8

Estimating the Welfare Effects of Trade Liberalization

We shall be concerned in this chapter with measuring the static welfare effects an economy may experience as the result of trade liberalization. These effects will arise as an economy adjusts to trade liberalization by altering its domestic pattern of consumption and production to the dictates of international prices and in the process more fully reaps the benefits of specialization according to its comparative advantage.

In actuality, trade liberalization will of course have a variety of complicated effects on an economy. In the short run, there may be important adjustment problems arising from the required transfer of resources among the different productive sectors. These problems may include balance-of-payments deficits or surpluses and unemployment of productive factors probably concentrated in particular industries and regions. Longer-run effects may include an alteration of the international flow of direct investment, domestic redistribution of income, revitalization of sluggish domestic industries due to economies of scale, and improved dissemination of technology. Evidently, then, the static welfare effects we shall treat are but a part of a host of complicated responses to trade liberalization.

We shall begin by examining the welfare effect of a prohibitive tariff in the case when exports and imports are treated in the aggregate as individual goods. Thereafter, we shall treat the case of a nonprohibitive tariff. We shall then explore the multigoods case, making allowance for the possibility of changes in the terms of trade and tariffs on imported inputs. Following our theoretical exposition will be a discussion of some of the measurement problems that arise in assessing the welfare effects of trade liberalization. We shall have occasion finally to indicate how the analysis may be related to the effects of customs unions and trade preferences.

THE WELFARE EFFECT OF A PROHIBITIVE TARIFF

A tariff on importables will raise the internal price of the importable good, and thus drive a wedge between the external price ratio and the internal price ratio. When the tariff becomes sufficiently high, international trade will cease. Such a prohibitive tariff is compared with free trade in Figure 8.1,

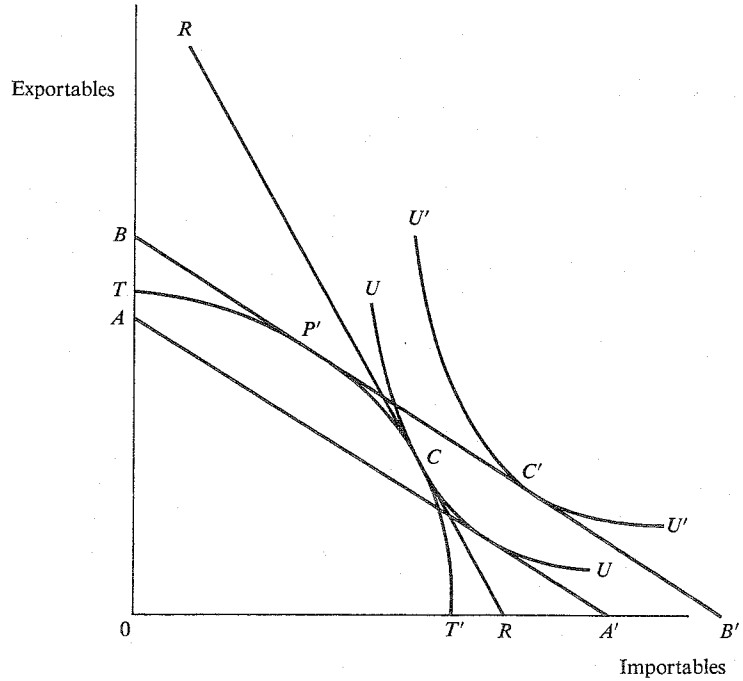

FIGURE 8.1

Welfare Effect of a Prohibitive Tariff

where TT' is the production possibilities curve, UU and $U'U'$ are community indifference curves, and AA' and BB' are international trading lines. Free trade and competitive conditions require that the international price line be tangent to both the production possibilities curve and the community indifference curve, thus requiring production at P' and consumption at C'. Under

the assumption of an infinitely elastic offer curve, the imposition of a tariff on importables will cause the internal price line to be steeper than the international price line. Consumption and production will adjust to maintain their tangencies with the internal price line, thus increasing the production and reducing the consumption of importables. When the internal price line is RR, both production and consumption are at C and trade with the rest of the world ceases. The loss in utility induced by the prohibitive tariff is reflected by the movement from $U'U'$ to UU, which may be measured at the international price ratio in terms of the exportable good as AB, the amount of the exportable good that could be surrendered and still maintain the pretrade level of utility.

