TARIFF STRUCTURES AND PROTECTION

A Background Paper

by

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I. INTRODUCTION

In the literature on tariffs economists have paid scant attention to tariff structures, confining their interest for the most part to the level and effects of a general tariff. However, over the past decade a few writers have called attention to the significance of a tariff schedule which applies different rates to intermediate and final goods. The protective effect of such a structure on a particular good is determined not only by the tariff rate on the output, but also by the duty on inputs used in producing the good.

Clarence L. Barber in 1955 noted that "in attempting to assess the protection given by an particular tariff rate it is important to distinguish between the formal or published rate and...the tariff's effective level."[1] The "effective" tariff rate in turn, depends "on the proportion of final value of the industry's product that consists of raw materials and supplies and on the terms on which these materials can be purchased."[2] Professor Barber went on to demonstrate "that where the tariff on the raw material is lower than the tariff on the final product the effective level of protection will exceed the apparent rate of protection, where the two are equal the effective and the apparent rate of protection will be the same, and where the tariff on the raw material is higher than the tariff on the final product the effective rate of protection received by the manufacturer will be less than the rate applied to his final product."[3]

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[1] "Canadian Tariff Policy", Canadian Journal of Economics and Political Science, November, 1955, p.523.

[2] Ibid., p.523.

[3] Ibid., p.524.

Barber develops an example running approximately as follows. Suppose there is a 20% ad valorem tariff on a product, and that the manufacturer of this product purchases raw materials at world prices amounting to one half of the final value of the product. In such a case the 20% tariff on the final price of the good provides the manufacturer with a total net protection of 40% of the value he adds to the product. In other words, the manufacturer's costs can amount to 40% more than those of a foreign producer but still be competitive in the domestic market. Furthermore, if the manufacturer's proportion of value added were only, say, 25%, the effective level of portection would amount to 80%.[4]

At about the same time a Swedish Royal Commission was in the process of revising the Swedish customs tariff. In its report, submitted in May, 1956, the Commission presented a schedule of rates purportedly involving "a net tariff protection which, in relation to the manufacturing (processing) costs, is of equal height for all classes of goods."[5]

More recently, serveral other economists have considered this theme. W.M. Corden cites Barber in his discussion of the Australian tariff, and presents a formula for calculating the effective rate of protection.[6] Santiago Macario of the U.N. Economic Commission for Latin America, in an extensive treatment of protectionism in Latin America, recommends a uniform net level of protection along the lines of the Swedish approach, and presents

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[4] Ibid., pp.523-24.

[5] Swedish Customs Tariff Commission, Revision of the Swedish Customs Tariff, Stockholm, 1957, p.47. This document is a summary in English of portions of the original report. Apparently the analytical framework is contained in the (complete) Swedish version.

[6] "The Tariff" in Alex Hunter, ed., The Economics of Australian Industry, Melbourne University Press, 1963, pp.195-197.

a formula.[7] However, neither of these latter two writers significantly elaborated the concepts developed earlier.

Recently, advances in this problem have been made by Harry Johnson on the theoretical side,[8] while Giorgio Basevi[9] and Bela Balassa[10] have carried out some empirical investigations. In the following I have drawn heavily on all three.

II. ANALYTICAL FRAMEWORK

A tariff introduces a divergence between the world market price of a good and the domestic price. This divergence may be expressed in terms of either world market values or domestic values. In this section the net protective effect of a tariff using world market values is derived, and then the same thing is done using domestic values.

In the analysis below the following are assumed: (a) The world supply of domestic imports is prefectly elastic. (b) The tariff is fully operative in creating a divergence between domestic and international values. (c) The only source of divergence between domestic and international values is the tariff. (d) Production functions are identical throughout the world. (e) There is international mobility of goods and immobility of factors.

Figure 1 shows an excess demand curve for a given commodity in the country under consideration.

