XI

Chapters 14 and 15 were prepared as reports for the Department of Commerce in 1965. Though they were rather widely circulated, both in and out of government circles, they have never before been published. Both chapters deal with the issue of GATT-type border-tax adjustments, the first one in the context of a "classical" model characterized by full employment and a fully operative international adjustment mechanism, and the second one in the context of a Keynesian model with fixed wages and exchange rates and with no automatic tendency for balance-of-payments adjustment. Given the nature of the two types of models, it seems appropriate to identify that of Chapter 14 with long-run equilibrium and that of Chapter 15 with relatively shorter-term variations under a fixed exchange-rate system.

In each case, specific mathematical models are developed which are then applied both to analyze indirect taxes of a fully general type and to treat the more likely case in which such taxes have only partial coverage. The implications of the possible substitution of indirect taxation (on which border-tax adjustments are allowable under the GATT rules) for corporation income taxation (against which GATT rules do not permit border-tax adjustments) are also explored in both cases.

Chapter 14

The Trade Effects of Alternative Tax Systems

The purpose of this chapter is to provide a theoretical framework for the analysis of the effects of different tax systems on the pattern of international trade. It is particularly concerned with the trade effects of a shift of (some of) the weight of taxation from direct, personal income taxes to indirect taxes, where the indirect taxes in question are subject to the GATT rule which permits "equalizing" import tariffs to be levied on imports of items which are struck by indirect taxes and which allows for the rebating of indirect taxes on items that are exported. Some attention will also be paid to the trade effects of a shift from direct, personal taxes to corporation income taxes to see what similarities exist between these effects and those stemming from a shift from personal taxes to indirect taxes.

THE ROLE OF ABSOLUTE PRICE-LEVEL MOVEMENTS

Much discussion on the subject is clouded by an issue that has little or nothing to do with the effects of taxation as such — namely, the behavior of the absolute price level and the rate of exchange. Suppose, for example, that a general value-added tax of 20 percent is imposed on all goods and services produced in an economy, replacing a general income tax of 20 percent. Furthermore, suppose that in the course of the economy's adjusting to this change, the general price level of goods produced in the economy is allowed to rise by 25 percent. Obviously, if the exchange rate is not permitted to change, the country will tend to import more and export less. But if the exchange rate (the price of foreign currency) is also allowed to rise by 25 percent, there will be no incentive to increase imports or reduce exports. Given a monetary policy that allows prices to rise by 25 percent, we have trade effects favorable to imports and unfavorable to exports so long as the exchange rate is held constant, and we have no trade effects so long as the exchange rate is permitted to rise to correspond to the rise of internal prices.

Analogously, we can assume that when the shift is made from a direct tax of 20 percent to an indirect, general value-added tax of 20 percent, the monetary policy pursued is such that internal prices (gross-of-tax) are not permitted to rise. Now we have no trade effects if the exchange rate is held constant. But

now nominal income accruing to factors of production has fallen from 100 to 80. If the exchange rate were to be allowed to fall in this case by 20 percent, reflecting the fall in unit factor costs of domestically produced goods, incentives favoring imports and discriminating against exports would again be produced. And, of course, if the exchange rate were to be raised, the incentives would work in the opposite direction.

It appears that almost anything can happen, depending on the monetary and exchange-rate policies pursued. But — and this is the first important point I want to make — we get the *same* effects from given policies even if we not change the tax system at all — i.e., if we stick with a straight, 20 percent personal income tax. Here, if the internal price level is allowed by monetary policy to rise from 100 to 125, there will emerge incentives against exports and in favor of imports unless the exchange rate is also raised by 25 percent. If the price level and the exchange rate are kept stable at 100 there are no trade effects, and if the price level is kept stable while the exchange rate is allowed to fall to 80 there are again the same trade effects as would emerge with a price level of 125 and an exchange rate of 100. Given the fact that we get the same trade effects from given combinations of monetary and exchange-rate policy, regardless of whether we make the shift from direct to indirect taxes or not, it seems to me to be completely misleading to attempt to attribute such effects to the tax change itself; they reflect the monetary and exchange-rate policy of the country rather than its tax policy.

