I. INTRODUCTION

For a small country that cannot affect its terms of trade through changes in commercial policy, the loss of real income due to protection can be divided into two elements: (a) the consumption costs resulting from the distorted prices facing consumers as domestic prices differ from world prices; and (b) the production costs resulting from the distortions of prices facing producers. Protection has the joint effect of being both a consumption tax and a production subsidy, and it reduces the utility enjoyed by the community both by reducing real output below the maximum attainable and by reducing the utility attainable from the expenditure of the real output below the potential maximum. The total cost of protection is measured by the total reduction in utility from these two effects.

The theory of commercial policy abounds with arguments about the harmful or beneficial effects of tariffs, based on simple general equilibrium models of trade and protection. However, measuring the costs of protection has usually been carried out in a partial equilibrium framework under ceteris paribus assumptions with the help of effective rates of protection (ERPS), as well as the concepts of producers’ and consumers’ surplus. These analyses, based on calculus techniques and Hicksian compensation tests, are restricted to small departures from free trade. In general, they do not include nontraded goods and are restricted to a few commodities. Because the magnitude of the gains from trade constitutes one of the most interesting problems in the theory of commercial policy, it seems worthwhile to use a methodology that remedies these defects.

The purpose of this paper is to present an alternative approach that is not restricted to small departures from free trade. The analysis...
is based on a social utility function that, when maximized subject to a budget constraint, yields a demand system fulfilling the fundamental postulates of demand theory. On the supply side producers maximize profits subject to a neoclassical technology. The results obtained by using this methodology are of course limited by the specific character of the resulting utility and production functions, though these functions are flexible enough to combine a wide range of parametric variations. The remainder of the paper is organized as follows: Section II presents the model used to analyze the effects of protection on welfare; Section III describes an illustrative application of the model to Colombia and reports the empirical results, which are compared to other estimates of the costs of protection in LDC's provided by Balassa (1971) and Bergsman (1974). They are followed by concluding comments in Section IV.

II. A WALRASIAN MODEL OF TRADE AND PROTECTION

This section briefly describes the model used to study the effects of protection on welfare. An important feature of the model is that it determines wages and prices endogenously. Johansen (1960) formulated the first price-endogenous model. His model and those of Taylor-Black (1974) and Staelin (1975) were linear in growth rates and so could be solved as a set of simultaneous linear equations. The Walrasian approach, which is used here, involves solving directly for a set of market-clearing prices and wages for a specified market behavior. This direct approach thus allows a great deal of freedom in the specification of the model and of how the various actors behave.

In contrast to the vast majority of multisector models, this model emphasizes the importance of substitution effects in both product and factor markets on the grounds that a removal of trade barriers entails a large change in relative prices, which is likely to affect both producers' and consumers' choices. To examine the effects of protection on welfare (and resource allocation), the demand and supply sides of the economy are examined in closer detail than in the studies mentioned above. This is done by the introduction of a utility function and of a greater number of factors of production. Moreover, a wider range of assumptions concerning factor supplies and factor mobility are incorporated to examine both the effects of protection on employment and the effects of rigidities in factor markets.

There are \( n = q_1 + q_2 \) goods produced in the economy; \( q_1 \) of these goods are traded; the remainder \( q_2 \) are classified as nontraded; \( k \) and
1 are the corresponding subscripts. Noncompetitive imports that are not produced domestically are lumped into a sector 0. Subscripts \(i\) and \(j\) refer to all producing sectors in the economy. Superscripts are used to distinguish between the initial distorted situation (zero), and any other situation (one). There are \(m\) primary factors of production that include capital, skilled and unskilled labor, and land, the use of which is restricted to agricultural sectors. The use of nonproduced resource \(R_\lambda\) by sector \(i\) is denoted by \(R_{\lambda i}\).

Following are the main components of the model: the foreign trade sector, the consuming sector, and the producing sector.

