INTERNATIONAL TRADE
Theory and Evidence

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15.1 INTRODUCTION
In Chapter 5 we contrasted a free trade equilibrium with an autarky equilibrium, in which a country does not trade at all. Both these extremes are virtually unheard of in practice. Instead, when a country does engage in trade, the government of that country will erect various barriers to restrict trade. The most common of these barriers are taxes levied on the importation of foreign goods. These taxes, commonly referred to as tariffs, are simply a form of commodity taxation. Tariffs are sometimes levied on exports as well as on imports. This is the case, for example, with Canadian exports of natural gas to the United States. While there are other forms of trade restriction, this chapter will concentrate on tariffs. Other barriers, such as import quotas, will be discussed in the following chapter, and we will defer until Chapter 19 a detailed discussion of why such policies are put into use by governments.

For now, we establish the two essential reasons that governments may choose to levy taxes on trade. The more important objective is to protect the operations of domestic industries that compete with imports. Taking a Heckscher-Ohlin framework, for example, we would expect import restrictions to be more severe in sectors that intensively use an economy's scarce factors. The most extreme form of protective tariff would be a tax
that eliminates imports. We refer to this as a prohibitive tariff. The second objective would be to raise revenues for the government. This practice is common in many developing countries, where it is easier to tax international trade at the border than to establish broad-based income taxes. Indeed, many exporters of primary products tax their foreign sales for revenue purposes. However, trade taxes are relatively unimportant as sources of revenue for developed economies.¹

15.2 THE WELFARE LOSS FROM TARIFFS

In this section we focus on a small economy facing fixed world prices. That is, the country can trade as little or as much as it wants at a fixed world price ratio \( p^* \). In this case, tariffs will affect the equilibrium price ratio facing domestic producers and consumers, but they will not affect \( p^* \). Assume also that the pattern of comparative advantage is such that this country exports \( Y \) and imports \( X \). Its government then places an ad valorem tax of \( t \) on each unit of \( X \) imported into the country.² Because \( p^* \) is fixed, the domestic price of \( X \) will rise by the full amount of the tax. Let \( p = p_x/p_y \) be the domestic price ratio. Because exports are not taxed, the domestic and world prices will be related by \( p_x = p_x^*(1 + t) \) and \( p_y = p_y^* \) or \( p = p^*(1 + t) \). Because of the import tariff on \( X \), the domestic price ratio will be greater than the world price ratio (\( p > p^* \)).

It is tariff-distorted domestic prices, rather than world prices, that consumers pay and producers receive. Of course, trade must still be balanced at the world price ratio, because \( p^* \) remains the price ratio at which the country does business with the rest of the world. These facts give us equilibrium conditions that can be summarized as follows:

\[
\text{MRS} = \text{MRT} = p = p^*(1 + t) > p^*
\]

(15.1)

\[
p_x^*(X_e - X_p) + p_y^*(Y_e - Y_p) = 0 \quad \text{or} \quad p^* = \frac{(Y_e - Y_p)}{(X_e - X_p)}
\]

(15.2)

where subscripts \( p \) and \( c \) again denote the amounts of a good produced and consumed, respectively. Equation (15.1) notes that domestic consumers and producers will equate the domestic MRS in consumption and MRT in production to the domestic price ratio, which is in turn greater than the world price ratio. Thus, at the post-tariff equilibrium, the slopes of the community indifference curve and the production frontier will be equal to each other but greater than the slope of the world price ratio. Equation (15.2) requires that the domestic production and consumption points be linked by the world price ratio.

These equilibrium conditions imply that the post-tariff equilibrium must be as shown in Fig. 15.1. In that diagram, \( A \) refers to the autarky equilibrium, whereas \( C_f \) and \( Q_f \) refer to the free-trade consumption and production points, respectively. A tariff on imports of \( X \) will result in production at a point like \( Q_f \) and consumption at a point like \( C_f \). Points \( Q_f \) and \( C_f \) are linked by the world price ratio as required by the balance-of-payments constraint (Eq. (15.2)). Points \( Q_f \) and \( C_f \) also satisfy Eq. (15.1) in that we have \( \text{MRS} = \text{MRT} > p^* \).

Several characteristics of the post-tariff equilibrium are clear from Fig. 15.1. First, the post-tariff level of welfare (\( U_f \)) is lower than the free-trade level (\( U_a \)) but higher than the autarky level (\( U_a \)). Therefore, the tariff leads to a welfare loss relative to free trade but certainly not relative to autarky. Second, the tariff causes production to move from the free-trade point \( Q_f \) back toward the autarky point \( A \). Third, the reduction in imports caused by the tariff also induces a decline in the volume of exports, which must be true in the absence of any change in the world price ratio. The new trade triangle is \( Q_f V C_f \). Third, tariffs reduce both imports and exports.

In the diagram, the slope of the production frontier will be equal to the slope of the world price ratio. It is clear from this equation that the resource shifts caused by tariffs must reduce production as expected. Finally, because exports of \( VQ_f \) units of \( Y \) are worth \( VZ_c \) units of \( X \) at domestic prices but \( VQ_c \) at world prices, the quantity \( Z_c \) depicts the tariff revenue, measured in units of the import good \( X \). We implicitly assume that the government rebates this revenue to citizens in a lump-sum fashion, allowing them to reach the consumption equilibrium at point \( C_f \).

These effects on welfare, production, and trade reveal the essential effect of tariffs, which is to move the country back from free trade in the direction of autarky. The country specializes less in the good in which it has a comparative advantage and thus sacrifices some of the gains from trade. Indeed, real national income is reduced from \( ON_f \) to \( ON_i \). If the tariff
were continually raised, the country would eventually find it unprofitable to import any $X$ in Fig. 15.1 and would be driven all the way back to the autarky equilibrium at A. As we mentioned, such a tariff is called a prohibitive tariff.