The situation is essentially similar when a general indirect tax is imposed on domestic buyers of final products rather than the domestic producers. Here, however, exchange adjustments create trade effects when the price level is allowed to rise to reflect the indirect tax, while downward exchange-rate adjustments are necessary to prevent trade effects if monetary policy holds the price level constant. If prices paid by domestic buyers rise from 100 to 125, prices paid for the country's exports by foreigners (which do not include the tax), stay put at 100. Likewise, if prices paid by domestic buyers for imports rise from 100 to 125, prices received by foreign suppliers also stay put at 100. Thus only if the exchange rate is kept at its prior level will there be no incentives to change the levels of imports or exports. On the other hand, if a monetary policy is followed which maintains the (gross-of-tax) price level at 100, prices received by domestic producers will have to fall to 80, and there will be incentives for export expansion. Likewise, prices of imports will tend to rise (gross-of-tax), and import quantities to fall. These trade effects can be avoided (still assuming a monetary policy which maintains the price level at 100), by an appreciation of the country's currency (i.e., a fall in the exchange rate to 80). When the exchange rate is at 80 per unit of foreign currency, the net-of-tax prices of both imports and exports can fall to 80 in domestic currency, while their foreign currency prices stay constant. This point is clearly seen by Musgrave and Richman in their paper "Allocation Aspects: Domestic and International."[1] They implicitly assume the exchange rate is kept constant, and state that a general indirect tax imposed on domestic buyers of all final products (which is equivalent to a value-added tax with GATT-rule treatment) will have no trade effects if the general price level is allowed by monetary policy to rise to reflect the tax, but will have trade effects if monetary policy does not allow this price-level adjustment. I would add only that regardless of what happens to the price level, an exchange-rate adjustment can be found that will render nil the trade effects of a shift from direct to general indirect taxation of final products at the domestic buyer level.

[1] National Bureau of Economic Research and The Brookings Institution, *The Role of Direct and Indirect Taxes in the Federal Revenue System* (Washington, D.C.: The Brookings Institution, 1964), p. 104.

A BASIC ASSUMPTION: BALANCE-OF-PAYMENTS ADJUSTMENT

The key question to be faced here is how to isolate the effects of a change in the tax system upon the pattern of trade, when the pattern of trade is so heavily influenced by both monetary and exchange-rate policies. The answer I propose is a simple one, and, I believe, the only one that can plausibly be defended: we must assume that monetary and exchange-rate policies are such as to bring about equilibrium in the balance of payments. This has been the assumption made in the international trade literature on the pure theory of tariffs and trade restrictions, and it was also adopted in an insightful paper, recently produced by the Office of Tax Analysis of the U.S. Treasury,[2] which deals with problems similar to those treated here.

One question which arises in connection with the assumption of balance-of-payments equilibrium is that it appears at first sight to assume trade effects away. Nothing could be further from the truth. A tariff policy which greatly restricts imports will by itself produce balance-of-payments equilibrium at a very low level of trade; a policy which heavily subsidizes exports will produce equilibrium at a much higher level of trade than a "neutral" tax policy, etc. Other tax policies can (and in general will) affect the "equilibrium" level of trade through their various influences upon the demand for and the supply of importable goods and exportable goods. Within these categories, the tax system can differentially affect different commodities, curtailing, for example, the level of trade in some importables and exportables, while expanding the volume of trade in other items in these same broad groups. To interpret these trade effects upon the rest of the world, we can reasonably assume that if exports by country A of a particular commodity are increased as a consequence of country A's tax policy, the effect will be to curtail to some extent the production of and trade in competing commodities by other countries, and conversely. Similarly, if tax policy leads to a reduction of imports of a good by country A, other countries' exports of that good will tend to be curtailed. Thus if we can estimate the pattern of effects of country A's tax system on its imports and exports, we can also indicate which exports of which other countries are likely to have been hurt or helped by that tax system.

