Nation 1 (the L-abundant nation) if labor is mobile but capital is not?

A8.6 Measurement of the Optimum Tariff

In Section 8.6A, we defined the optimum tariff as 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 the reduction in the volume of trade. The reason offer curve 2^* in Figure 8.7 is associated with the optimum tariff for Nation 2 is that point E^* is on the *highest trade indifference curve* that Nation 2 can achieve with any tariff. This is shown by *TI* in Figure 8.12, which is otherwise identical to Figure 8.7.

Trade indifference curves were derived for Nation 1 in Section A4.1. Other trade indifference curves for Nation 2 have the same general shape as *TI* in Figure 8.12 but are either

to the left of *TI* (and therefore refer to a lower welfare for Nation 2) or to the right of *TI* (and, as such, are superior to *TI* but cannot be reached by Nation 2).

Thus, the optimum tariff is the tariff rate that makes the nation reach its highest trade indifference curve possible. This is the trade indifference curve that is tangent to the trade partner's offer curve. Thus, *TI* is tangent to Nation 1's (or the rest of the world's) offer curve. To reach *TI* and point E^*, Nation 2 must impose that import or export tariff that rotates its offer curve from 2 to 2^*.

Nation 2 can cause its offer curve to rotate from 2 to 2^* by imposing a 100 percent ad valorem export tariff on commodity Y. Specifically, at equilibrium point E^*, Nation 2's exporters will export 50Y (JN), of which 25Y (JE^*) is collected by the government of Nation 2 as an export tax on commodity Y, and the remainder of 25Y (E^*N) goes to foreigners in exchange for 40X. Note that Nation 2 could also get its offer curve to rotate from 2 to 2^* with a seemingly much larger import tariff on commodity X. In reality, the optimum export tariff *rate* is equal to the optimum import tariff rate (even though this does not seem so in Figure 8.12). This can be proved adequately only with mathematics in more advanced graduate texts.

However, since it is more likely for a nation to have some monopoly power over its exports (for example, Brazil over coffee exports and petroleum-exporting countries over petroleum exports through OPEC) than it is for a nation to have some monopsony power

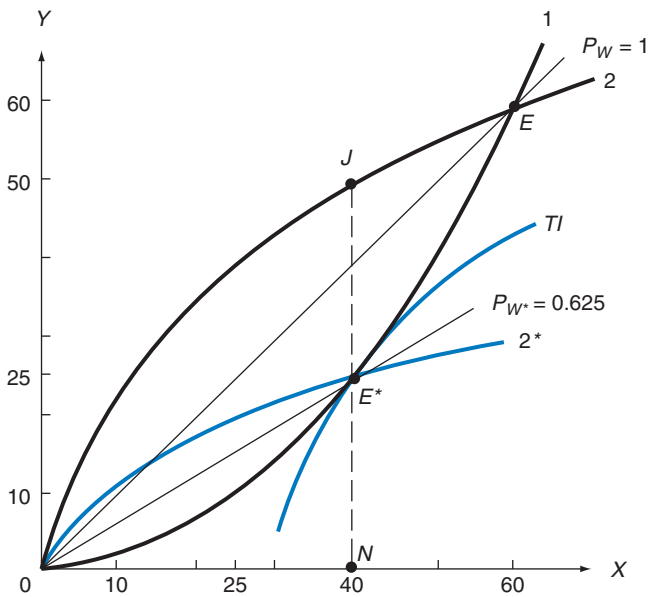

FIGURE 8.12. Measurement of the Optimum Tariff.
Offer curve 2^* is associated with the optimum tariff rate for Nation 2 because equilibrium point E^* is on the highest trade indifference curve Nation 2 can reach. This is given by *TI*, which is tangent to Nation 1's offer curve. Nation 2 can get to equilibrium point E^* on *TI* by imposing a 100 percent ad valorem export tariff (since $JE^* = E^*N$). Nation 2 cannot reach a trade indifference curve higher than *TI*. On the other hand, any tariff other than the optimum rate of 100 percent will put the nation on a trade indifference curve lower than *TI*.

over its imports, our discussion of the optimum tariff is perhaps more relevant in terms of exports than imports.

The optimum export or import tariff rate (t^*) can also be calculated with the following formula:

$$t^* = \frac{1}{e - 1} \tag{8A-6}$$

where e is the (absolute value of the) elasticity of the trade partner's offer curve. Thus, when e is infinite (i.e., when the trade partner's offer curve is a straight line, which also means that Nation 2 is a small nation), then the optimum tariff for Nation 2 is zero (see the formula). On the other hand, when Nation 1's (or the rest of the world's) offer curve has some curvature (so that e is less than infinite), t^* has a positive value. The lower is the value of e (i.e., the greater is the curvature of the trade partner's offer curve), the greater is the value of t^*. However, formula 8A-6 is not very operational because in order to use it to calculate the optimum tariff, we must first identify point E^* (see Figure 8.12).