The length AB is associated with the notion of consumer surplus and can be calculated under a rather strict assumption as a triangle under an ordinary import-demand function. To refresh the reader's memory on this point, we shall briefly review the argument that leads to the measurement of such triangles.[1] Referring to Figure 8.2, suppose an individual enters the

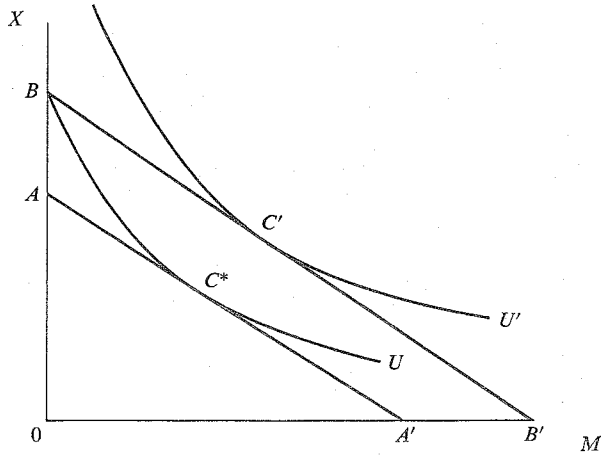

FIGURE 8.2

Welfare Gain in a Simple Exchange Situation

market place with OB of good X and a utility level U. Trading at the competitive price indicated by the straight line BB', he adjusts his consumption to point C' and enjoys a utility increment that may be measured by AB, the

[1] For other descriptions see Friedman [12] or Patinkin [26].

amount of good X he could surrender and still be as well off as he was in the pretrade situation.

It is convenient to break up the length AB into smaller segments x_i, as in Figure 8.3. If we let P' be the slope of the utility curve at C^* and let P_i be

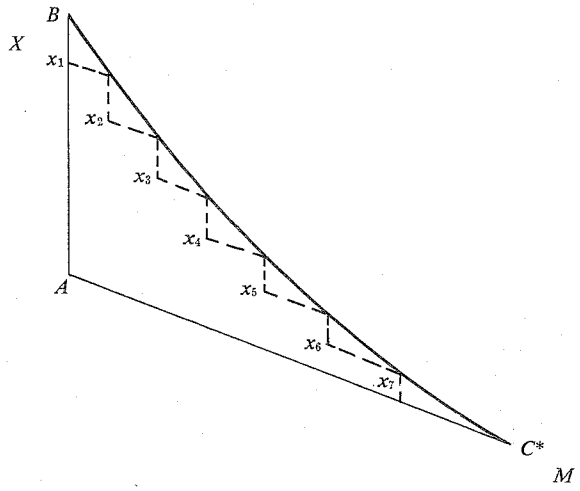

FIGURE 8.3

Measurement of Welfare Gain: A

the slope of the utility curve in segment i, we may then calculate the length x_i as depicted in Figure 8.4 as

$$x_i = P_i \Delta M_i - P' \Delta M_i \tag{8.1}$$

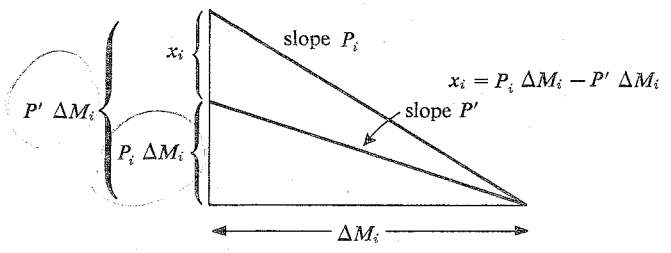

FIGURE 8.4

Measurement of Welfare Gain: B

The length AB is just the sum of these segments: [2]

$$AB = \sum_i x_i = \sum_i (P_i \Delta M_i - P' \Delta M_i) \tag{8.2}$$

We may now define a compensated demand curve Dd in Figure 8.5, which indicates the amount that would be purchased if consumption were constrained to the initial utility level by compensating variations in money income. The height of such a curve is simply the slope P_i of the utility curve at the relevant point. The segment x_i is thus the rectangular area as indicated,