A second question that also arises in connection with the assumption of balance-of-payments equilibrium concerns its realism. Can we realistically assume that an adjustment mechanism is at work which actually brings about

[2] U.S. Treasury, Office of Tax Analysis, "The Foreign Trade Effects of Changes in Domestic Tax Systems" (mimeo., March 5, 1964).

continued equilibrium in a country's balance of payments? Obviously not. But on the other hand, can we realistically assume that an adjustment mechanism is absent? I would say even more obviously not. The world economy has probably doubled in "size" during the postwar period; vast changes have taken place in the technologies and the structures of production of the different national economies; internal price levels and wage levels have exhibited vastly different movements in different countries; the composition of trade itself has changed very significantly in a number of countries. If the basic changes that produced these and other effects had somehow worked themselves out *without* there existing any tendency for balances of payments to be brought somewhere "near" equilibrium, I think there can be no doubt at all but what gold movements and international liquidity crises would have emerged that would utterly dwarf those that in fact have occurred. Something has obviously been helping to keep balances of payments under some sort of control. We have had currency depreciations and currency appreciations; we have had differential price-level movements; interest rate policies have been manipulated so as to affect the movement of capital and thus at least assuage existing pressures on particular countries' balances of payments. These forces have maintained, I believe, a reasonable degree of order in the world payments picture in spite of disturbances that in and of themselves would be very disruptive of that order. I cannot see how one can say that the world payments system has somehow been able to adjust to such powerful changes as the emergence of Italy and Japan as major exporters of new products, as the differential inflations that have occurred in the various major trading countries, while it has not tended to adjust to the comparatively minor impact on trade of having one type of tax system rather than another in one or more countries. Imperfect though the adjustment mechanism is, it is surely working. And it is doing a reasonable job of accommodating disturbing forces that are far greater than the kinds of tax changes we are analyzing here. Hence as we proceed to analyze the effects of alternative tax systems, we are on much safer ground assuming balance-of-payments adjustment than we would be if we attempted somehow to rule adjustment mechanisms out of the picture.

THE RELATION OF TAX INCIDENCE TO THE QUESTION AT HAND

Having already shown that it is unwarranted to attribute absolute price-level differences to the presence or absence of a particular type of taxation, we can now rather easily dispose of another issue that has weighted down much previous work on the subject of this chapter. As part of the erroneous concentration on absolute price-level effects, the point of view is often expressed that if a tax is shifted forward it tends to hamper trade, while if it is shifted backward it does not. The March 5, 1964, Treasury paper effectively disposes of this view, but its presentation is, in my view, somewhat marred by the association of shifting with absolute price-level movements. The shifting and incidence of taxation is a question which can and should be explored in the framework of relative rather than absolute prices. A perfectly general value-added tax, for example,

has the same ultimate incidence regardless of whether the price level is permitted to rise to 125, keeping factor incomes constant at 100, or if the price level is kept constant at 100, allowing factor incomes to fall to 80, provided that the exchange rate is appropriately adjusted in the second case. The Treasury study comes to the correct conclusion that the price-level response does not matter, but in doing so it calls the case of a rising price level a case of forward shifting, and the case of a falling price level one of backward shifting. The study makes no fundamental mistake, only, perhaps, an inelegant use of terms, yet in doing this it tends to perpetuate the association of the shifting/incidence question with absolute price-level effects.

The Musgrave-Richman paper, on the other hand, clearly sees that monetary policy is the key element in governing price-level movements when it treats the value-added tax (p. 104). On this subject, the paper's flaw is that it does not allow for any adjustment mechanism; hence it arrives at different answers depending on the monetary policy followed. (When exchange rate adjustments are later briefly mentioned (p. 110), the possibility of their "neutralizing" a value-added tax is noted, but even here the connection between the nature of monetary policy on the one hand and the necessity or nonnecessity of devaluation on the other, is not brought out.)

The Musgrave-Richman paper takes a different tack, however, when it analyzes the effects of corporation income taxes (pp. 112–113). Here, when the corporation income tax is assumed to be shifted, this is taken to imply that the absolute price level rises to reflect the tax; when the corporation income tax is assumed not to be shifted, the absolute price level is taken to remain constant. When the authors compare corporation tax treatment with a value-added tax alternative, they make alternate assumptions concerning whether the value-added tax also is (or is not) reflected in the absolute price level. We have been told earlier that these consequences of value-added taxation depended on monetary policy (i.e., not on incidence), yet when the corporation tax is discussed it appears to be incidence rather than monetary policy that is bringing about the absolute price-level effects.