The Foreign Trade Sector

With a few notable exceptions the economy is assumed to face fixed terms of trade; it can influence the price of only some primary commodities (coffee for Colombia) where the limited number of suppliers explains the presence of monopolistic power in trade. Moreover, the country faces a balance of payments constraint, and the exchange rate adjusts to clear the foreign trade sector. Equations (1)–(3) embody these assumptions.

\[
P_k = \pi_k (1 + t_k) R
\]

(2) \[T_p = b_p \pi_p^{\eta_p} \quad p, k = 1, \ldots, q_1\]

(3) \[\sum_k \pi_k T_k + \pi_0 M_0 = \Delta.\]

Equation (1) states that the domestic price \(P_k\) of commodity \(k\) is equal to the world price \(\pi_k\) times one plus the ad valorem tariff or subsidy \(t_k\), translated to domestic prices via the exchange rate \(R\). Equation (2) recognizes the presence of monopolistic power for some traded goods by making quantities traded \(T_p\) a function of world prices. In the limit when the elasticity of demand \(\eta_p\) approaches zero, the quantity traded \(T_p\) becomes fixed, and the tax rate adjusts so as to maintain the quota level. Equation (3) translates the balance of payments constraint.

The Consuming Sector

The social utility function is of the Cobb-Douglas variety and is given by

\[
U = \sum_i \gamma_i \ln(c_i - \delta_i) \quad i = 1, \ldots, n,
\]

where
When maximized subject to a budget constraint, it yields the linear expenditure system (LES) whose typical demand function can be written as

\[ P_i \delta_i = P_i \gamma_i (Y - \sum P_j \delta_j) \quad i, j = 1, \ldots, n, \]

where \( C_i \) is the quantity of good \( i \) privately consumed and \( Y \) is total expenditure. As stated, the LES satisfies the usual conditions of demand theory. However, the parametric restrictions imposed on the utility function rule out inferior and complementary goods, and the resulting Engel curves are linear. At the relatively high level of aggregation of the model, it is unlikely that the consumption of any commodity would decline with an increase in income.

**The Producing Sector**

The output \( x_i \) of sector \( i \) is a function of primary factors \( R_{\lambda i} \) and intermediate inputs \( X_{ji} \). The requirements for intermediate inputs are given by fixed input-output coefficients \( X_{ji} = A_{ji} X_i \), and substitution possibilities are restricted to primary factors. The demand for intermediate inputs is accounted for in the material balance equations. The linear homogeneous production function for sector \( i \) may then be written as

\[ X_i = f_i (R_{1i}, \ldots, R_{mi}) \quad i = 1, \ldots, n \]

Producers are assumed to maximize profits. Because the cost of intermediate inputs is proportional to output, net price \( P^*_i \) is equal to sale price minus intermediate input costs and noncompetitive imports:

\[ P^*_i = P_i - \sum A_{ji} P_j - A_{0i} P_0 \quad i, j = 1, \ldots, n. \]

The factor demand equations are given by the first-order conditions for profit maximization; they equate the marginal product of factors to the sectoral wage rate:

\[ P^*_i \left( \frac{\partial f_i}{\partial R_{\lambda i}} \right) = w_{\lambda i} \quad i = 1, \ldots, n \]

These demand equations indicate different wage rates to identical factors across sectors. The introduction of differential wage rates \( w_{\lambda i} = \phi_{\lambda i} W_\lambda \) destroys the purely competitive behavior of the model.
ESTIMATING THE COSTS OF PROTECTION

on the factor market side. It accommodates the widely observed fact that returns to identical factors differ across sectors.\(^8\)

Finally, there are total supply equations for each sector. These are given by

\[ C_i = X_i + T_i - \sum_j A_{ij} X_j - A_{0i} X_i - Z_i; \quad T_i = 0 \text{ for } i > q_1 \]

\[ i = 1, \ldots, n. \]

Exogenous final demand in each sector \(Z_i\) is composed of government demand plus investment plus depreciation; it is fixed in base year prices. This "open loop" specification implying that trade policy does not affect investment is made to simplify the interpretation of the comparative static experiments with respect to the welfare costs of protection. By substituting through the flow balance equation (9), it can be shown that under a zero balance of trade, disposable factor income for consumption is equal to gross domestic product minus exogenous investment minus net revenues from trade taxes, tariffs, and subsidies. Therefore, direct taxes on factor incomes cover the difference between government expenditures and revenues on foreign trade.

Equilibrium in product and factor markets requires that excess demands be equal to zero. The quantities demanded (\(C_i^d\) from equation (5)) must equal the quantities supplied (\(C_i^s\) from equation (9)). Similarly, the total demand for each of factor \(R_{\lambda i}\), obtained by summing the sectoral demands \(R_{\lambda i}\) over all sectors, must be equal to the total supply of that factor \(R_{\lambda i}\). Factor prices, product prices for non-traded goods, and quantities traded are all endogenously determined so as to clear their respective markets.