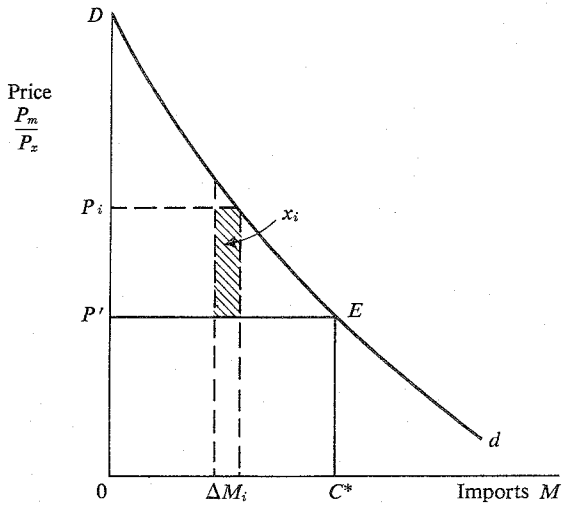

FIGURE 8.5

Compensated Demand Curve

and the length AB is represented by the triangular area $P'ED$. We thus have the consumer surplus measured in terms of the good X as a triangular area under a compensated demand curve.

[2] More precisely

$$AB = \int_{M'}^{M''} \left[\frac{\partial X}{\partial M}(M) - \frac{\partial X}{\partial M}(M'') \right] dM$$

where M' and M'' are the initial and final values of M and $(\partial X/\partial M)\,(M)$ is the slope of the particular utility curve evaluated at M.

Unfortunately there are no observations available to us which would disclose the nature of the compensated demand curve. We would require for this purpose that a compensating variation of income be made that in turn would require a knowledge of the unknown utility structure. What is observed, however, is the ordinary demand curve indicating purchases of importables as a function of money income and prices. If the compensated and ordinary demand curves are related in some known way, the compensated curve could be constructed from the observable ordinary demand function. One way to relate the two demand curves is to assume that importables have a zero income elasticity of demand. Under this assumption the purchases of M depend only on relative prices, and thus compensating variations in income do not alter the amount purchased, and, correspondingly, the ordinary and compensated demand curves are identical. Accordingly, under the assumption of zero income effect, triangles under ordinary demand curves will provide a measure of the consumer surplus rendered by the exchange possibilities of liberalized trade.

This analysis is appropriately thought to apply to a single individual who behaves consistently to maximize some ordinal preference map. Whether it can be aggregated to the level of a national economy is questionable on two counts. In the first place, we will have to construct a community indifference map by aggregating individual preferences. This will involve problems of income distribution and, implicitly, interpersonal comparisons of utility. Secondly, we will have to assume that the community behaves in a fashion that seeks to maximize the indifference map. Otherwise empirical observations will disclose nothing about the true indifference structure.

To summarize, we have seen that if the community has a consistent utility map and obtains maximum utility as indicated by that map, the surplus rendered by the exchange possibilities of international markets can be measured by the area under a compensated demand curve reflecting the amount of the export good that could be surrendered with no loss in welfare. When the observed demand curve is inelastic to income changes, it will correspond with the compensated demand curve and the welfare gain is simply the appropriate triangle under the ordinary demand curve. The assumptions implicit in this welfare analysis are clearly quite restrictive. We shall return subsequently to discuss the likely impact of departures from them.

Our discussion thus far has been confined to the simplest possible type of exchange situation. Let us introduce some further complexities. In particular, we shall now make allowance for adjustments in production as well as consumption, as in Figure 8.1, in the context of assessing the welfare impact of a nonprohibitive tariff.

THE WELFARE EFFECT OF A NONPROHIBITIVE TARIFF

Figure 8.6 illustrates the effect of a nonprohibitive tariff. As before, the international price lines are AA' and BB' and the internal price lines are RR' and SS' with importables relatively more expensive. Production and consumption adjust with the tariff to P and C to maintain the tangency conditions with respect to the internal price lines. Trading in international markets occurs at the international price ratio, and the line PC is parallel to AA'. The loss of utility due to the imposition of the tariff may be measured by AB, the amount of the exportable good that could be surrendered with no loss in utility.