Let me here assert flatly that there is no direct association between the incidence of the corporation income tax and the level of the general price level in the economy. The corporation income tax can be entirely shifted, and the price level can go up or down; it can be entirely borne or more than completely borne by capital, and the price level can go up or down. The shifting question concerns the percentage shares of capital and labor in the national income, while the price-level question concerns the nominal size of the pie which is being divided. The price level can go up, and capital can obtain either a smaller, the same, or a bigger net-of-tax share of the pie, and likewise if the price level goes down. Moreover, *regardless of its incidence*, the corporation income tax is guaranteed by accounting procedures to be "part" of the price of the products of corporate enterprise. But this does not mean that if the tax were taken off, the price level would decline by the proportion that corporate tax receipts bear to national income. We simply must maintain the clear independence of questions of shifting and incidence from questions of general price-level determination, and I believe we are well advised to take the further step adopted

here of assuming an international adjustment mechanism to be at work. This last assumption automatically makes the level of a country's general price level irrelevant to the effects of particular types of taxation in that country.

INDIRECT TAXES DO HAVE TRADE EFFECTS

In general, one can expect that a set of indirect taxes will have trade effects. If the indirect taxes are placed on the production of the affected commodities, and so long as the indirect taxes are not completely general, the normal effect will be to restrict the production of the taxed commodities, to expand imports of competing goods, and to contract exports of the taxed commodities. If, on the other hand, the indirect taxes are placed on the consumption of the affected commodities, and again so long as the indirect taxes are not completely general, the normal effect will be to restrict the consumption of the taxed commodities, to reduce imports of competing goods, and to expand exports of the taxed goods. Taxes on consumption (or, what is the same thing, taxes on production with GATT-rule border-tax adjustments) thus produce incentives in the direction of expanding exports and contracting imports of the taxed goods, while taxes on production without border-tax adjustments generate incentives for the expansion of imports and the contraction of exports of the affected commodities.

The balance-of-payments adjustments induced by these types of taxes will be the reverse of the direct effects. For consumption taxes, balance-of-payments adjustment will require contraction of other exports and expansion of other imports — effects which can be brought about by internal inflation and/or by currency appreciation. For production taxes, balance-of-payments adjustment will require expansion of other exports and contraction of other imports — which can be brought about by internal deflation and/or currency depreciation. One cannot say, a priori, whether the total ultimate effect of either kind of tax upon trade will be positive or negative, but one can outline the key forces that are involved.

If consumption taxes fall exclusively on importables, the normal effect will be to decrease trade; if they fall exclusively on exportables, the normal effect will be to increase trade. If production taxes (without border-tax adjustments) fall exclusively on importables the normal effect will be to increase trade, and if they fall exclusively on exportables, the normal effect will be to decrease trade. Beyond this no simple generalizations can be made.

The procedure for finding the general solution in any specific case is, however, clear. Let commodities 1 to k be exportables, commodities k to n be importables, and commodities n to q be purely domestic goods. Measure the commodities in units of foreign currency (on the assumption that their foreign currency price is beyond the control of the country in question). Let H_{ij} be $\partial X_i/\partial t_j$, measuring the effect of a change in the tax rate on commodity j upon the production of commodity i. Likewise, let G_{ij} be $\partial C_i/\partial t_j$, measuring the effect of a change in the tax rate on j upon the consumption of commodity i. Let $E_i(= X_i - C_i)$ be exports (imports if negative) of commodity i, and let D_i represent $\partial X_i/\partial r$ — measuring the effect of a change in the exchange rate upon production of i; and let B_i represent $\partial C_i/\partial r$ — measuring the effect of a change in

the exchange rate upon the consumption of i. The effect of a given pattern of taxes upon exports of i will be $\sum_j (H_{ij} - G_{ij})t_j + (D_i - B_i)\,\Delta r$, and the effects upon total exports will be

$$\sum_{i=1}^{k}\sum_{j=1}^{q}(H_{ij} - G_{ij})t_j + \sum_{i=1}^{k}(D_i - B_i)\,\Delta r.$$