The above system of equations is homogeneous of degree zero in prices and factor wages so that only relative prices can be determined. Some sort of normalization on prices and wages is therefore required. To compare relative prices, it is convenient to maintain a constant price level, thereby implying that monetary authorities control the money supply during the resource shifts between sectors. This amounts to determining a price level such that base year GNP valued at current prices remains constant, i.e.,

\[ \sum_i p_i^{*1} x_i^0 = \sum_i p_i^{*0} x_i^0 \quad i = 1, \ldots, n. \]

The solution method applied to this system of nonlinear equations consists of a tâtonnement process in factor markets. Initial guesses at sectoral factor stocks are substituted into the sectoral production functions. Returning to factor markets after having carried
out substitutions through the demand side, we see that the algorithm checks whether the supplies of factors to each sector imply a rate of return to each factor above or below its economy-wide average. The iterative procedure comes to an end when excess demands in factor markets are driven sufficiently close to zero.9

The description of the model is now complete. Two points about it are worth mentioning. First, there will be some specialization when tariffs are removed if the number of traded sectors exceeds the number of factors of production \( (q_1 > m) \).10 Indeed, specialization according to comparative advantage is to be expected, and in an analysis of the welfare costs of protection, no arbitrary attempts should be made to prevent the economy from specializing, since they would bias downward the welfare gains from a removal of trade distortions.11 Second, in the application to Colombia the economy is represented by a general equilibrium model so that we brush aside the question of whether or not a competitive equilibrium represents the economy, and it is assumed that distortions do not reflect disequilibrium. While such a representation is clearly questionable, especially for an LDC, it allows us to simulate the behavior of product and factor markets.

III. AN APPLICATION OF THE MODEL: THE COSTS OF PROTECTION IN COLOMBIA

This section describes an illustrative application estimating the costs of protection in Colombia, taking 1970 as the base year. The sectoral classification, data requirements, and data sources are described in the Appendix. Two particular aspects of the Colombian context are featured in the model. First, coffee is treated as a separate sector within agriculture to take account of the fact that Colombia has a quota share on the world market amounting to 14 percent of world production in 1970. Second, there is ample evidence of unemployment in Colombia. It may therefore be reasonable to assume that the wage rate for unskilled labor \( w_u \) is fixed in real terms. Such a formulation involves only a minor change, and in some of the experiments the assumption of a fixed supply of unskilled labor has been replaced by a fixed real wage for unskilled labor:

\[
(11) \quad w_u^1 = w_u^0 \left( \sum_i p_i^1 c_i^0 \right) / \left( \sum_i p_i^1 c_i^0 \right).
\]

However, the supply of unskilled labor cannot exceed the open unemployment rate \( \bar{U} \), so that12
While the model outlined in Section II is capable of handling a number of behavioral assumptions concerning factor and commodity markets, as well as a wide range of experiments, only a few experiments relating to the removal of tariffs are reported here. All the experiments consist of removing tariffs and subsides in all sectors other than coffee. As a point of reference, the ad valorem distortions amount to an average nominal protection of 25 percent. With an average effective rate of protection of 29 percent in the manufacturing sector, in comparison with other developing countries, Colombia enjoys a relatively low level of protection. One might therefore conjecture that the allocative costs of protection in Colombia are smaller than in the sample of LDC's analyzed by Bergsman (1975).

The following experiments are directed toward three sets of issues. First, what are the potential effects on welfare gains of removing price distortions when there are rigidities in some of the factor markets that may be viewed as imperfections or as the short-run effects of protection? A second set of questions is related to the effects of commercial policies on employment; finally, the issue of the gains to be obtained from the imposition of an optimal tariff is briefly considered because it is of particular relevance to LDC exports of primary commodities. In these experiments an elasticity of foreign demand of -1.5 is assumed, since it is the estimated long-run price elasticity of demand for Colombian coffee. Only the polar cases have been selected here in the hope that they provide sufficient information on the likely range of the costs of protection under a spectrum of assumptions. The following effects will be examined in turn: (1) the welfare costs of protection, (2) the exchange rate adjustment required to keep the balance of payments in equilibrium, (3) the effects of protection on factor rewards and the distribution of income, and finally (4) the effects of protection on employment.