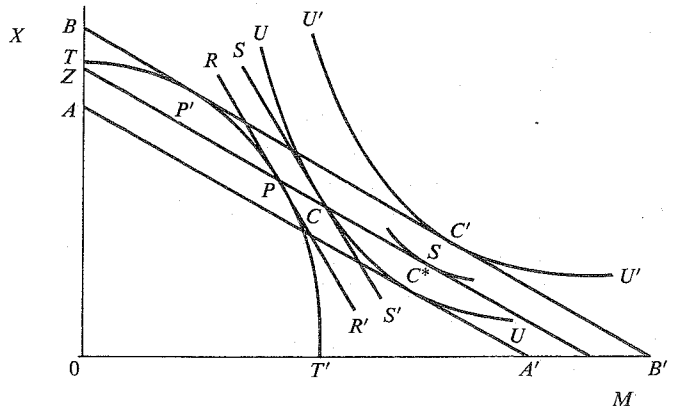

FIGURE 8.6

Welfare Effect of a Nonprohibitive Tariff

It is convenient to separate the exchange surplus Ab into two segments, AZ and ZB. We may associate the segment AZ with the adjustment of consumption, and ZB with the adjustment in production. It is clear that if production is fixed at P, AZ is the amount of the exportable good that consumers could be deprived of and still be as well off as they were with the tariff. Similarly with consumption fixed at C, producers could be deprived of the amount ZB and still would be able to satisfy the consumption requirements.

We may now adapt the previous analysis of the simple exchange to this more complex situation. A consumer who enters the market with the bundle indicated by C will trade to S, which is exactly analogous to the consumer of

Figure 8.2 who traded from B to C'. Accordingly, we may define a compensated demand curve that maintains real income at level U. This is the dd curve in Figure 8.7 with the triangle GHJ measuring the length AZ. In an analogous fashion, a producer entering the market with bundle P would adjust to P'. The curve ss in Figure 8.7 is thus defined as the production of M constrained to the production possibilities curve TT', and the triangle DFE measures the exchange surplus ZB.[3]

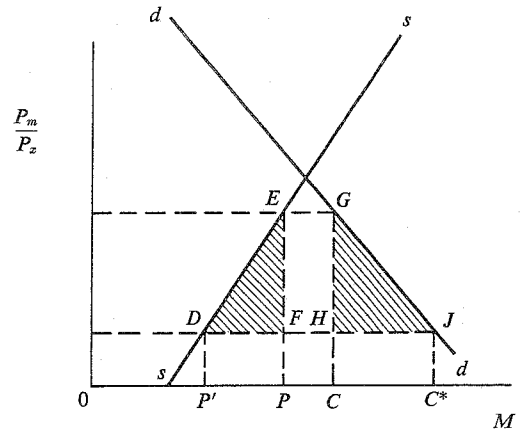

FIGURE 8.7

Welfare Triangles

While dd is properly defined as a compensated demand curve, for measurement purposes we will again assume that the import good enjoys a zero income effect and that, as a consequence, the ordinary demand curve corresponds with the compensated one. This has the further desirable property of making the compensated demand curve dd independent of the initial tariff level (i.e., the particular utility curve from which it was calculated). It should be noted that the supply curve will not require a similar assumption, since production will be constrained under competitive conditions to fall on the transformation curve. Empirical observations will thus disclose directly the nature of the supply curve.

[3] This analysis is due to Johnson [16]. The area under the supply curve is often referred to as producer's surplus. Mishan [24] argues that any separation of consumer's surplus from producer's surplus is "arbitrary and erroneous." We have avoided such terminology here.

The welfare triangles DEF and GHJ may be calculated as follows (noting that ΔC is negative)

$$\begin{aligned}&\frac{1}{2}\Delta P\,\Delta\frac{P_m}{P_x}-\frac{1}{2}\Delta C\,\Delta\frac{P_m}{P_x}\\&\quad=\frac{1}{2}\left[\frac{\Delta(P_m/P_x)}{(P_m/P_x)}\right]^2\left[\frac{(\Delta P-\Delta C)/(P-C)}{\Delta(P_m/P_x)/(P_m/P_x)}\right](P-C)\frac{P_m}{P_x}\qquad(8.3)\\&\quad=\frac{1}{2}\left(\%\Delta\frac{P_m}{P_x}\right)^2\eta_I V_I\end{aligned}$$

where V_I is the value of imports expressed in units of the exportable good, η_I is the elasticity of the import excess-demand function, and $\%\Delta P_m/P_x$ is the percentage change in prices due to tariff reduction.[4] The import excess-demand function relates imports (consumption minus production) to relative prices. This is the same function whose estimation was discussed in Chapter 2, and the elasticities calculated by that route are appropriate for use here.