As pointed out in Section 8.6B, the gain to a nation from the optimum tariff comes at the expense of the trade partner, who is likely to retaliate. The process of retaliation may continue until in the end both nations lose all or most of the gains from trade. The volume of trade may shrink to zero unless, by coincidence, both nations happen to be imposing their optimum tariff *simultaneously*, given the trade partner's tariff.

Problem (a) Draw a figure analogous to Figure 8.12 showing the optimum export tariff on commodity X *for Nation 1*. (*Hint*: For the general shape of Nation 1's trade indifference curves, see Figure 4.8.) Can you show on the same figure the optimum tariff for Nation 2 after Nation 1 has already imposed its optimum tariff? (*Hint*: See Figure 8.7.) (b) What are the approximate terms of trade of Nation 1 and Nation 2 after Nation 1 has imposed an optimum tariff and Nation 2 has retaliated with an optimum tariff of its own? (c) How has the welfare of each nation changed from the free trade position?

SELECTED BIBLIOGRAPHY

For a problem-solving approach to the theory of tariffs, see:

- D. Salvatore, *Theory and Problems of International Economics*, 4th ed. (New York: McGraw-Hill, 1996), ch. 6.

Comprehensive surveys of trade policies, in general, and the theory and measurement of tariffs, in particular, are:

- W. M. Corden, *The Theory of Protection* (London: Oxford University Press, 1971).
- W. M. Corden, *Trade Policy and Economic Welfare* (London: Oxford University Press, 1974).
- H. G. Johnson, *Aspects of the Theory of Tariffs* (London: Allen & Unwin, 1974).
- M. Michaely, *Theory of Commercial Policy* (Chicago: University of Chicago Press, 1977).
- J. N. Bhagwati, in R. C. Feenstra, ed., *The Theory of Commercial Policy* (Cambridge, Mass.: MIT Press, 1983).
- W. M. Corden, "The Normative Theory of International Trade," in R. W. Jones and P. B. Kenen, eds., *Handbook of International Economics* (Amsterdam: North-Holland, 1984), pp. 63–130.
- J. N. Bhagwati, *Protectionism* (Cambridge, Mass.: MIT Press, 1988).

- S. P. Magee, W. A. Brock, and L. Young, *Black Hole Tariffs and Endogenous Policy Theory* (New York: Cambridge University Press, 1989).
- W. M. Corden, *International Trade Theory and Policy* (Brookfield, Vt.: Edward Elgar, 1992).
- D. Salvatore, *Handbook of National Trade Policies* (Amsterdam and Westport, Conn.: North-Holland and Greenwood Press, 1992).
- D. Rodrik, "Political Economy of Trade Policy," in G. M. Grossman and K. Rogoff, eds., *Handbook of International Economics*, Vol. III (Amsterdam: Elsevier, 1995), pp. 1457–1494.
- I. M. Destler, *American Trade Politics* (Washington, D.C.: Institute for International Economics, 1995).
- OECD, *Indicators of Tariff and Non-Tariff Trade Barriers* (Paris: OECD, 1996).
- J. N. Bhagwati, A. Panagariya, and T. N. Srinivasan, *Lectures on International Trade* (Cambridge, Mass.: MIT Press, 1998), Part II (chs. 12–16).
- I. Destler and P. J. Balint, *The New Politics of American Trade* (Washington, D.C.: Institute for International Economics, 1999).
- J. Bhagwati, *Free Trade Today* (Princeton, N.J.: Princeton University Press, 2002).
- WTO, *Annual Report* (WTO: Geneva, 2008).
- United States Trade Representative, *Foreign Trade Barriers* (Washington, D.C.: U.S. Government Printing Office, 2008).
- U.S. International Trade Commission (USITC), *Annual Report* (Washington, D.C., 2008).
- D. A. Irwin, *Free Trade under Fire*, 3rd ed. (Princeton, N.J.: Princeton University Press, 2009).

The standard works on the theory of tariff structure and the rate of effective protection are:

- H. G. Johnson, "The Theory of Tariff Structure with Special Reference to World Trade and Development," in H. G. Johnson and P. B. Kenen, eds., *Trade and Development*, (Geneva: United Nations, 1965), pp. 9–29.
- B. Balassa, "Tariff Protection in Industrial Countries: An Evaluation," *Journal of Political Economy*, December 1965, pp. 573–594. Reprinted in R. E. Caves and H. G. Johnson, *Readings in International Economics* (Homewood, Ill.: Irwin, 1968), pp. 579–604.
- B. Balassa et al., *The Structure of Protection in Developing Countries* (Baltimore: Johns Hopkins University Press, 1971).
- H. G. Grubel and H. G. Johnson, *Effective Tariff Protection* (Geneva: United Nations, 1971).
- W. M. Corden, *The Theory of Protection* (London: Oxford University Press, 1971).
- A. J. Yeats, "Effective Tariff Protection in the United States, the European Economic Community, and Japan," *Quarterly Review of Economics and Business*, Summer 1974, pp. 41–50.
- A. V. Deardorff and R. M. Stern, "The Effects of the Tokyo Round and the Structure of Protection" in R. E. Baldwin and A. O. Krueger, eds., *The Structure and Evolution of Recent U.S. Trade Policy* (Chicago: University of Chicago Press, 1984), pp. 370–375.
- WTO, *Market Access: Unfinished Business* (Geneva: WTO, 2001).
- D. Salvatore, "The Challenge to the Liberal Trading System" *Journal of Policy Modeling* July/August 2009), pp. 593–599.
- D. Salvatore, "Globalization, International Competitiveness, and Growth," *Journal of International Commerce, Economics and Policy (JICEP)*, April 2010, pp. 21–32.
- WTO, *World Trade Report* (Geneva: WTO, 2001).

For measures of the cost of protection, see:

- G. H. Hufbauer, D. T. Berliner and K. A. Elliott, *Trade Protection in the United States: 31 Cases* (Washington, D.C.: Institute for International Economics, 1986).
- S. Laird and A. Yeats, *Quantitative Methods for Trade Barrier Analysis* (New York: New York University Press, 1990).
- J. de Melo and D. Tarr, *A General Equilibrium Analysis of U.S. Foreign Trade Policy* (Cambridge, Mass.: MIT Press, 1992).
- G. H. Hufbauer and K. A. Elliott, *Measuring the Cost of Protection in the United States* (Washington, D.C.: Institute for International Economics, 1994).
- Y. Sazanami, S. Urata, and H. Kawai, *Measuring the Cost of Protection in Japan* (Washington, D.C.: Institute for International Economics, 1999).
- P. Messerlin, *Measuring the Cost of Protection in the European Union* (Washington, D.C.: Institute for International Economics, 2001).
- A. Panagarya, "Cost of Protection: Where Do We Stand?" *American Economic Review*, May 2002, pp. 175–179.
- J. E. Anderson and E. van Wincoop, "Trade Costs," *Journal of Economic Literature*, September 2004, pp. 691–751.
- R. C. Feenstra, *Advanced Trade Theory* (Princeton, N.J.: Princeton University Press, 2004), ch. 7.

- U.S. International Trade Commission, *The Economic Effects of Significant U.S. Import Restraints* (Washington, D.C.: U.S. Government Printing Office, August 2011).

The Stolper–Samuelson theorem, the Metzler paradox, and the conditions for the occurrence of the Metzler paradox, respectively, are found in:

- W. F. Stolper and P. A. Samuelson, "Protection and Real Wages," *Review of Economic Studies*, November 1941, pp. 58–73. Reprinted in H. S. Ellis and L. A. Metzler, *Readings in the Theory of International Trade* (Homewood, Ill.: Irwin, 1950), pp. 333–357.
- L. A. Metzler, "Tariffs, the Terms of Trade and the Distribution of National Income," *Journal of Political Economy*, February 1949, pp. 1–29. Reprinted in R. E. Caves and H. G. Johnson, *Readings in International Economics* (Homewood, Ill.: Irwin, 1968), pp. 24–57.
- J. Bhagwati and M. H. Kosters, eds., *Trade and Wages: Leveling Wages Down?* (Washington, D.C.: American Enterprise Institute, 1994).
- R. A. Brecher and E. U. Choudhri, "Liberalizing Multinational Investment: The Stolper–Samuelson Question Revisited," in R. E. Feenstra, G. M. Grossman, and D. A. Irwin, eds., *The Political Economy of Trade Policy* (Cambridge, Mass.: MIT Press, 1996), pp. 77–88.

The classics on the optimum tariff are:

- A. P. Lerner, "The Symmetry Between Import and Export Taxes," *Economica*, August 1936, pp. 306–313. Reprinted in R. E. Caves and H. G. Johnson, *Reading in International Economics* (Homewood, Ill.: Irwin, 1968), pp. 197–203.
- T. Scitovsky, "A Reconsideration of the Theory of Tariffs," *Review of Economic Studies*, no. 2, 1942, pp. 89–110. Reprinted in H. S. Ellis and L. M. Metzler, *Readings in the Theory of International Trade* (Homewood, Ill.: Irwin, 1950), pp. 358–392.
- V. J. de Graff, "On Optimum Tariff Structures," *Review of Economic Studies*, no. 1, 1949, pp. 47–59.
- C. M. Broda, N. Limao, and D. E. Weinstein, "Optimal Tariffs: The Evidence," *American Economic Review*, December 2008, pp. 2032–2065.

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For international trade policies in the United States, visit the Internet site for the Economic Report of the President (and click on the most recent year to get the latest report), and the Internet site of the State Department, the United States Trade Representative, and the U.S. International Trade Commission, respectively, at:

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