Tariffs accomplish this movement toward autarky by distorting domestic prices and, because domestic producers and consumers respond to domestic prices, by distorting domestic decision making. By raising the price of $X$, the tariff makes it seem that $X$ is more valuable than it actually is and thereby encourages domestic producers to produce more of it. Resources are diverted from the true pattern of comparative advantage by this misrepresentation, so gains from specialization are lost. Consumer prices are similarly distorted, so gains from exchange are also lost.

Now examine the effects of tariffs by using an excess demand curve like those developed in Chapter 4. In Fig. 15.2, the excess demand curve for the small country crosses the price axis at $p_a$, showing that at lower relative prices, the economy would choose to import good $X$. The fact that this is a small economy is depicted by the existence of a perfectly elastic foreign excess demand curve $E^*$ at free-trade price ratio $p^*$. The free-trade equilibrium involves a level of imports equal to $X_f$ at that price. An ad valorem import tariff on $X$ imposed at rate $t$ will shift down the import demand section of good $X$’s excess demand curve by $t$ percent. That is, in Figure 15.2, $E^*_t$ is defined by the relationship $p(1 + t) = p$, where $p$ gives price along the original excess demand curve. Note that this tariff would be prohibitive if the world price $p^*$ were between $p_a'$ and $p_a$. At the world price of $p^*$ in Fig.

15.2, the tariff reduces imports from $X_f$ to $X_t$, with exports correspondingly reduced to $p^*X_t$ units of good $Y$, whether the tax is imposed on imports or exports. The domestic relative price ratio in the small importer becomes $\frac{p}{p^*} = (1 + t)$, while tariff revenues are the rectangle $pp^*TS$, which is measured in units of $Y$.

An additional important point is that in addition to reducing overall income, tariffs redistribute income. In Fig. 15.1, the tariff raises the domestic price of $X$ and shifts production from $Q_f$ to $Q_t$. We know from our earlier analysis that this shift will generally change factor prices. In the Heckscher-Ohlin model, the increase in the price and production of $X$ will increase the real income of the factor used intensively in the production of that good and decrease the real income of the other factor (the Stolper-Samuelson theorem). Thus, in this case, the losses shown in Fig. 15.1 are shared unevenly, and one factor is actually made better off. Because overall welfare in the economy falls with the tariff, it follows that the other factor suffers a welfare loss in excess of the entire welfare loss. These distributional consequences of protection help to explain why we have protectionist policies. Chapter 19 will focus on this issue.

15.3 TARIFFS, TAXES, AND DISTORTIONS

As we noted earlier, tariffs are simply a special kind of tax. The purpose of this section is to expand on the notion of tariffs as taxes and to analyze the relationship of tariffs to other types of taxes. Recall from Fig. 15.1 that an import tariff on $X$ has the effect of raising both the price charged to the consumers and the price received by the producers. This hurts the consumer of $X$ and helps its producers. The tariff acts like a tax on consumers and a subsidy to producers. In fact, a tariff has the equivalent effect of a consumption tax combined with a production subsidy. From the information in Fig. 15.1 alone, we would find it impossible to tell whether the equilibrium at $C_t$ was caused by an import tariff or by a combined consumption-tax/production-subsidy on $X$.

Import Tariffs and Export Taxes

It is somewhat more difficult to grasp the point that an import tariff on $X$ is exactly equivalent to some export tax on $Y$. As we indicated earlier, restricting imports is equivalent to restricting exports. Recall that an import tariff on $X$ raises the domestic price of $X$ above the world price ($p_t > p^*_w$) while leaving the domestic price of $Y$ equal to the world price ($p_s = p^*_w$). The effect of the tariff on relative prices is to set $p > p^*$. For its part, an export tax establishes the following relationship between the domestic price of $Y$ and the world price: $p_s = p^*_w(1 - t)$. (Note that for this small country, the tax would reduce the domestic price received by producers
of the export good by the full amount of the tax, because exports must be sold at the fixed world price.) Thus, the tax drives a wedge between the domestic and world prices of Y ($p_s < p^*$) while leaving the domestic price of X equal to the world price ($p_s = p^*_s$). The effect of the export tax is also to set $p > p^*$. That is, we have to turn the import-competing industries into export-competing industries. Again looking only at the information in Fig. 15.1, we would find it impossible to tell whether the equilibrium at $C_r$ was generated by an import tariff or by an export tax.

Export taxes and import tariffs are equivalent in that they tend to raise the relative domestic price of imports and lower the relative domestic price of exports. Both tend to shift resources out of export industries into import-competing industries. Many observers have argued that countries should restrict imports by tariffs and simultaneously encourage exports by subsidies. This contention is wrong on two accounts. First, we should not do either in a small economy, where free trade is optimal, and second, the two proposed policies have exactly opposite effects and would therefore tend to cancel each other.

**Export Subsidies**

It is interesting to consider the effects of subsidizing exports in a small open economy. This policy is analyzed in Fig. 15.3. Suppose that $s$ is an ad valorem subsidy rate on exports of Y. Then $p_s = p^*_y(1 + s)$ and $p = p^*/(1 + s) < p^*$. Equation (15.1) must be replaced by

$$\text{MRS} = \text{MRT} = \frac{p^*}{1 + s} < p^*$$

(15.3)

The balance-of-payments constraint in Eq. (15.2) must, of course, continue to hold.

Figure 15.3 shows that the export subsidy causes the country to produce more $Y$ and less $X$ (point $Q_s$) than at the free trade equilibrium (point $Q_f$). Thus, real national income of $ON_s$ is smaller than in free trade, as was the case with the tariff. Both policies distort resource allocation. The difference is that the subsidy generates excessive production of $Y$, while the tariff generates excessive production of $X$. Consumption occurs at $C_s$, where the MRS in consumption equals the distorted domestic price ratio. The country trades more with the rest of the world (both exports and imports increase), but welfare is reduced from $U_f$ to $U_s$. Observe the implication that artificially increasing trade by subsidizing exports will not make an economy better off in general. Indeed, export subsidies are usually more welfare-decreasing than tariffs because they require taxpayers to fund them, rather than generating tax revenues.