A. Welfare Costs of Protection

Production costs result from the protection-induced distortion in relative commodity prices that interferes with (a) intersectoral specialization according to comparative advantage between primary activities and manufacturing industries, as well as (b) specialization within the manufacturing sector itself. The choice of input mix between capital and labor is also affected by this distortion. Moreover, the reduced extent of interindustry specialization involves a consumption cost as well as a production cost. The welfare costs are
measured by the percentage change in the utility indicator. To provide a basis for comparison with other calculations, GNP is measured at world prices under both the protected and free trade alternatives, since world market prices, rather than domestic prices distorted by protection, indicate the alternatives available to the economy. The valuation of nontraded goods requires the choice of an index; base year prices for nontraded goods were chosen.

Table I indicates the costs of protection under each of the experiments. Because exogenous demand that includes investment (which equals savings ex post) remains fixed, the welfare effects of a removal of distortions are measured by the change in the utility indicator. Since the welfare indicator is a cardinal measure, it is possible to rank free trade solutions from largest to smallest utility gain.

Inspection of Column 3 indicates that welfare gains behave in the following way: (a) increase with factor mobility, (b) are an increasing function of the world elasticity of demand for coffee, and (c) are greater when unskilled labor is in infinitely elastic supply. When both capital and land are fixed and there is a fixed quota on coffee exports, welfare actually declines by 0.3 percent. This result indicates that the welfare loss from maintaining a fixed quota level outweighs the welfare gains from removing other distortions. This paradoxical result illustrates the empirical relevance of a well-known proposition in the theory of the second best which says that removing a distortion in the presence of others may lead to a decrease in welfare. Thus, to maintain its quota share, the government has to raise the export tax on coffee, thereby impeding specialization and leading to a greater price distortion.

With perfect factor mobility the efficiency gain from removing tariffs increases to 1.8 percent. When unskilled labor is in infinitely elastic supply, the gains are larger because the expanding industries (which use unskilled labor relatively intensively) can hire that factor at a fixed real wage.15

Recognizing the existence of an optimal tax on coffee exports complicates the assessment of the costs of protection because, due to the importance of coffee among Colombian exports (58 percent of the total value of exports at world prices), their magnitude is very sensitive to variations in the value of the elasticity of demand for coffee. Since it is difficult to obtain reliable estimates for that parameter, few experiments with the optimal coffee tax are reported here. The results in Table I indicate that, provided Colombia has the opportunity to impose an optimal tax on coffee exports, the welfare gains from such
### Table 1

**Welfare Costs of Protection and the Factorial Distribution of Income**

<table>
<thead>
<tr>
<th>Experiment</th>
<th>Description</th>
<th>Skilled labor share</th>
<th>Unskilled labor share</th>
<th>Capital share</th>
<th>GNP**</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-1</td>
<td>Capital and land fixed: quota on coffee</td>
<td>0.3</td>
<td>-1.5</td>
<td>10.4</td>
<td>38.9</td>
</tr>
<tr>
<td>A-2</td>
<td>Land fixed: quota on coffee</td>
<td>1.1</td>
<td>1.9</td>
<td>9.4</td>
<td>42.6</td>
</tr>
<tr>
<td>A-3</td>
<td>Quota on coffee</td>
<td>3.9</td>
<td>11.0</td>
<td>0.4</td>
<td>39.8</td>
</tr>
<tr>
<td>A-4</td>
<td>Land fixed: optimal coffee tax</td>
<td>1.8</td>
<td>3.8</td>
<td>11.0</td>
<td>42.7</td>
</tr>
<tr>
<td>B-1</td>
<td>Same as A-1 but fix the real wage</td>
<td>2.1</td>
<td>0.3</td>
<td>4.7</td>
<td>9.6</td>
</tr>
<tr>
<td>B-2</td>
<td>Same as A-2 but fix the real wage</td>
<td>4.7</td>
<td>0.4</td>
<td>4.7</td>
<td>9.6</td>
</tr>
<tr>
<td>B-3</td>
<td>Same as A-3 but fix the real wage</td>
<td>2.5</td>
<td>0.4</td>
<td>5.8</td>
<td>9.4</td>
</tr>
<tr>
<td>B-4</td>
<td>Same as A-4 but fix the real wage</td>
<td>5.5</td>
<td>0.0</td>
<td>15.8</td>
<td>9.0</td>
</tr>
</tbody>
</table>

*All figures are in percent. All factor shares are factor shares out of GNP. These shares under the tariff solution are land (61.4 percent), capital (40.6 percent), unskilled labor (32.8 percent), skilled labor (17.7 percent).*

**Percentage change from tariff solution.**
an imposition are substantial, especially when measured in terms of GNP. Under the assumed world elasticity of demand of $-1.5$, the optimal coffee tax is 82.9 percent, almost twice as large as the actual tax rate of 44 percent. With the elasticity of demand for coffee reflecting long-run conditions, the result should be interpreted as a tax to be imposed on coffee producers to reach the long-term optimal level of coffee production under present world demand conditions for that commodity. This result indicates the substantial gains to be obtained from exploiting monopolistic power in trade by imposing the optimal tax on coffee exports.