The relevant expression for Δr is obtained by the requirement of equilibrium in the balance of trade, i.e.

$$\sum_{i=1}^{n}\sum_{j=1}^{q}(H_{ij} - G_{ij})t_j + \sum_{i=1}^{n}(D_i - B_i)\,\Delta r = 0.$$

To see how this general analysis applies in a simple case, assume that a consumption tax is imposed on only one export good, j. This will produce a negative effect on consumption of that good ($G_{jj} < 0$), and will in and of itself have no effect on the production of that good ($H_{jj} = 0$), because the price facing producers is simply the world price translated at the prevailing exchange rate. Thus the "impact effect" of the tax will be to expand exports of good j, producing on that account a favorable tendency in the balance of trade. The restoration of equilibrium in the balance of trade requires an appreciation of the currency which will produce effects restricting exports and expanding imports, operating generally over all commodities. These induced effects upon exports will in part offset the expansion in exports of good j, but not fully, because the induced effects upon imports will do some of the offsetting. The net effect is therefore an expansion in exports of good j, a contraction of other exports, and an expansion of imports of all kinds. (Even this simple case could be complicated by the cross-effects of the tax on good j upon the production and consumption of other commodities. If these cross-effects are significant upon other traded items, the tax on j could conceivably result in a net contraction of trade. I plan to investigate this possibility further.)

COMPARISON OF THE TRADE EFFECTS OF INDIRECT TAXES AND OF TARIFFS

Whatever may be the effects of a set of indirect taxes upon trade, they are likely to be substantially less than the effects of taxes at the same rates falling on trade alone — i.e., production or consumption taxes will have less effect upon trade than tariffs. To establish this proposition we need only note that the effects of a tariff can be duplicated by a similar tax on the consumption of the tariffed commodity (whether imported or domestically produced), and a simultaneous subsidy to the domestic production of the tariffed good. The trade effects of a tariff are therefore composed of two parts: a disincentive to consumption which could be reproduced by a consumption tax; and an incentive to domestic production which could be reproduced by a production subsidy. An indirect tax on consumption will give us the first of these effects, while an indirect tax on production will cause changes in trade similar in magnitude (though opposite in sign) to the second of these effects.

It is likely that in most cases the production effects of tariffs are greater than the consumption effects; therefore, as a guide to our judgment, we may assume that a set of consumption taxes on importables would have somewhat less than half of the effect upon trade that would ensue from a set of tariffs on the same commodities at similar rates to the consumption taxes. However, the effects on trade of existing consumption-type indirect tax systems are likely to be still smaller than this, for these tax systems also strike exportables, and in this area they operate to increase trade. Therefore, unless an indirect tax system is heavily concentrated on either importables or exportables, its trade effects are likely to be only a small fraction of the trade effects of tariffs at similar rates.

TRADE EFFECTS OF CORPORATION INCOME TAXES

Corporation income taxes can be viewed as partial value-added taxes — striking only that part of value added which is represented by the income from corporate equity capital. They operate to reduce production in the corporate sector, as against what it would otherwise be, to stimulate production in the noncorporate sector, and to alter factor intensities in favor of labor in the corporate sector and in favor of capital in the noncorporate sector. It is highly unlikely that the last-mentioned effect of corporation taxes on relative factor intensities has any significant bearing on the trade effects of these taxes. The principal trade effects will stem mainly from the production incentives created by the tax, and will be similar to the trade effects of production-type value-added taxes. To the extent that the corporate sector is concentrated mainly in the production of exportables, the effect of corporation income taxation will likely be to decrease trade; to the extent that the corporate sector is concentrated mainly in the production of importables, it is likely that corporation income taxation will increase the volume of trade. The effects upon trade of the corporation income tax are likely to be very similar to those of an alternative set of indirect taxes on value added, where the tax on value added in any activity would equal the fraction which corporate tax payments now bear to value added in that activity.