In fact, an export (or import) subsidy could actually make an economy worse off than in autarky, as we prove later in Section 15.7. It is possible to see this, however, by considering Fig. 15.3 again. If the production distortion induced by the subsidy is so large that the world price line emanating from point $Q_s$ actually passes below indifference curve $U_a$, the country would be better off not trading than subsidizing exports.

**Consumption Taxes and Production Subsidies**

Now let us return to the notion that an import tariff (or export tax) is equivalent to a consumption tax and a production subsidy. Suppose that for some political reason the government is determined to increase production in the import-competing sector relative to the level it attains in free trade. One reason the government might wish to do this is that some minimum level of production in the import-competing sector is viewed as important for national security reasons, as might be the case with steel, oil, or semiconductors. Given this objective, the important economic question is, what is the least-cost method of achieving it? The problem with an import tariff is that it acts as a tax on consumption, in addition to serving as a subsidy to production. Might it not be better to use a direct output subsidy instead? The answer is definitely yes, as is shown in Fig. 15.4. If the government uses an import tariff to shift production from $Q_f$ to $Q_t$, consumption will move to $C_t$, resulting in a welfare level of $U_t$. 
Suppose instead that the government simply subsidizes production of \( X \) in such a way that the producer receipts per unit are the same as with the tariff. In this case output will still shift to \( Q_f \), but consumers will not face distorted prices and will instead be allowed to trade at world prices. This will allow consumers to attain consumption bundle \( C_s \) and utility level \( U_t \) in Fig. 15.4. This result can be explained by using the terminology of gains from exchange and gains from specialization developed in Chapter 5. The tariff in Fig. 15.4 distorts both consumer and producer prices, thereby causing a loss of gains from exchange as well as gains from specialization. The subsidy distorts only producer prices and thereby causes a loss only of gains from specialization. Curiously, despite the logic in Fig. 15.4, politicians and the general public appear to find tariffs more acceptable than subsidies because tariffs are the more common method of protection. More will be said about the politics underlying such choices in Chapter 19.

**Tariffs and Distortions**

A final point concerning tariffs and taxes is explored in Fig. 15.5. As we noted earlier in this chapter, the result that tariffs are harmful for a small open economy relies on the assumption that there are no distortions in the economy. If there are distortions, it may be the case that tariffs could be used to offset these distortions and thereby increase welfare. This possibility is an application of what is known in economics as the *theory of the second best*. This theory states that in the presence of multiple distortions (such as domestic taxes or monopoly), welfare is not necessarily improved by removing a single distortion (such as an import tariff). An equivalent statement is that in the presence of distortions, adding an additional distortion may improve welfare.

An application of the latter form of the theory of the second best is shown in Fig. 15.5. Suppose that for some political reason, the producers of \( Y \) have managed to obtain a subsidy from the government and that the government is unwilling to take the political risk of removing the subsidy. Free trade production will take place at a point like \( Q_f \) in Fig. 15.5, where the domestic producer price ratio \( p_t \) (the slope of the production frontier) is flatter than the world price ratio. Consumers can trade at world prices, and so consumption is given by point \( C_f \). Even though the government cannot remove the subsidy, it can improve welfare by introducing an additional distortion, namely, an import tariff on \( X \). This will raise the domestic price of \( X \) and, with the rate of subsidy on \( Y \) unchanged, encourage the production of \( X \) and moving the output mix from \( Q_f \) to \( Q_t \). The consumer prices will then be distorted by the tariff on \( X(p > p^*) \), so consumption will occur at a point like \( C_f \). Welfare is thus improved by the tariff, even though the country trades at fixed world prices. The tariff accomplishes this result by influencing production in a direction opposite to the influence of the distortionary subsidy. The effect of the tariff is to push the economy back in the direction of its efficient pattern of specialization. Of course, as our earlier analysis pointed out, imposition of the tariff could also lower welfare if the tariff-inclusive domestic price ratio does not induce much change in production but substantially worsens the consumption distortion. Such an
equilibrium would occur on an indifference curve below the one giving the original consumption choice. 5

15.4 MONOPOLY POWER

Thus far we have assumed that the country is small and faces fixed world prices (i.e., the country is essentially a perfect competitor on world markets). Suppose now that the country is large enough that world prices will be influenced by what the country wishes to buy and sell. More specifically, the world price of our export good will fall as we export more, and the world price of our import good will rise as we import more. The more we wish to trade, the worse our terms of trade become. 6

Figure 15.6 depicts two countries in a trading situation in which $E_x^h$ is the home country's excess demand curve for good $X$ and $E_x^f$ is the foreign country's excess demand for $X$. An equilibrium would be established in free trade at $p^* (see point $F$). Home imports are $X^0_f$, which coincide with foreign exports of $X^0_h$. Notice the effect, however, when the home country imposes a tariff (either as an import tariff on $X$ or an export tariff on $Y$). The resulting downward shift in the home country's excess demand curve to $E_x^f$ causes the equilibrium world price ratio to fall to $p^*_f$ (point $T$) at the same time that it drives up the domestic price ratio in the home country to $p$ (point $S$; recall that $p = p^*_f(1 + t)$). The resulting restriction of imports in the home country to level $X^1_f$ (and of foreign exports to $X^1_h$) is a move toward autarky. This comes about because of the higher domestic price that distorts production and consumption decisions and that would lower welfare in the home country. However, the fall in the relative equilibrium world price of the home country's import good from $p^*_f$ to $p^*_h$ represents a gain in the home country's terms of trade. The welfare benefits from this would, to some extent, offset the welfare losses from reduced trade. Tariff revenue is the area $p^*_hTS$.