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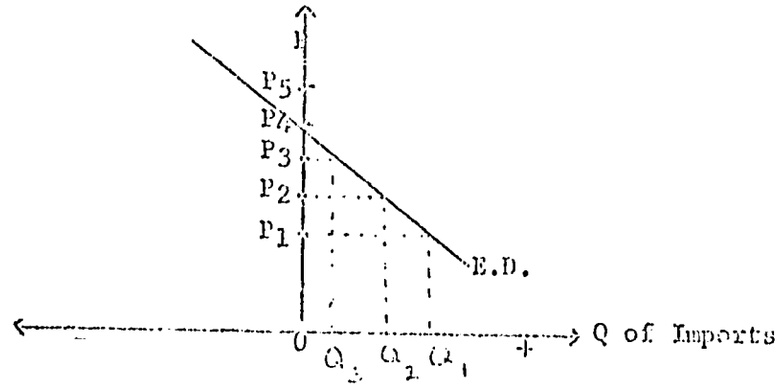
[7] "Proteccionismo e Industrialización en America Latina", Boletin Economico de America Latina, March, 1964, pp.86-88.

[8] "The Theory of Tariff Structure with Speical Reference to World Trade and Development", in Harry G. Johnson and Peter B. Kenen, Trade and Development, Geneva, Librairie Droz, 1965, pp.9-29.

[9] "The U.S. Tariff Structure: Estimates of Effective Rates of Protection of U.S. Industries and Industrial Labor", Review of Economics and Statistics, forthcoming.

[10] "Tariff Protection in Industrial Countries: An Evaluation", Journal of Political Economy, December, 1965, pp.573-594.

Figure 1



The world price is OP_1, but a tariff of P_1P_2 results in a domestic price of OP_2. The first assumption implies that the world price is unaffected by any reduction in this country's demand as a result of a tariff. This is generally acceptable if the country's demand is small relative to world demand for the good. The second assumption excludes from the analysis, for example, a tariff of P_1P_2 on an export good. Aside from transport costs, even if such a tariff appears in the schedule, it is normally non-operative in creating a divergence between domestic and international values. This assumption also excludes "excessive" tariff rates which are more than sufficient to eliminate imports. In this sense a tariff of P_1P_5 is excessive because it will not raise the domestic price beyond the no trade price of OP_4. The third assumption excludes the possibility of other barriers to free trade such as exchange and import controls. If such controls limited imports to, say, OQ_3 the domestic price of OP_3 would be greater than the duty-paid price of OP_2.

1. World Market Values

Let S = money value of total output of a given good at world prices,

M = money value of inputs used by the industry in the production of the good (raw materials, semi-finished products, and services bought from other industries), at world prices,

V = money value added in the production of the good (compensation of employees, profits, capital consumption allowances, etc., of the industry), at world prices.

Then

(1) $$S = M + V$$

But in domestic production equation (1) must be modified to take into account the divergence between domestic and international values so that

(2) $$S(1 + t_o) = M(1 + t_i) + V(1 + f_o)$$

where

t_o = the tariff rate on the good produced by the industry

t_i = the tariff rate on the inputs

f_o = the net rate of protection of value added in the industry.

Solving equation (2) for f_o[11] yields (3).[12]

(3) $$f_o = \frac{St_o - Mt_i}{V}$$

Harry Johnson, using an input-output model, derives a similar formula.[13] His derivation proceeds in the following manner.

In an input-output system

(4) $$1 = \sum_i a_{ij} + v_j$$

or

(4a) $$v_j = 1 - \sum_i a_{ij}$$

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[11] The solution is obtained in the following manner:

$$St_o = Mt_i + Vf_o$$

$$Vf_o = St_o - Mt_i$$

[12] With some manipulation, (3) is the same formula that Macario presents (without a derivation), and by my translation has the same meaning, op.cit., paragraph 93.

[13] Op. cit., pp.11, ff.

where a_{ij} = coefficient of value of input from industry i per unit value of output of industry good j,

v_j = value added in industry j per unit value of output.