The Multigood Case The multigood case is considerably more complicated, as it involves potential consumption and production adjustments in many directions even for the comparatively simple instance of a change in a single tariff. As Johnson [17, p. 332] has pointed out, two possibilities will greatly aggravate the situation: (1) changes in relative prices of nontraded goods, and (2) substitutions between imports and domestic goods and among domestic goods. However, Johnson has argued that these complications may be neglected either because of a negligibly small group of nontraded goods or because welfare losses and welfare gains of these adjustments will tend to cancel. In that event the appropriate welfare measure is simply: [5]

$$\frac{1}{2}\sum_i\left(\Delta\frac{P_m}{P_x}\right)_i(\Delta P_i-\Delta C_i)\qquad(8.4)$$

The foregoing formula is not so simple as it might appear, however, since the ΔP_i and ΔC_i are production and consumption adjustments that occur as a result of all the price changes, including the own price $[\Delta(P_m/P_x)]_i$. Only when cross effects are neglected can this be modified as in (8.3) to

$$\frac{1}{2}\sum_i\left(\%\Delta\frac{P_m}{P_x}\right)_i^2\eta_i V_i\qquad(8.5)$$

where η_i is the elasticity of the import excess-demand function, and V_i is the value of imports of commodity i expressed in terms of the numeraire export good.

[4] This formula may be easily modified when production of the importable good goes to zero with the tariff reduction. See Johnson [17, p. 333].

[5] See Johnson [17, p. 341]. Stern [27] has used this formula to calculate the welfare effect of the U.S. tariff.

When the international supply is infinitely elastic, as would be the case if we were dealing with a relatively small country vis-à-vis the world market, the percentage change in prices due to tariff elimination is simply the proportional tariff rate t_i, and we may modify (8.4) and (8.5) to

$$\sum_i\frac{1}{2}t_i\frac{P_m}{P_x}\Delta(P_i-C_i)\qquad(8.4')$$

and

$$\sum_i\tfrac{1}{2}t_i^2\eta_i V_i\qquad(8.5')$$

Furthermore, in the multigood case it is convenient to use a composite good such as money GNP as the numeraire X, in which case the V_i terms assume their monetary values, as the welfare gain does. In such cases the welfare gain is often expressed as a percent of GNP for interpretative purposes.

Terms-of-Trade Changes Another complication we will need to consider is the effect of a change in the terms of trade. If the international offer curve is not infinitely elastic, that is, if world demand for exportables (or world supply of importables) is not infinitely elastic, tariff reduction will result in excess supply of the country's goods in world markets and/or excess demand for importables. Price adjustment will cheapen the country's goods

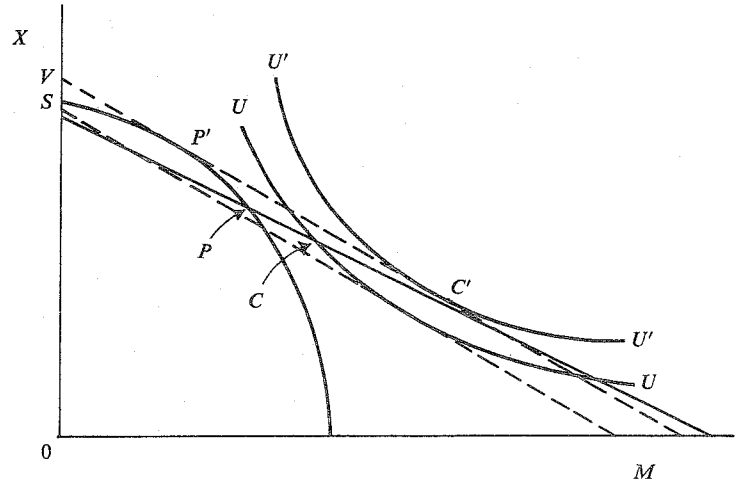

FIGURE 8.8

The Impact of Terms-of-Trade Changes

and reduce the welfare gain from tariff reduction. This possibility is graphed in Figure 8.8, where the elimination of tariffs has cheapened exportables so that the new terms of trade are represented by the dotted lines. The welfare increase is thus given by SV, which may be negative. This complication applies only to Formulas (8.4′) and (8.5′) specifically because the proportional tariff rates t_i no longer reflect the percentage change in prices from tariff elimination. Formulas (8.4) and (8.5) continue to hold, but with the caveat that the terms must include price adjustments from terms-of-trade changes.[6]