Figure 15.7 illustrates the possibility that the improvement in the terms of trade is so strong that Country $H$ is actually made better off by the tariff. The tariff lowers the world price ratio from $p^*_f$ to $p^*_h$, resulting in post-tariff production and consumption at $Q_f$ and $C_f$, respectively. Home welfare increases from $U_f$ to $U_H$ following the imposition of the tariff.

The economic explanation of this possibility is fairly simple. While a country would like its firms to behave competitively when selling at home, it would be beneficial for the country to behave as a monopolist when selling abroad. Because we have assumed that individual firms are competitive, they cannot behave in this way. Therefore, the government can act to make the country behave as a monopolist. The tariff causes the country to restrict its "output" (exports) like a monopolist and also to restrict its "demand" (imports) like a monopsonist, thereby moving prices in the country's favor. At the same time, however, this action clearly worsens the other country's economic welfare. Country $P$ suffers both a terms-of-trade loss and distortionary losses from the fact that the altered relative price pushes resources out of its export sector and changes consumption decisions. Accordingly, we might expect $P$ to retaliate against

\[ Y \]

\[ X \]

\text{FIGURE 15.6}
Terms of trade effects from tariffs.

\text{FIGURE 15.7}
Welfare improvement from tariffs.
H with its own tariff on H exports. This process of tariff imposition and retaliation—a "trade war" in popular terminology—is harmful to global welfare and is likely to leave both H and F worse off than in free trade. We discuss this possibility more fully in the next section.

15.5 THE OPTIMUM TARIFF AND RETALIATION

When a country can gain by imposing a tariff, we might ask what the best possible tariff level is. This is known as the optimal tariff issue. The key to deriving the optimal tariff was contained in our preceding discussion, where we noted that a tariff could allow a country to exert its monopoly power in the supply of its export good or to exert its monopsony power in purchases of its import good.

Since most of our discussion has concerned tariffs on imports, let us take the latter approach and think of the country as exercising its monopsony power in the purchase of imports. Figure 15.8 depicts the situation for Country H, which is again assumed to import good X. \( E^I_x \) is the partial-equilibrium foreign supply curve (technically, the excess supply curve) and \( I^h \) is the home country's (excess) demand curve for X. Free trade equilibrium would be given by the intersection of the two, establishing a free trade price of \( p^*_x \), and setting imports equal to \( I^f \).

But this free trade equilibrium is not a welfare optimum for Country H. An optimum requires that Country H equate the domestic price of X to the marginal cost of imports. The foreign supply curve gives the price of imports for each quantity of imports, and price is simply the average cost. Let \( C_x \) denote the total cost of imports. We have

\[
C_x = p^*_x I_x; \quad AC_x = \frac{C_x}{I_x} = p^*_x; \quad I_x = X_o - X_p
\]

where \( AC_x \) is the average cost of imports. Free trade thus equates the domestic price of X to the average cost of X (\( p^*_x = p^*_x \)).

Marginal cost is defined as the change in cost (\( \Delta C_x \)) in response to a change in the quantity of imports (\( \Delta I_x \)). \( \Delta C_x \) can be approximated as follows.

\[
\Delta C_x = p^*_x \Delta I_x + I_x \Delta p^*_x
\]

(15.5)

Dividing Eq. (15.5) by \( \Delta I_x \), we have

\[
\frac{\Delta C_x}{\Delta I_x} = p^*_x + I_x \frac{\Delta p^*_x}{\Delta I_x} = p^*_x \left[ 1 + \frac{I_x \Delta p^*_x}{p^*_x \Delta I_x} \right]
\]

(15.6)

Let \( e^f_x \) be defined as Country F's elasticity of supply of exports. Since \( \frac{\Delta C_x}{\Delta I_x} = MC_x \), Eq. (15.6) can be rewritten as

\[
MC_x = p^*_x \left( 1 + \frac{1}{e^f_x} \right); \quad e^f_x = \frac{p^*_x \Delta I_x}{I_x \Delta p^*_x}
\]

(15.7)

Since the supply curve slopes upward, \( e^f_x \) is positive, and marginal cost is greater than average cost (\( MC_x > AC_x = p^*_x \)). The marginal cost curve is shown by \( MC_x \) in Fig. 15.8. The economic reason that marginal cost of imports exceeds average cost is straightforward. Let the home country choose to import another unit of X, which would cost \( p^*_x \) at the free-trade price. However, because the home country is large, its decision to import another unit would raise the world price, increasing the cost on all units imported. Thus, full marginal costs consist of the price of another unit of imports plus the extra inframarginal costs generated on existing imports.

Country H maximizes its welfare by equating \( p^*_x \) to \( MC_x \). Thus in Fig. 15.8 the country should import quantity \( I^{f*} \), requiring a domestic price of \( p^*_x \). This restriction on imports drives down the world price of X from \( p^*_x \) to \( p^*_x \), and results in a welfare gain for Country H, as discussed in the previous section. We also know that an import tariff will lead to the relationship \( p^*_x = p^*_x (1 + t) \), where \( t \) is the ad valorem tariff rate. Thus, the optimal tariff rate will be the rate that solves the equation

\[
p^*_x = p^*_x (1 + t) = p^*_x \left(1 + \frac{1}{e^f_x} \right); \quad t = \frac{1}{e^f_x}
\]

(15.8)

The optimum tariff is thus equal to the inverse elasticity of foreign export supply. The more inelastic foreign excess supply is, the larger the optimum tariff will thus be (i.e., \( t \) will be large when \( e^f_x \) is small).
It is easy to see that the optimum tariff formula covers the special case of a small open economy. If a country can trade as much or as little as it wishes at fixed world prices, this means that the supply curve facing the country is horizontal, or infinitely elastic. In this situation, \( e^f \) is infinite and \( 1/e^f \) is zero. Thus, the optimal tariff for a small economy is zero, and free trade is indeed the optimal policy, as discussed in section 15.2.