With a tariff t_j on the output of industry j and a tariff t_i on the ith input, (4) becomes

(5) $$1 + t_j = v_j' + \sum_i a_{ij} + \sum_i a_{ij} t_i$$

where v_j' is the value added coefficient, tariffs included. It is the proportionate change of v_j to v_j' that is the effective rate of protection of value added, f_j: i.e.,

(6) $$f_j = \frac{v_j' - v_j}{v_j}$$

rearranging (5),

(5a) $$v_j' = 1 + t_j - \sum_i a_{ij}(1 + t_i) = v_j + t_j - \sum_i a_{ij} t_i$$

and substituting (4a) and (5a) into (6), one obtains the solution for f_j.[14]

(7) $$f_j = \frac{t_j - \sum_i a_{ij} t_i}{v_j}$$

This is the same as (3) above if one converts (7) from coefficients to absolute values by multiplying both numerator and denominator by the total value of output of good j (i.e., S_j).

To facilitate recognition of certain important relationships, take equation (3) (or just as easily (7)), and with some manipulation[15]

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[14] Equation (7) corresponds to Balassa's formulation, op.cit., p.577

[15] The manipulation proceeds as follows:

$$f_o = \frac{St_o - Mt_i}{V} = \frac{St_o - Mt_i + t_oM - t_oM}{V}$$

$$= \frac{t_o(S-M)}{V} + \frac{(t_o - t_i)M}{V}$$

$$= t_o + \frac{(t_o - t_i)M}{V}$$

one obtains

(8) $$f_o = t_o + \frac{(t_o - t_i)M}{V}$$

It is evident that

(a) where $t_o = t_i$ then $f_o = t_o$

(b) where $t_o > t_i$ then $f_o > t_o$

(c) where $t_o < t_i$ then $f_o < t_o$

(d) and when t_i becomes so much greater than t_o that the second right-hand side term in (8) becomes absolutely larger than t_o, then $f_o < 0$.

2. Domestic Market Values

Using the same symbols as above, but priming them to indicate value at domestic prices, we have in domestic production

(9) $$S' = M' + V'$$

and, similarly, taking account of tariffs, in world production

(10) $$\frac{S'}{1 + t_o} = \frac{M'}{1 + t_i} + \frac{V'}{1 + f_o}$$

Solving (10) for f_o[16] one obtains equation (11).[17]

(11) $$f_o = \frac{V'}{\frac{S'}{1 + t_o} - \frac{M'}{1 + t_i}} - 1$$

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[16] The solution is obtained in the following manner:

$$\frac{S'}{1 + t_o} - \frac{M'}{1 + t_i} = \frac{V'}{1 + f_o}$$

$$1 + f_o = \frac{V'}{\frac{S'}{1 + t_o} - \frac{M'}{1 + t_i}}$$

[17] Equation (11) is essentially the same formula that Corden uses, op.cit., p.197, and is also the one that Basevi derives (in a different manner), and uses in his calculations for the United States, op. cit.

It is also possible to express the same relationships in terms of an input-output system. Using the same values as in the input-output derivation above, but priming them to indicate values expressed in domestic prices, one has

$$v'_j = 1 - \sum_i a'_{ij} \tag{12}$$

while at world prices

$$v_j = \frac{1}{1 + t_j} \cdot \sum_i \frac{a_{ij}}{1 + t_i} \tag{13}$$

Taking the definition of net protection from above

$$f_j = \frac{v'_j - v_j}{v_j} = \frac{v'_j}{v_j} - 1 \tag{6}$$

and substituting (13) into (6), one obtains the following formula for f_j expressed in terms of domestic values.

$$f_j = \frac{v'_j}{\frac{1}{1 + t_j} \cdot \sum_i \frac{a_{ij}}{1 + t_i}} - 1 \tag{14}$$

Although equations (11) and (14) bear little resemblance to (3), (7), and (8), the relationships between f_o and t_o (or f_j and t_j) specified above still hold. Where the tariff on inputs is equal to the tariff on the final product, the effective level of protection equals the nominal tariff rate. If the tariff rate on inputs is greater than on the final product the effective level of protection is less than the nominal rate. And, if the tariff rate on inputs is less than on the final product, effective protection exceeds nominal protection. Finally, the tariff on inputs may be so large, relative to the tariff on the final good, that the effective level of protection becomes negative.