Imported Inputs Finally, we must acknowledge the fact that tariffs apply to materials and unfinished goods as well as to finished goods. The opportunity cost theory embodied in our diagrams does not allow for such tariffs. What we can do at least in principle is seek to define a "uniform tariff equivalent" as the tariff rate that if applied uniformly to all imports would yield the same restriction as the existing tariff structure. Such a rate could then be used to assess the welfare gains. We must not be deceived of course into thinking that this represents a solution to the problem, since there are acute difficulties in measuring a "uniform tariff equivalent." [7] From an applications standpoint, the problem of tariffs on inputs thus remains substantially unresolved.

STATISTICAL ESTIMATION OF WELFARE EFFECTS

The formulas just presented involve tariffs, import values, and elasticities. Tariff and import value data are of course available, but detailed (disaggregated) estimates of elasticities are not. Researchers have in practice provided educated guesses as to the elasticities, but these should be viewed with considerable skepticism. A formula which has been used to assist the guesswork is

$$\eta = \frac{P}{M}\epsilon^S + \frac{C}{M}\epsilon^D \tag{8.6}$$

where ϵ^S and ϵ^D are the (positive) elasticities of the domestic supply and demand curves and P, C, M are domestic production, consumption and imports.[8] This formula will provide improved estimates only to the extent that ϵ^S and ϵ^D can be more accurately guessed than η itself. There is no particular reason to believe that this will be the case.

An additional difficulty is introduced when quotas are used instead of tariffs. In this case researchers have attempted to estimate a tariff equivalent to the quota defined as the tariff that would provide the same degree of protection as the quota. They have taken this to be the deviation between the protected home market price and the prevailing international price, a calculation which assumes competitive conditions.

[6] As Johnson [17, p. 330] has pointed out, this gain can no longer be thought of as the amount of exportables that could be extracted with no loss in income since this would involve a terms-of-trade change. Rather the extraction of goods must be "divided between importables and exportables in accordance with the country's marginal propensity to import."

Kreinin's [22] calculations suggest to him that about half of a tariff reduction accrues to the foreign suppliers in the form of increased prices. Basevi [5] has constructed a model that includes the terms-of-trade effect, and he calculates an efficiency *gain* from the U.S. tariff structure ranging from $258 to $558 million. This compares with Stern's [27] estimate (ignoring the terms-of-trade effect) of a *loss* ranging from $258 to $448 million, neither of which is very large when compared with U.S. GNP.

[7] In Basevi's [5, p. 850] words: "Estimates . . . are subjected to a high degree of guesswork." See Balassa [2] for relevant estimates and formulas in the context of his work on effective protection.

CUSTOMS UNIONS AND TRADE PREFERENCES

The welfare analysis of customs unions and trade preferences is essentially the application of the ideas expressed earlier to a multicountry framework. In the absence of terms-of-trade effects this amounts simply to performing the calculations for more than one country. The endogenous inclusion of the terms-of-trade effects in a multicountry trade liberalization scheme involves complicated calculations that have not in practice been made. Rather, researchers provide guesstimates of the likely terms-of-trade changes and apply the welfare formulas straightforwardly. For example, Balassa and Kreinin [4] guess that the effect of trade liberalization under the "Kennedy Round" would increase European export prices of manufactured goods by one-third of the tariff reduction. Ignoring the welfare effects of the decrease in EEC and EFTA discrimination due to such reduction, they computed the welfare