Two qualifications of this discussion should be noted. First, the optimal tariff formula is deceptively simple in that it seems to tell us exactly what the tariff should be. But in fact, \( e^f \) is generally a variable that changes its value as we move along the foreign demand supply curve. The equation \( t = 1/e^f \) is unfortunately no more than an equilibrium condition and does not by itself tell us what the numerical value of \( t \) should be. The optimal value of \( t \) must be found by first estimating \( e^f \) and \( I^f_t \) and then using \( E^f_p \) to construct \( MC_x \), or \( e^f \). It is only after this has been done that the formula can be applied to find the optimal value of \( t \). Note especially in this regard that \( t \) will depend on domestic factors, even though the optimal tariff formula seems to rely only on the foreign elasticity. The optimal tariff \( t \) will equal \( 1/e^f \) evaluated at the point where the domestic excess demand curve crosses \( MC_x \). Because \( e^f \) generally varies along \( MC_x \), the actual value of \( e^f \) and therefore \( t \) will depend on where \( I^f_t \) crosses \( MC_x \). Thus, domestic factors do indeed help determine the value of the optimum tariff, and the simple formula does not, in fact, provide a shortcut to finding this value.

The second qualification is a much more important one. The optimal tariff discussed here is based on the assumption that the government in Country F will not retaliate when Country H institutes the tariff. However, H's optimal tariff clearly reduces F's welfare by reducing F's trade volume and worsening terms of trade (that is, it reduces the relative price of F's export good). Suppose, then, that the foreign government will exactly match any tariff that H imposes with a tariff on H's exports. From our earlier analysis we know that this tariff is equivalent to Country F imposing a tax on its exports. Thus, in Fig. 15.6, this retaliatory move will cause the export-supply portion of \( E^f_p \) (i.e., the portion to the left of the vertical axis) to shift up, which will further restrict trade and move the terms of trade back against Country H. Indeed, it is quite possible to end up with exactly the same world price ratio that prevailed with free trade. The volume of trade will be lower, and therefore, since neither country has succeeded in improving its terms of trade, both countries will be unambiguously worse off.

Because of the high probability of foreign retaliation, the term "optimal tariff" is very misleading. It is optimal only under the special assumption of no retaliation. If all countries pursue this so-called "optimal" strategy simultaneously, it is likely that every country will be worse off—hardly an optimal outcome. If countries cooperate instead of myopically pursuing their self-interests, they may find that relatively free trade constitutes the optimal policy.

### 15.6 Effective Protection

One fundamental implication of our discussion thus far is that a tariff provides protection from imports, allowing expanded domestic production of the protected commodity. This prediction assumes that the tariff is the only tax that directly affects costs and prices of the good in question. Such an assumption is reasonable for goods that are produced solely by untraded primary inputs, such as capital and labor, and for goods that require intermediate inputs that are freely traded internationally. However, most commodities are produced with the use of intermediate goods that are themselves subject to trade taxes. Thus, a tariff on imported steel, for example, would raise costs and lower output in the automobile sector even if there were a protective tariff on cars. In general, manufacturers are better off as tariffs rise on imports that compete with their outputs and worse off as tariffs rise on their imported inputs. The term effective protection refers to the fact that all such tariffs need to be taken into account in computing the net protective effect of the tariff structure.

Because our goal is to isolate the costs of intermediate inputs, the notion of effective protection actually refers to the positive or negative stimulus to value added in production of a commodity. Value added per unit of output, \( v \), is the difference between the price of a final good and the cost of purchasing intermediate inputs. As such, it measures the portion of the value of output that is available for payments to primary inputs. For example, if the price of an automobile is $15,000 and the cost of acquiring the steel, leather, glass, rubber, and so on needed to produce the car is $10,000, there remain $5,000 to pay for wages, the costs of capital (e.g., profits and interest), and the costs of land (e.g., rents). Value added thus captures the costs of primary inputs. In this case, value added makes up 33 percent of the gross value of the car. If the tariff structure combines to expand value added relative to free trade, it effectively raises payments to these primary factors.

In this sense, the effective rate of protection, \( t_e \), is defined as the percentage change in a sector's value added per unit of output to a situation in which tariffs have been, \( v' \), in moving from free trade with no tariffs imposed.

\[
t_e = \frac{1}{v} (v' - v) \tag{15.9}
\]

Continuing with this example, suppose for simplicity that steel is the only intermediate input in cars and that the prices given exist in free trade. We choose units so that one unit of steel is required per automobile. Now suppose that a 20-percent tariff is imposed on imported cars and that the domestic producers of cars respond to the tariff by raising their price by 20 percent, to $18,000. With no tariff on steel, domestic value added thus rises to $8,000 per car, and the effective rate of protection becomes

\[
t_e = (8,000 - 5,000)/5,000 = 0.6, \text{ or 60 percent.}
\]

Interestingly, the 20 percent nominal tariff on the final good raises the effective tariff from zero to 60 percent. Of course, this result simply reflects the fact that value added
is a portion of gross output, so the nominal tariff has a magnified effect on value added. Thus, the share of primary inputs in cars (measured at free trade prices) rises by 60 percent, the effective protection provided them.

Suppose now that a 20-percent tariff is imposed on imported steel, raising its domestic price to $12,000, while the tariff on cars remains. The effective protection afforded to cars is now $t_e = ($8,000 - $5,000)/$5,000 = 0.5$, or 20 percent. In this case, the effective rate of protection equals the nominal rate. Finally, if we raise the steel tariff to 50 percent, our computation becomes $t_e = ($3,000 - $5,000)/$5,000 = -0.4$, or -40 percent. Thus, it is possible for the tariff on inputs to be high enough to reduce effective protection for the final good relative to free trade. Thus, despite the existence of the 20 percent nominal tariff on automobiles, production of cars will probably fall as the sector is forced to shed labor and other primary inputs.

From these examples we can draw certain conclusions.

1. If the tariff on the output exceeds the tariff on the input, the effective rate of protection is higher than the nominal tariff.
2. If the tariffs are equal, the effective rate of protection is equal to the nominal tariff.
3. If the output tariff is lower than the tariff on the input, the effective rate of protection is less than the nominal tariff and may even be negative.  