It is customary in a partial equilibrium framework to evaluate the static allocative costs of protection in terms of GNP valued at world prices. Such an evaluation requires, *inter alia*, estimating the exchange rate adjustment following a removal of tariffs. Under the set of assumptions describing the model, the free trade solution yields a direct estimate of the costs of protection as a percentage of GNP under the modeling assumptions.

Column 4 reports the percentage change in GNP at world prices following the removal of trade distortions. The first obvious observation to make is that the estimates of the costs of protection in terms of GNP are indeed quite sensitive to the assumptions concerning factor supply and factor mobility. Abstracting from the experiments with an optimal coffee tax, the costs of protection vary from $-1.5$ percent to 5.8 percent, a range far wider than the one reported by Bergsman in his sensitivity analysis for Brazil.\(^{16}\) Assuming a quota on coffee exports, he finds that the costs of protection for Brazil are insensitive to parametric variations and amount to 0.3 percent–0.4 percent of GNP. While such results may hold in a partial equilibrium framework in the absence of explicit recognition of various constraints faced by the economy, it is clearly not the case in this model where technology and factor endowments are examined in some detail. The second and more reassuring observation is that the results generally conform to a priori expectations.

**B. Exchange Rate Adjustment**

The exchange rate adjustment is given by the change in the value of nontraded goods and the change in the world price of coffee. The normalization rule, stating that base year GNP measured at current prices remains constant, implies that the monetary authorities are following a "no inflation" monetary policy thereby successfully avoiding any inflationary pressures following the removal of the tariff structure.
Table II indicates the necessary devaluation required to keep the balance of payments in equilibrium under the different modeling assumptions. The large devaluation registered in Experiment A-1 is a consequence of the increase in the coffee export tax noted earlier. Other things equal, fixing the supply of unskilled labor reduces slightly the amount by which the peso would have to be devalued. It can also be seen that factor immobility increases the magnitude of the exchange rate adjustment because factor rigidity increases the price adjustment necessary to eliminate excess demands in nontraded sectors. When unskilled labor is in infinitely elastic supply and an optimal coffee tax is imposed, the devaluation is smaller because there is a greater amount of unskilled labor available for nontraded sectors, particularly the large service sector which uses that factor intensively so that its price increase is 2.5 percent instead of 6.5 percent when its output expansion is constrained by the fixed supply of unskilled labor.

Although the magnitude of the exchange rate adjustment is ultimately an empirical question largely dependent on sectoral technology and the link between traded and nontraded industries through the transactions table and the system of demand equations, it is noteworthy that the extent of devaluation is quite sensitive to the modeling assumptions, thereby justifying the framework developed here.

C. Protection and Distribution of Income

With a single representative consumer this model is not ideally suited to study the effects of protection on the size distribution of income. However, the number of factors in the model helps determine the likely effects of a change in relative product prices on the distribution of income. Columns 5–8 in Table I describe the effect of protection on the functional distribution of income. Note that this table does not provide any information on the absolute distribution of in-
come that is affected by the change in GNP. It can be seen that skilled and unskilled labor will suffer in almost all cases as their share of GNP declines. Landowners and capitalists will benefit substantially from the alternative policies considered, except for the case where an optimal coffee tax reducing coffee output lowers the share accruing to landowners. What happens to unskilled labor's share is to some extent determined by the assumptions concerning its supply. Other things equal, its relative share will be higher when it is in perfectly elastic supply at a fixed real wage. Despite some absolute gains due to the removal of distortions, the relative share of unskilled labor would deteriorate. Naturally, the relative share of capital rises. On the whole, one can conclude that the distribution of income among factors would be affected by a change in policies, but that the extent of this redistribution would not be very large in Colombia. These results are therefore in agreement with other simple macroeconomic models where it is generally found that the functional distribution of income shows small variations.