This similarity of the trade effects of the corporation tax and of a corresponding set of value-added taxes suggests that border-tax adjustments are just as justifiable for the corporation tax as for value-added taxes. Before exploring this idea, let me state briefly the "justification" for border-tax adjustments. It is *not* that these adjustments render indirect taxes neutral with respect to trade, but rather it is that the trade effects of indirect taxes striking the consumption of goods of a given type (regardless of their place of origin) are likely to be smaller than the trade effects of taxes of similar size striking the production of those same goods within the country imposing the tax. Border-tax adjustments simply perform the function of transmuting taxes levied nominally upon production into taxes which are in effect taxes on consumption of the affected commodities.

If we have a tax on value added in a given set of industries, we can view that tax as striking the returns to all factors of production occupied in those

industries, and we can view the border-tax adjustments as placing a countervailing tax on competitive imports and as rebating the taxes on returns to factors of production for those goods that are reported. The same procedure can be applied when the tax does not strike the returns to all factors of production but only, say, the returns to corporate equity capital.

The objections to the making of border-tax adjustments for corporation income-tax payments appear to be mainly practical rather than theoretical ones. Although, in general, corporation taxes are levied as a flat percentage of profits, the ratio which they bear to the price of the product varies with relative factor intensities, with the capital structure of the companies concerned, and with the rate of return to equity capital. Thus, a 50 percent tax on the return to equity capital might represent 10 percent of the price of some cotton textiles, and 20 or 30 percent of the price of other cotton textiles. What rate would be appropriate as the countervailing duty on imports of textiles? There is no obvious answer to this question, but it presages some of the difficulties that would accompany any attempt to make border-tax adjustments for the corporation income tax. Other difficulties emerge in connection with the rebating of the tax for export purposes, as it is not known how much corporation tax has been paid at each of the various stages through which a product has passed before finally being exported.

A final point in this connection is that the corporation income tax is not likely to be concentrated heavily in either the exportables or the importables industries. Since its effect in the case of exportables is trade-contracting, and in the case of importables is trade-expanding, the presence of these offsetting forces upon trade may well produce a rather small net effect.

SOME INDICATIONS AS TO THE SIZE OF TRADE EFFECTS OF INDIRECT TAXES

A fully general indirect tax striking all production in the economy at a single rate would presumably have no effects on trade, on production or on consumption (recall that we are comparing this indirect tax with an alternative way, e.g., an income tax, of raising the same revenues). The same statement can be made for a fully general indirect tax striking all purchases of final goods and services. Thus as far as fully general taxes are concerned, one need not worry about trade effects, regardless of the "type" of tax. By the same token, for fully general taxes there can be no serious defense for border-tax adjustments — they convert production taxes into consumption taxes, but so long as one is speaking of fully general taxes there will be no trade effects from either set; the border-tax adjustments would appear in this case to be superfluous and therefore unnecessary.

When one gets down to indirect taxes that are not fully general, however, trade effects may occur, and border-tax adjustments may affect their magnitude. The following analysis sketches the principal effects for a relatively simple case.

Suppose, initially, that indirect taxes are levied only on products which happen to be either exportables or importables. Assume, furthermore, that the country in question cannot affect the world prices of either of these classes of

goods. This assumption enables us to juxtapose the demand function for imports and the supply function for exports, by measuring the quantities of both imports and exports in terms of their foreign-currency values. The level of trade will be determined by the intersection of these two functions, as in Figure 14.1. Altering the tax system will, presumably, shift these functions and thus alter the equilibrium level of trade. We must thus inquire into how various methods of taxation will affect the location of the functions in question.

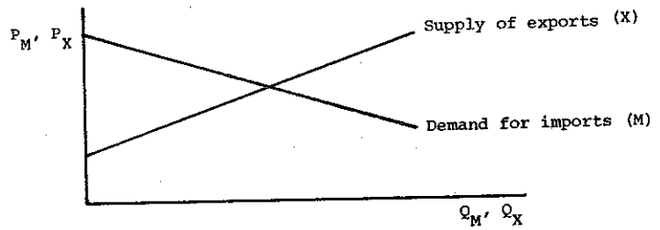

FIGURE 14.1

Consider first the demand for imports. This function will be the difference between the demand function for importables (I) and the supply function for these goods. Taking the price of home goods (neither exportable nor importable) as the numeraire, we write the demand function for importables as

$$I^d = a_0 + a_1(P_I + T_I) + a_2(P_E + T_E), \tag{14.1}$$

where T_I and T_E are the unit taxes on the consumption of importables and of exportables, respectively, and P_I and P_E are their net-of-tax prices, which must be equal to each other because of the choice of units in which exportables and importables are measured. Assume also that, given the price of home goods, the locally produced supply of importables is a function solely of the price received by producers. Thus

$$I^s = b_0 + b_1 P_I. \tag{14.2}$$

The demand function for imports can therefore be written as

$$M^d = I^d - I^s = (a_0 - b_0) + (a_1 + a_2 - b_1)P_I + a_1 T_I + a_2 T_E. \tag{14.3}$$