A further point to note is that tariffs are not the only determinants of effective protection. Trade taxes, domestic taxes, subsidies, quotas, and other nontariff barriers on outputs and inputs must be considered. One inference we can make is that any tariff system will be a serious disadvantage to export industries, which must sell at world prices. For an export industry, input tariffs will raise costs that may not be offset by export subsidies. Thus, we can expect that a general reduction in tariffs will be a substantial impetus to exports by improving their competitive position.

While the concept of effective protection provides important insights, it should be noted that it relies on several restrictive assumptions. Perhaps the most crucial is that all production functions exhibit constant returns to scale with fixed input coefficients. The first characteristic allows us to compute value added per unit of output without regard to the actual level of output. If constant returns to scale were not assumed, computations of value added would become more complicated. For example, suppose the automobile tariff just discussed would, by itself, double domestic output of cars. Unless steel inputs also doubled, which would not happen except under constant returns, the impact on the share of primary inputs would depend on the tariff and on returns to scale. Because we wish to isolate the changes due to tariffs, it is convenient to focus on the constant-returns case. Similarly, the assumption of fixed coefficients implies that inputs are always combined in the same proportions, regardless of factor prices or output scale. In theoretical terms, this notion means that isoquants are right-angled, or that elasticities of substitution among inputs are zero. If, however, production functions allow for substitution in production, then any change in factor prices would be expected to change the production coefficients. Like the problem with returns to scale, such changes would affect observed value-added shifts, making computations more difficult.

Removing the assumption of fixed coefficients causes two major effects. First, allowing input substitution tends to reduce calculated effective rates of protection. Second, it may alter the ranking of effective rates across sectors. However, evidence suggests that such shifts in rankings are not great even when substitution elasticities as high as 2 are assumed. Thus, it seems practical to use effective rates of protection as indicators of how the full tariff structure will influence resource allocation across industries.

A further assumption is that production and trade take place in the protected industries both before and after the tariffs are imposed. This assumption is necessary to ensure that the calculated rates actually do measure changes in value added relative to free trade levels. A final assumption is that the elasticities of foreign demand for exports, foreign supply of imports, and domestic supply of nontraded inputs are infinite. These assumptions eliminate the possibility of price changes other than those associated with the imposition of tariffs. Thus, changes in the terms of trade associated with the tariff structure are ignored. This is a major limitation on studies of effective protection because accounting for finite elasticities would change the computations significantly. Unfortunately, relatively little reliable information exists on the values of the requisite elasticities. In general it has been found that relaxing the assumption of perfectly elastic supplies of domestic, nontraded inputs tends to lower the effective rates of protection.

We should also note that allowing for more complex production processes with many required inputs complicates the process of calculating effective rates of protection, although not excessively. In particular, the importance of the various intermediate inputs must be weighted in the calculation process, and the data requirements for these calculations increase in proportion to the number of inputs.

We conclude this section with two notes on the practical relevance of effective rates of protection. First, developed countries often have a structure of escalating tariffs, meaning that raw materials are allowed to be imported largely duty-free, while processed intermediates have higher tariffs, and finished goods have yet higher import taxes. As suggested earlier, this structure means that the effective protection provided to finished products is higher than nominal rates would suggest. In general, estimates suggest that in the industrialized countries, effective rates of protection on final goods are approximately twice the nominal tariff rates. This is especially true in certain labor-intensive products, suggesting that the tariff structure may be used to achieve substantial implicit protection. Tariff escalation continues to be a significant issue of contention between developed-country importers and developing-country exporters in multilateral trade negotiations.
TABLE 15.1  Nominal and effective rates of protection in selected industries, United States, Japan, and Republic of Korea

<table>
<thead>
<tr>
<th>Industry</th>
<th>United States</th>
<th>Japan</th>
<th>Republic of Korea</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NRP (%)</td>
<td>ERP (%)</td>
<td>NRP (%)</td>
</tr>
<tr>
<td>Agriculture</td>
<td>1.50</td>
<td>1.91</td>
<td>18.40</td>
</tr>
<tr>
<td>Food products</td>
<td>4.70</td>
<td>10.16</td>
<td>25.40</td>
</tr>
<tr>
<td>Wearing apparel</td>
<td>22.70</td>
<td>45.30</td>
<td>13.80</td>
</tr>
<tr>
<td>Wood products</td>
<td>1.70</td>
<td>1.72</td>
<td>0.30</td>
</tr>
<tr>
<td>Chemicals</td>
<td>2.40</td>
<td>3.66</td>
<td>4.50</td>
</tr>
<tr>
<td>Iron and steel</td>
<td>3.60</td>
<td>6.18</td>
<td>2.80</td>
</tr>
<tr>
<td>Electrical machinery</td>
<td>4.40</td>
<td>6.34</td>
<td>4.50</td>
</tr>
<tr>
<td>Transport equipment</td>
<td>3.50</td>
<td>1.94</td>
<td>1.50</td>
</tr>
</tbody>
</table>


* Nominal tariff rates and effective rates of protection to be phased in by 1986 following the Tokyo Round of tariff negotiations.

A second observation is that many developing countries have arranged their protective structures so that effective tariffs are far higher than published tariffs. In part, this is an attempt to foster growth in domestic manufacturing through a regime of import-substituting industrialization. Again, the goal is to promote domestic output of final goods by escalating tariffs on the inputs. This policy is often accompanied by a deliberate overvaluation of the domestic currency, done in part to discourage exports of primary products in favor of keeping primary goods at home for use in manufacturing import-competing goods. On occasion, these protection levels can be extraordinary. For example, it was estimated that in 1969, Argentina had nominal tariff rates of 63 percent on finished textiles and 76 percent on woodworking industries. However, the associated effective rates of protection, accounting for trade barriers, taxes, and the exchange-rate regime, amounted to 832 percent and 1,308 percent, respectively.11

To provide further perspective, Table 15.1 presents recent nominal tariff rates and estimates of effective protection rates in the United States, Japan, and the Republic of Korea. It can be seen that all countries heavily protect wearing apparel, while Japan and Korea strongly protect their agricultural sectors. Indeed, the costs of agricultural protection in Korea are so high that the food products industry is effectively taxed, despite an 11.7 percent nominal tariff.