D. Substitution and Employment

While simplifying assumptions allow for an estimation of the costs of protection and exchange rate adjustments in a partial equilibrium framework, it is far more difficult to include an estimation of the likely effects of protection on employment. This is due to several factors: (1) it is necessary to take into account factor price effects that influence the use and allocation of primary factors; (2) interindustry linkages involve flows of both material and nonmaterial inputs between traded and nontraded sectors; and (3) one must explicitly incorporate the technology and factor endowments available to the economy. Clearly, these effects are best captured in a general equilibrium analysis. The impact of a removal of trade barriers on employment is reported in Table III.

The results in Table III, showing an increase in employment under all experiments when the supply of labor is not fixed, explain why the welfare gains are greater under this assumption than when the supply of unskilled labor is fixed.

When specialization is impaired by fixed capital stocks, employment of unskilled labor increases by only 5.4 percent. Fixed land results in greater employment gains than when that factor is mobile between agricultural sectors. This is so because when land is fixed there are no substitution possibilities between it and other factors and the output of agriculture—which is relatively intensive in its use of unskilled labor—increases; whereas when land is mobile, there is a
small contraction in output (0.7 percent) that is accompanied by a
decline in employment of unskilled labor.

It is not clear, however, that even in the long run the elasticity
of substitution between different types of primary inputs is unity. As
an alternative, one can postulate a C.E.S. technology between dif-
ferent categories of capital and labor. This formulation has the ad-
vantage of not imposing equal elasticities of substitution across all
primary factors of production. The available estimates of the elas-
ticity of substitution between capital and labor give an "average"
economy-wide elasticity of substitution of 0.83. The previous results
were tested against those obtained under a C.E.S. technology. Un-
derstandably, they yielded slightly smaller gains as employment of
unskilled labor rose by a smaller amount (8.5 percent instead of 9.0
percent in case B-3).

Since the robustness of the econometric estimates underlying
the demand system and the elasticity of substitution between capital
and labor are clearly doubtful, it is appropriate to check the sensitivity
of the results to systemic variations in their values. Tests with respect
to variations in the income and price elasticities of demand indicated
that greater flexibility in the demand system increased the gains from
a return to free trade. However, the macro results are much less sen-
sitive to variations in demand elasticities than to variations in the
elasticity of substitution between capital and labor, especially when
unskilled labor is not in fixed supply. This result may be expected,
since increasing the flexibility of consumption mainly affects the
pattern of trade and does not allow the economy to reap the benefits
from increased specialization as is the case when the elasticity of
substitution between factors is raised. Systematic variations of the
elasticity of substitution indicate substantial sensitivity of results to
the specification of technology. It also indicates that the fixed
coefficients assumed in linear programming models would seriously
understate the gains in employment from a removal of distortions if
the elasticity of substitution between capital and labor is different
from zero. The results from the sensitivity analysis reveal the quan-
titative importance of properly specifying supply relationships when estimating the costs of protection.

V. CONCLUSIONS

In his summary of the models dealing with the measurements of the cost of protection, Basevi (1968) distinguishes four stages. The first three stages of the development of these models were concerned with disaggregation of the analysis to include, first, several categories of imports, and then later on, intermediate products and input-output relationships of actual economic systems. It was only in the fourth stage of analytical development that empirical models included terms-of-trade effects in a general equilibrium model. These models, however, remained extremely simple as they included only a demand and supply schedule for imports and exports accompanied by elasticities of foreign demand for imports and exports. In particular, these models did not incorporate intermediate products, nontraded commodities, factor markets, or consumer preferences. The Walrasian approach to the specification of a general equilibrium framework for measuring the costs of protection, of which the model presented here is a simple example, may be viewed as an extension toward a more complete empirical estimation of these costs.

Although the estimates presented here take into account substitution effects previously neglected, the policies that were examined are only part of a development strategy, and the costs of protection due to allocative inefficiency are only a part of the total costs of protection even within the narrow confines of perfectly competitive equilibrium. To be more fruitful, the model developed here should be extended to consider the dynamic costs of protection and also some attempts should be made to take explicit account of the noncompetitive behavior in some sectors of the economy. It might then be applied to examine the justification for protection based on infant industry arguments.