III. EMPIRICAL ESTIMATION

The above analysis may be applied to several problems involving the impact of protective measures which differentiate between intermediate and

final goods. For example, Johnson has pointed out that duty-drawbacks and tariff concessions granted on imported inputs in fact increase the effective level of protection granted the finished product. He has also noted that development policies that rely on protectionism and import substitution are often taxing the export sector by increasing the cost of inputs employed by that sector.[18]

A few empirical estimates of effective tariff rates have been made. Balassa's estimates[19] cover thirty-six industries of five countries: The United States, The United Kingdom, The European Economic Community, Sweden, and Japan. Basevi's estimates are for more detailed industrial classifications in the United States only.[20]

The two sets of rates for the U.S. are not directly comparable since the industrial classifications and input-output data differ. However, the results are generally consistent: wide divergencies between nominal and effective tariff rates, and occasional negative levels of effective protection.[21]

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[18] Harry Johnson, op. cit., pp.14 ff.

[19] Bela Balassa, op. cit., pp.579 ff.

[20] G. Basevi, op. cit.

[21] In addition to effective rates of protection of value added by primary resources (labor and capital), Basevi calculates effective labor rates of protection--protection as a proportion of labor value added only--on the assumption that labor is the only internationally immobile factor. The labor rates of effective protection are consistently greater than value added rates. Alternatively, under certain conditions one might define effective protection as a percentage of profits in order to increase the stimulus that protection gives to entrepreneurial decisions. Basevi, op. cit.

There are several problems which can arise in estimation of effective protection, even assuming that appropriate data are available. In what follows I will outline a few of the major considerations which should be taken into account in empirical work.

1. Appropriate Input-Output Information

From the formulation in Part II above it is evident that in order to calculate the effective rate of protection afforded an industry one must first obtain data on the inputs used, and the value added by the primary factors. Two potential sources of this information are: (1) an input-output table; and (2) a census of industry. The major weakness of the former is that the sectors may be so broad and heterogeneous as to be meaningless for several industries. The latter, however, may fall short of the ideal as well, for the source of substantial material inputs may be unspecified.

If one uses an input-output table expressed in domestic values then the formula contained in equation (14) (or (11) if an industry census) is appropriate. However, if a "standardized" input-output table expressing coefficients in world values is to be used, equation (7) would be applied. Note that in either case the coefficients are in value, not, quantity terms.

2. Tariffs

In the theoretical formulation I did not deal with three matters of particular significance regarding nominal tariff rates. First, the tariff should be expressed as a percentage of C.I.F. value. This requires a conversion of any specific duties to their ad valorem equivalents. It may also necessitate conversion of the ad valorem tariff schedule from, say, an F.O.B. basis to a C.I.F. basis where the tariff is not levied on the C.I.F. value. To do this, one should multiply each ad valorem tariff

rate by the ratio of the F.O.B. to the C.I.F. price of the good in question. Data for such conversions may not be available, in which case the best one can do is to recognize the nature of the bias which this introduces. Basevi points out that "since transport costs on raw materials and semi-manufactured products are generally a higher proportion of the value than on finished products, omission of the F.O.B./C.I.F. adjustment introduces a downward bias in calculated rates of (effective) protection."[22]

Second, the tariff rate specified in the schedule for a particular good may not be fully operative in creating a divergence between the domestic and international price. The most conspicuous example is an exported commodity, the world price of which equals the domestic price (neglecting transportation costs), in the absence of other influences such as an export subsidy or monopolistic price discrimination between the domestic and world markets. In such a situation one should assume that the nominal tariff rate equals zero.

The specification of what is an "export" should befairly easy in a less developed country for such commodities are generally well identified. However, a simple check can be made by comparing the relevant domestic price with the international price.

Exports, however, are not the only commodities for which the posted nominal tariff rate is not fully operative. The tariff rate on a good may be "excessive" in the sense that the domestic price amounts to less than the world price plus the tariff. The solution in such a case is to estimate the actual divergence, express it as a percentage of the world price, and use the rate in place of the posted nominal tariff.