In like manner, we write the demand function for exportables:

$$E^d = c_0 + c_1(P_E + T_E) + c_2(P_I + T_I). \tag{14.4}$$

The supply function for exportables is

$$E^s = e_0 + e_1 P_E, \tag{14.5}$$

and the supply function for exports:

$$X^s = E^s - E^d = (e_0 - c_0) + (e_1 - c_1 - c_2)P_I - c_1 T_E - c_2 T_I, \tag{14.6}$$

recalling at this last step that $P_E = P_I$.

Denoting, for simplicity, $(a_0 - b_0)$ by f_0, $(a_1 + a_2 - b_1)$ by f_1, $(e_0 - c_0)$ by g_0, and $(e_1 - c_1 - c_2)$ by g_1, we can equate M^d and X^s to obtain

$$f_0 + f_1 P_I + a_1 T_I + a_2 T_E = g_0 + g_1 P_I - c_1 T_E - c_2 T_I. \tag{14.7}$$

This yields

$$P_I = \frac{(f_0 - g_0) + (a_1 + c_2)T_I + (a_2 + c_1)T_E}{g_1 - f_1} \tag{14.8}$$

and

$$M = f_0 + \frac{f_1(f_0 - g_0) + f_1(a_1 + c_2)T_I + f_1(a_2 + c_1)T_E}{(g_1 - f_1)} + a_1 T_I + a_2 T_E, \tag{14.9}$$

where $M\,(= X)$ now represents the equilibrium volume of trade. Thus, as compared with a situation in which no indirect taxes are levied, the change in the level of trade resulting from having taxes of T_I and T_E per unit on the consumption of importables and exportables, respectively, will be

$$\Delta M = \frac{f_1(a_1 + c_2)T_I + f_1(a_2 + c_1)T_E + (g_1 - f_1)a_1 T_I + (g_1 - f_1)a_2 T_E}{(g_1 - f_1)}$$

$$\Delta M = \frac{(f_1 c_2 + g_1 a_1)T_I + (f_1 c_1 + g_1 a_2)T_E}{(g_1 - f_1)} \tag{14.10}$$

To analyze this expression, we must determine the presumptive signs of the relevant parameters

f_1 = price slope of import demand function — negative

g_1 = price slope of export supply function — positive

a_1, c_1 = own-price slopes of demand functions for importables and exportables — negative

a_2, c_2 = cross-price slope of demand functions for importables and exportables — positive

$\frac{f_1 c_2 + g_1 a_1}{g_1 - f_1}$ = partial effect of T_I upon trade — negative

$\frac{f_1 c_1 + g_1 a_2}{g_1 - f_1}$ = partial effect of T_E upon trade — positive.

The partial effects of T_I and T_E upon trade are seen each to be a weighted average of an own-price demand effect and a cross-price demand effect. If we set $[-f_1/(g_1 - f_1)] = w_1$, and $[g_1/(g_1 - f_1)] = w_2$, we can express the partial

effect of T_I upon trade as $w_1(-c_2) + w_2a_1$, and the partial effect of T_E upon trade as $w_1(-c_1) + w_2a_2$.