Returning to estimates of the static allocative costs of protection, the range of these costs under the different assumptions in factor markets indicates that intuition, upon which previous estimates of the costs of protection have usually been based, cannot trace some of the interactions emerging even from a simple general equilibrium model. These results indicate that there is no shortcut to a careful consideration of market structures and technologies even under the stringent assumptions of competition, and that one cannot place too
TABLE IV

<table>
<thead>
<tr>
<th>Sectors</th>
<th>Price distortion (%)</th>
<th>Value added (billions of Pesos, 1970)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Coffee (+)</td>
<td>-44.0</td>
<td>4.639</td>
</tr>
<tr>
<td>2. Agriculture (+)</td>
<td>3.5</td>
<td>24.482</td>
</tr>
<tr>
<td>3. Food, beverages and tobacco (+)</td>
<td>8.4</td>
<td>12.322</td>
</tr>
<tr>
<td>4. Textiles and apparel (−)</td>
<td>15.2</td>
<td>6.263</td>
</tr>
<tr>
<td>5. Paper, wood, leather (−)</td>
<td>12.5</td>
<td>1.141</td>
</tr>
<tr>
<td>6. Rubber, chemicals (−)</td>
<td>46.0</td>
<td>2.498</td>
</tr>
<tr>
<td>7. Metals and metal products (−)</td>
<td>56.3</td>
<td>1.296</td>
</tr>
<tr>
<td>8. Nonmetallic products (+)</td>
<td>4.7</td>
<td>1.558</td>
</tr>
<tr>
<td>9. Mining (+)</td>
<td>−0.2</td>
<td>1.490</td>
</tr>
<tr>
<td>10. Machinery (−)</td>
<td>144.6</td>
<td>1.380</td>
</tr>
<tr>
<td>11. Diverse industries (−)</td>
<td>149.1</td>
<td>1.756</td>
</tr>
<tr>
<td>12. Light domestic industries</td>
<td></td>
<td>3.700</td>
</tr>
<tr>
<td>13. Construction</td>
<td></td>
<td>10.698</td>
</tr>
<tr>
<td>14. Transport and communication</td>
<td></td>
<td>6.451</td>
</tr>
<tr>
<td>15. Services</td>
<td></td>
<td>28.033</td>
</tr>
</tbody>
</table>

much confidence in the available estimates of the allocative costs of protection.

Although the estimates refer only to a single country and the degree of aggregation is a limiting factor, perhaps the most important recommendation to be drawn is that trade strategies have an important effect on employment in LDC’s. In view of the high rates of unemployment in developing countries, the effects of commercial policies on industrialization and its related use of labor should be studied in greater detail. The results, at least for Colombia, suggest that the effects of protection on the distribution of income among factors are difficult to estimate and may be of a second order of magnitude. But for countries such as Colombia, which have some monopolistic power in trade, planners and policy makers should be urged to estimate the level of optimum export taxes for those commodities in which the country influences the world price.

APPENDIX

This Appendix describes the sectoral classification, data requirements, and data sources for the study. Table IV indicates the sectoral breakdown of the economy used in this paper. The space between items 11 and 12 separates traded sectors from nontraded ones. Price distortions were obtained from Hutcheson’s study (1973);
they take into account both price and nonprice distortions, such as quotas. Column 1 indicates that coffee and mining exports are taxed. For the other sectors the price distortion is a tariff or a subsidy according to whether the sector is a net importer (−) or a net exporter (+).

The data requirements for implementing the model are quite extensive. Following is the list of ingredients: (1) price comparisons between domestic and world prices for representative products in each of the tradable sectors, (2) value of production for each sector, (3) an input-output table in producers' prices, (4) exports and imports for each sector, (5) marginal budget shares and subsistence minima to implement the linear expenditure system, (6) trade margins to differentiate between producers' prices reflected in the input-output table, and consumer prices faced by households; (7) value added shares received by each sector to fit the shift parameters of the sectoral production functions; and finally (9) some estimates of the elasticity of substitution between capital and labor in the case where production functions are assumed to be two-level C.E.S. Admittedly, such a list is quite large. However, note that calculation of ERP's require information on at least items 1 to 4. Naturally, estimates of factor stocks, especially capital, are hard to come by; they were obtained from Berry (1974).

Because the vector of final demand of the Colombian transactions table was not broken into its components, it was necessary to derive exogenous demand residually from estimates of imports, exports, and private final demand. The marginal budget shares and subsistence minima entering the demand system were obtained from Howe (1974). The pattern of price, cross-price, and expenditure elasticities is given in de Melo (1975, Table 4-3). For further description of the data base see de Melo (1975).