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[22] G. Basevi, op. cit.

Third, the tariff schedule is generally expressed in considerably more detail than industry data. Consequently, one faces the problem of how to combine several tariff items to obtain a single rate for each input or final good. Weighting by value of domestic imports gives misleading results because the composition of imports is biased toward low duty items. Simple unweighted averages[23] would also be misleading in many cases since the "law of large numbers" on which this approach relies does not apply when the number of rates to be averaged becomes small. Balassa maintains that the best approximation would be to weight tariff rates by the value of each item in world trade. Lacking such data, he uses as weights the combined imports of the five units in his study.[24] In my view, however, Balassa's approach is incorrect also. He appears to be aiming at a weighting that would reflect the composition of imports under free trade. This, however, is not what one wants at this stage. Such weighting is appropriate when one has already calculated the effective rates of protection and wants to use them to estimate the restrictive effect of a country's tariffs on its trade.

The ideal weighting procedure, in my view, is to weight each nominal tariff item by the proportion of output which the corresponding subsector represents in the total output of the sector. The proportions used should be derived from world values, not domestic values.

For example, suppose there are two nominal tariff classifications included in the accompanying hypothetical sector 1. We know the domestic

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[23] On the applicability of unweighted tariff averages see Balassa, op. cit., p.575.

[24] B. Balassa, op. cit., p.579.

value of output of the sector, and of each subsector. We also know the tariff rate applicable to each subsector. The problem is to determine the appropriate tariff rate for the entire sector.

Output and Tariffs: Sector 1

	Subsector 1.A	Subsector 1.B	Sector 1 Total
Output--domestic prices	$22	$104	$126
Nominal Tariff	10%	30%	
Output--world prices	$20	$ 80	$100
Proportion of Output (world values)	0.2	0.8	1.0
Weighted Tariff	(0.2)(0.1)	(0.8)(0.3)	0.26

The divergence between domestic and international values of the sector's production amounts to $26: i.e., the nominal tariff rate for sector 1 is 26%. The same result may be obtained by weighting each subsector's tariff rate in proportion to production (derived from world values, not domestic). Thus, subsector 1.A accounts for 0.2 of the sector's production, and subsector 1.B accounts for 0.8. The tariff rate for subsector 1.A is 0.1, and for 1.B is 0.3. Multiplying each tariff rate by the production weight, and summing the two products, one obtains a nominal tariff rate of 0.26 for sector 1.

3. Non-Tariff Barriers

The analysis up to this point has assumed, in effect, that tariffs are responsible for the entire difference between world and domestic values. If, however, there exist non-tariff barriers or subsidies which create a divergence between the domestic value and the duty-paid value of a commodity, one must take these into account in order to estimate the true level of effective protection pertaining in an industry. In other words, equation

(10) becomes

$$(15) \qquad \frac{S'}{1 + p_o} = \frac{M'}{1 + p_i} + \frac{V'}{1 + g_o}$$

and solving for g_o, the counterpart of (11) becomes

$$(16) \qquad g_o = \frac{V'}{\frac{S'}{1 + p_o} - \frac{M'}{1 + p_i}}$$

where p_o is the proportion by which the domestic price of the output of the industry exceeds the world price, and p_i is the proportion by which the domestic price of the input exceeds the world price. The value of g_o represents the total net protection afforded domestic production of the good.

Estimates of this type are particularly significant when one is concerned with a country that places considerable reliance on non-tariff forms of protection, for if g_o exceeds f_o, the tariff is irrelevant in creating a divergence between domestic and international prices.[25] The data required to calculate g_o may be difficult to obtain for a substantial number of commodities. However, a few representative values would indicate the extent to which various types of domestic production are protected or taxed by the structure of trade barriers. The results may not correspond to expressed policy goals.

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[25] Note that where $f_o < g_o$, and the good is imported, the government could capture a greater share of the economic rent by increasing f_o to equal g_o.