These two effects are likely to be quite similar in magnitude, though opposite in sign. Our problem, with the assumptions that have been made including a fully employed economy, precludes the existence of first-order income effects. The price-slopes a_1, a_2, c_1 and c_2 therefore represent substitution effects, and we can write $a_1 + a_2 + a_3 = 0$; $c_1 + c_2 + c_3 = 0$, defining a_3 as $\partial I^d/\partial P_3$, and c_3 as $\partial E^d/\partial P_3$, with P_3 representing the price of home goods. Thus we have

$$\text{Partial effect of } T_I \text{ upon trade} = w_1c_1 + w_2a_1 + w_1c_3,$$
$$\text{Partial effect of } T_E \text{ upon trade} = w_1(-c_1) + w_2(-a_1) + w_2(-a_3).$$

These expressions differ only in respect of their third terms. The partial effect of T_E upon trade will tend to be greater than that of T_I if first $a_3 > c_3$, i.e., exportables are better substitutes for home goods than importables, and second $w_2 > w_1$, i.e., the elasticity of supply of exports is greater than the elasticity of demand for imports, and conversely.

We now turn to the analysis of the trade effects of indirect taxes that are levied on the production rather than the consumption of the affected commodities. Taking R_I and R_E as the unit taxes on importables and exportables, respectively, we have, recalling that $P_I = P_E$,

$$(14.1') \qquad I^d = a_0 + (a_1 + a_2)P_I$$
$$(14.2') \qquad I^s = b_0 + b_1(P_I - R_I)$$
$$(14.3') \qquad M^d = I^d - I^s = (a_0 - b_0) + (a_1 + a_2 - b_1)P_I + b_1R_I$$
$$(14.4') \qquad E^d = c_0 + (c_1 + c_2)P_I$$
$$(14.5') \qquad E^s = e_0 + e_1(P_I - R_E)$$
$$(14.6') \qquad X^s = E^s - E^d = (e_0 - c_0) + (e_1 - c_1 - c_2)P_I - e_1R_E.$$

Equating X^s and M^d, and defining f_0, f_1, g_0, g_1 as before, we have

$$(14.7') \qquad f_0 + f_1P_I + b_1R_I = g_0 + g_1P_I - e_1R_E.$$

This yields

$$(14.8') \qquad P_I = \frac{(f_0 - g_0) + e_1R_E + b_1R_I}{(g_1 - f_1)},$$

and

$$(14.9') \qquad M = f_0 + \frac{f_1(f_0 - g_0) + f_1c_1R_E + f_1b_1R_I}{(g_1 - f_1)} + b_1R_I.$$

Thus, as compared with a situation with no indirect taxes, the change in the level of trade stemming from the taxes R_I and R_E on the production of importables respectively, will be

$$\Delta M = \frac{f_1e_1R_E + f_1b_1R_I + (g_1 - f_1)b_1R_I}{(g_1 - f_1)}$$

$$(14.10') \qquad \Delta M = \frac{f_1e_1R_E + g_1b_1R_I}{g_1 - f_1}$$

$$\Delta M = w_1(-e_1)R_E + w_2b_1R_I.$$

Our results, as expected, show that the effect upon trade of a production tax on exportables will be negative, and that of a production tax on importables positive.

We are now in a position to compare the relative magnitudes of the effects of taxes striking production. This comparison is relevant because the effect of border-tax adjustments is to convert a production-based tax into a consumption-based tax. Taking exportables first, we can see that a consumption-based tax will increase trade by $[w_1(-c_1) + w_2a_2]T_E$, while a production-based tax will decrease trade by $w_1e_1R_E$. Thus if the responsiveness of production of exportables to price changes is sufficiently greater than the responsiveness of their consumption, i.e., if $w_1e_1 - w_1(-c_1) > w_2a_2$, the production-based tax will have a greater effect upon trade than the consumption-based tax. Now taking importables, we find that a consumption-based tax will decrease trade by $[w_2(-a_1) + w_1c_2]T_I$, while a production-based tax will increase trade by $w_2b_1R_I$. Thus if the responsiveness of production of importables to price changes is sufficiently greater than the responsiveness of their consumption, i.e., if $w_2b_1 - w_2(-a_1) > w_1c_2$, a production-based tax of given magnitude will have a greater effect upon trade than a consumption-based tax of similar magnitude. The same conclusion holds in both instances. I believe it is highly likely that production of both exportables and importables is substantially more sensitive to price changes than their consumption. If this judgment is correct, the conclusion to be derived is that border-tax adjustments in and of themselves tend to reduce the magnitude of the trade effects stemming from indirect taxes.