15.7 GAINS FROM TRADE WITH MANY GOODS, TRADE TAXES, AND SUBSIDIES

Up to this point, we have focused mainly on a simple model in which there are only two goods. Results of the analysis suggest that an import tariff reduces welfare relative to free trade but still leaves welfare greater than or equal to the autarky level. An import or export subsidy, however, has the potential of making the country worse off relative to autarky.

Can we say anything about a country that trades many goods, some of which are taxed and some of which are subsidized? It turns out that there is in fact a very simple condition for gains from trade: if net trade tax revenue (the sum of all import and export tax revenues minus trade subsidy payments) is positive, then the country is better off than in autarky.

Another way of saying this is that if trade is, on average, taxed more than it is subsidized, then there are still gains from trade.

Suppose that there are n goods, \(X_1, \ldots, X_n\), with fixed world prices \(p_1^w, \ldots, p_n^w\) (although the argument easily generalizes to a large economy) and corresponding domestic prices \(p_1, \ldots, p_n\). Domestic and world prices are related by \(p_i = p_i^w(1 + t_i)\). If good i is imported, then a positive \(t_i\) is an import tariff and a negative \(t_i\) is an import subsidy. If good i is exported, then a positive \(t_i\) is an export subsidy and a negative \(t_i\) is an export tax (e.g., if the world price is higher than the domestic price \(t_i < 0\), then \(t_i\) is an export tax).

Domestic producers optimize with respect to domestic prices. In a competitive economy, this means that the value of production at domestic prices in (distorted) trade is greater than or equal to the value of autarky production at these same prices. Let superscript d denote quantities in tax/subsidy distorted trade and superscript a denote autarky quantities. Subscripts p and c denote production and consumption quantities as before. Competitive equilibrium is characterized by

\[
\sum_{i} p_i^a(1 + t_i)X_i^a = \sum_{i} p_i^a(1 + t_i)X_i^d
\]

Equation (15.10) can be rearranged as

\[
\sum_{i} p_i^aX_i^a = \sum_{i} p_i^aX_i^{a} + \sum_{i} p_i^a t_i(X_i^a - X_i^d)
\]

The balance-of-trade condition and the autarky market-clearing condition are given by

\[
\sum_{i} p_i^aX_i^a = \sum_{i} p_i^aX_i^{a} + \sum_{i} p_i^a t_i(X_i^a - X_i^d)
\]

Substituting Eq. (15.12) into Eq. (15.11), the latter becomes

\[
\sum_{i} p_i^aX_i^c = \sum_{i} p_i^aX_i^{c} + \sum_{i} p_i^a t_i(X_i^d - X_i^c)
\]

A welfare comparison of distorted-trade versus autarky consumption must, however, be done at domestic prices. By adding and subtracting several terms to both sides of the equation, Eq. (15.13) becomes

\[
\sum_{i} p_i^d(1 + t_i)X_i^c = \sum_{i} p_i^d(1 + t_i)X_i^{c} + \sum_{i} p_i^d t_i [(X_i^c - X_i^{d}) - (X_i^a - X_i^c)]
\]
Consider the term in square brackets on the right-hand side of Eq. (15.14). Let \( M^i_e = X^i_e - X^i_p \) be the imports of good \( i \) in autarky; these are zero. Thus, the term in square brackets on the right-hand side of Eq. (15.14) reduces to \( M^i_e \). Using the relationship between world and domestic prices, Eq. (15.14) then reduces to a relatively simple expression.

\[
\sum_{i} p^i X^i_e \geq \sum_{i} p^i X^i_e + \sum_{i} p^i t^i M^i_e
\]

The second summation on the right-hand side of Eq. (15.15) gives the total net value of trade tax revenue. Equation (15.15) gives us the welfare comparison we are seeking. The value of domestic consumption in the distorted trade equilibrium is greater than or equal to the value of autarky consumption (evaluated at distorted-trade, domestic prices) if net trade tax revenue is positive. Again, recall that if \( X^i_e \) is imported \((M^i_e > 0)\), \( t^i > 0 \) is an import tariff, and if \( X^i_e \) is exported \((M^i_e < 0)\), \( t^i < 0 \) is an export tax. A country whose taxes on trade exceed its subsidies cannot be worse off than in autarky, but a country whose subsidies exceed its taxes on trade can be worse off.

15.8 CONCLUDING REMARKS

Tariffs, which are taxes on imports, are the most common form of government interference with international trade. They exist largely to protect domestic firms that compete with imports, though tariffs are sometimes levied for purposes of raising government revenues. We have analyzed tariffs and other trade taxes and subsidies in our general equilibrium framework, making the following major points.

1. Tariffs, like other forms of commodity taxes, alter relative prices and change quantities traded. Import tariffs raise the domestic price of imports and so reduce their quantity. If a country is small and thus faces fixed world prices, this reduction causes a reduction in the gains from trade, thereby reducing national welfare. Tariffs simply move the country back in the direction of autarky.

2. The effects of tariffs, as policy distortions, on consumers and producers can be examined in terms of both the import-competing and export sectors. Specifically, an import tariff is equivalent to a combination of a tax on consumption of the import good combined with a subsidy on production of the import-competing good. Furthermore, an import tax is equivalent to an export tax (in a two-sector model), and an import tariff can be offset by an export subsidy.