[8] For the U.S., Stern [27, p. 463] assumed representative elasticities to be −0.25 and zero for crude materials, foodstuffs, and animals, −0.40 and 0.20 for manufactures, −0.50 and 0.25 for nondurable finished manufactures, and −1.00 and 0.50 for durable finished manufactures. Balassa [2, p. 601] assumed the following demand and supply elasticities for his commodity categories: intermediate products whose main inputs are natural raw materials, −0.2 and 0.1; intermediate goods at higher levels of fabrication, −0.3 and 0.2; consumer goods, −1.0 and 0.8; and investment goods, −0.3 and 0.3. Basevi [5, p. 849] used the following estimates of Floyd [11]: supply elasticities of exports and imports, 4.5 and 6.1; and demand elasticities for exports and imports, a high of −9.9 and −2.7 and a low of −5.1 and −1.5. Floyd's estimates reflected ostensibly an upward adjustment of empirically estimated elasticities to take account of the simultaneity bias.

effects listed in Table 8.1. It will be noted that these effects are all relatively small.[9]

TABLE 8.1

Estimated Direct Welfare Effects of Trade Liberalization in the Kennedy Round †
(Millions of Dollars)

	Cost of Protection	Terms-of-Trade Effects	Total
United States	+69	−63	+ 6
Canada	+39	− 7	+32
Common Market	+39	+61	+100
United Kingdom	+30	+ 9	+39
Continental EFTA	+12	+ 7	+19
Japan	+15	− 7	+ 8
Industrial Countries	+204	—	+204

† Adapted from B. Balassa and M. Kreinin, "Trade Liberalization under the 'Kennedy Round': The Static Effects," *Review of Economics and Statistics*, XLIX (May 1967), 136.

CONCLUSION

In conclusion, we may review the variety of assumptions implicit in the foregoing analysis. They are:

(1) Competitive conditions that assure that production occurs on the transformation curve.
(2) The existence of a community indifference map, which is actually used when the level of imports/exports is decided on. Otherwise the observed demand curve is quite irrelevant for assessing welfare gains.[10]

[9] It is interesting to quote Corden [6, p. 51] in this connection:

> . . . the reason for the cost or benefit of these changes turning out to be so small is that imports are rarely more than 20 per cent of a country's G.N.P., that any particular trade policy rarely affects more than, say, one-quarter of these imports, and that (income distribution apart) the social costs of foregoing these imports and producing similar goods at home instead, or the social gain from ceasing to protect, is usually less than the value of these duty-free imports simply because tariffs are usually less than 100 per cent.

[10] A perhaps more fruitful approach is to assume a particular utility structure as Johnson [17] does. Welfare gains under such a scheme would remain potential unless redistributive programs were adopted. The actual gain would of course not be assessed since the community would not consume to maximize the assumed utility function.

(3) Zero income elasticity of the imported good.
(4) Negligible substitutions in production and consumption among nontraded and between nontraded and import goods.
(5) Negligible substitutions in production and consumption of import goods.
(6) Infinitely elastic supply of international goods and, consequently, constant terms of trade.

With a suitably complicated analysis, (4), (5), and (6) may be dropped, although only (6) has been dropped in actual practice.

In addition to this long list of assumptions, the import-demand elasticities and any terms-of-trade changes that have been incorporated are in general merely guesses. Can we, then, place any faith at all in the estimate obtained? It should be clear from our theoretical analysis that there is a real surplus to be gained through the international exchange of goods and services and that tariffs tend to eat into that surplus. The numerical value of that surplus and its response to tariff policy should thus be an important parameter of commercial policy. In the absence of perfect information, policymakers will consequently have to make do with what is available.

That the estimates provide an accurate assessment of the surplus is highly doubtful. However, the formulas used do provide high estimates when tariff rates are high and when imports are highly responsive to price adjustments. Clearly, this is as it should be. Thus, while the formulas may not be perfectly accurate, they may be taken to provide an order-of-magnitude approximation. Furthermore, inasmuch as the same assumptions are applied to all countries with perhaps equal validity, the calculated welfare gains may provide a reasonably accurate ranking of the countries involved. In any case, the welfare estimates do seem to enjoy at least a slight preference over pure guesswork.[11]

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[11] Corden [6, p. 51] concludes in this regard:

> It seems quite probable that as the "unimportance of international trade," or at least the relative unimportance of most changes in trade policies, is more fully appreciated we will see a general rehabilitation of partial techniques in trade theory at the expense of the more elegant but less directly applicable general-equilibrium techniques.

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