3. While tariffs are almost surely welfare-reducing for a small country, a large country may be able to exploit its monopoly power on world markets by using a tariff to gain a favorable terms-of-trade effect for itself. However, this power is greatly undermined by the likelihood that other countries will retaliate against the country imposing the tariff. The noncooperative scenario of tariff imposition and retaliation is unlikely to benefit any country. The probable outcome is that the volume of world trade will be reduced without a significant gain for any country in terms-of-trade advantage. Gains from trade are lost with the reduction in world trade. Stated in other terms, all countries suffer efficiency losses in terms of distorted consumption and production decisions with no offsetting advantages in international relative prices. However, in a cooperative scenario, countries are likely to find that the so-called "optimal" tariffs are not, in fact, optimal at all. By cooperatively reducing their tariffs, countries can expand trade without suffering adverse terms-of-trade effects and can thereby increase their welfare.

4. Tariffs frequently fall upon imported intermediate goods in the production process. The effect of these tariffs is to generate a pattern of distortions in the use of intermediate goods in the production process. The real extent of tariff protection in such cases is hidden by the layering of tariffs, and effective protection on final goods may be much greater or smaller than nominal tariff rates would indicate. It is important to account for these intersectoral effects of the tax structure in order to understand the nature of resource allocation pressures.

PROBLEMS

1. Is it possible for a tariff to make a country worse off than in free trade?
2. Redraw Fig. 15.1 for the case in which the country exports \( X \) and imports \( Y \).
3. Suppose a country produces two goods, \( X \) and \( Y \), along a linear production transformation curve where \( X \) is the imported good and production is specialized in \( Y \). Show the welfare losses from the imposition of a tariff on \( X \) and decompose these losses into production losses and consumption losses.
4. The government of the Republic of Korea at one time followed an aggressive policy of import protection with tariffs and export promotion with subsidies. Contrast this policy with one of free trade.
5. For the past several years, the United States has been subsidizing exports of grain. Analyze the welfare effects of this policy.
6. Suppose that instead of instituting an optimal import tariff, the government decides to use an optimal export tax. Using a methodology similar to that of Fig. 15.8, can you derive the optimal export tax formula? (Hint: in this case the home country would act as a monopolist in its export good).
7. Suppose a commodity is produced only after the introduction of a tariff on imports with which it competes. Will the usual effective-protection calculation be correct in this case?
8. Assume that yarn is the only input into cloth and that the proportion of yarn in the unit cost of cloth is 0.4 (that is, \( a^c = 0.4 \)). Let the nominal tariff rate on cloth be 25%. Compute the effective rates of protection to cloth when the yarn tariff is: (a) 0%, (b) 10%, (c) 25%, (d) 50%. Solve for the tariff rate on yarn that would make the effective rate on cloth zero.
9. Consider an industry $X_1$ with two intermediate inputs, $X_{21}$ and $X_{31}$, and suppose that $a_{21} = 0.2$ and $a_{31} = 0.5$. Tariff rates are $t_1 = 30\%$, $t_2 = 20\%$, and $t_3 = 10\%$. Calculate the effective rate of protection on $X_1$.

10. Suppose that a small country exports both goods $X_1$ and $X_{31}$, where $X_{31}$ is an input into $X_1$. Let $a_{31} = 0.3$ and suppose that the export tax rates are $t_1 = 25\%$ and $t_3 = 10\%$. Can you compute the effective rate of tax on $X_1$?

NOTES

1. For example, tariff revenue amounts to only 0.01 percent of total government revenue in the United Kingdom, 0.62 percent in Germany, and 1.56 percent in the United States. On the other hand, tariffs provide the government of Argentina with 13.31 percent of total revenue and the government of Ghana with 40.90 percent of all revenues. The source for these figures is International Monetary Fund (1986).

2. An ad valorem tax is one that is levied as a percentage of the value of the taxed goods, like a sales or excise tax. Not all tariffs are of this form. Some tariffs are specific tariffs, levied per unit of quantity, as in so many dollars per ton of fish. Frequently, specific and ad valorem tariffs are combined into compound tariffs.

3. A comprehensive treatment of the effects of various taxes on trade and welfare is given by Melvin (1976).

4. This point is credited to Lerner (1936), who assumed competitive markets in its proof. See also Kaempfer and Tower (1982) for an extension of numerous complications to the simple model.

5. Certain aspects of trade policy in the presence of domestic distortions are discussed in Bhagwati (1967, 1971), Johnson (1965), and Melvin (1976).

6. The original argument was made by Bickerdike (1966) and was formalized and generalized by a number of authors, including Graaff (1949).

7. See Johnson (1954) for a full discussion of the tariff war outcome and Markusen (1981) for an analysis of the opposite problem of cooperative tariff reduction. Note that the threat of retaliation by $F$ might be sufficient to deter the initial decision by $H$ to impose its optimal tariff, so there is a strategic element to this analysis as well.

8. Thus, we assume that the price of cars goes up by 20 percent, whether they are produced domestically or imported. Implicitly, this means that the importing country is small and that imported and domestic cars are perfect substitutes. We retain these assumptions with respect to intermediate inputs as well.

9. A further possibility is the existence of negative value added, which refers to the unusual situation in which an efficient domestic activity is so heavily protected that it is induced to produce a certain output, despite the fact that at world prices, the value of that output is less than the value of the intermediate inputs. For example, heavily distorted economies produce some products, such as cars, that cannot be sold on world markets for a price that would cover input costs.

10. In the presence of multiple inputs into the production of some good $j$, the value added of $j$ with protection on inputs will be

\[ v'_j = (1 + t_j) \sum_{i=1}^{n} a_{ij}(1 + t_i) \]

Here, $a_{ij}$ denotes input-output coefficients, and $t_j$ refers to the tariff rate on the output and on the inputs. To derive value added in free trade, this equation can be recalculated with all tariff rates set to zero. The resulting $v'_j$ and $v_j$ can then be substituted into Eq. (15.9) in order to calculate the effective rate.

11. See the paper by J. Berlinski and D. M. Schydlovsky (1982).

12. Recall the possibility that a tariff could raise welfare in the face of some other domestic distortion.