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NOTES

1. Estimates of the costs of misallocations induced by the effect of protection on relative prices are to be found in Corden (1957), Harberger (1959), Johnson (1960), Krueger (1966), and Basevi (1968). More recently Balassa (1971) and Bergsman (1974) have expanded this methodology to include the costs of protection due to other inefficiencies in the form of monopoly returns, and have estimated the effects of protection on both allocative inefficiency and "other inefficiency." By other inefficiency Bergsman is referring to what Leibenstein (1966) calls "X-inefficiency," namely, that firms are not on their production possibility frontiers. In this paper the costs of protection due to "X-inefficiency" will not be considered.

2. See Johnson (1965) for a two-commodity demonstration model using a social utility function.

3. The linearization techniques used to solve these models constrained them to small changes around equilibrium. See Taylor-Black (1974).

4. An alternative is to use a programming approach as in Evans (1972). However,
such an approach is not well suited for the incorporation of price distortions and is not a good simulator of market behavior. Also note that the conditions of a competitive equilibrium requiring that all budget constraints be satisfied are met in a Walrasian model but not in the programming approach as formulated by Evans.

5. To facilitate exposition, the following notation is adopted throughout: Greek letters and lower case italic letters refer to exogenous parameters whose values are given to the model; upper case italic letters refer to endogenous variables, although upper case italic letters with a bar are used for exogenous variables.

6. The assumption of flexible exchange rates is used here to make the results more directly comparable with partial equilibrium analysis, which provides some estimates of the likely exchange rate adjustment.

7. For the empirical application two types of production functions have been considered: multifactor Cobb-Douglas and two-level C.E.S. The use of two-level C.E.S. production functions does not constrain the elasticity of substitution to be equal across all factors; see Sato (1967). Note that to fit these production functions to existing factor stocks, it is necessary to recalculate the distribution parameters along with the exponents entering the embedded Cobb-Douglas functions; see de Melo (1975) for the necessary derivations. Having obtained the distribution parameters, we see that the shift parameters which are normalizing constants defining units of measurement, are calculated as in the Cobb-Douglas case from equation (6) on the basis of observed values for factor stocks and output levels in the base year.

8. See Magee (1973) for a discussion of why these differentials exist. The presence of differentials or quotas will violate the conditions for Pareto optimality after tariff removal.

9. See de Melo (1975, Ch. 3) for a further description of the solution technique inspired from Dervis (1975).

10. See Samuelson (1953) for a discussion of specialization. In the empirical application to Colombia up to five sectors disappear under perfect factor mobility.

11. See, for example, Evans (1972), who introduces upper and lower bounds on quantities traded to prevent specialization. The incorporation of such constraints is justifiable in a sectoral analysis.

12. In this analysis no attempt has been made to measure the elasticity of supply of unskilled labor or the size of the labor surplus. Only the extreme cases of a fixed and an infinitely elastic supply of unskilled labor at a fixed real wage are considered. It would be easy to model but difficult to estimate a supply equation for unskilled labor with a constant but less than infinite elasticity of supply.

13. Finding the optimal coffee tax is computationally expensive, since it amounts to solving the model for each guess at the optimal tax. The algorithm iterates until the partial derivative of the utility function with respect to the coffee export tax is sufficiently close to zero. However, note that the imposition of an optimal tax in lieu of a quota does not imply Pareto optimality because the presence of differential wage rates in factor markets (equation (8)) implies that the marginal rate of transformation in domestic production does not equal the marginal rate of substitution in consumption.

14. However, note that the composition of a unit of capital does not enter the model. A change in relative prices affects the domestic and foreign price components of a unit of capital, therefore changing the price of capital. In a dynamic framework with investment explicitly entering the model, it would be imperative to give a more detailed treatment of capital.

15. See Brecher (1974) for an analysis of the gains from trade in a two-sector model in the presence of a minimum wage law identical to experiment B. It is shown there that, if the sector in which the country has comparative advantage is capital intensive, specialization according to comparative advantage would entail a decline in employment and therefore a decline in welfare. However, this is not the case for Colombia.

16. It should be noted that Colombia and Brazil, despite their disparity in market size, are comparable, since for both countries coffee exports account for slightly more than half of their total export earnings. Balassa (1971) has estimated the static costs of protection to be 1.4 percent of GNP for Chile, a small open economy more comparable to Colombia than Brazil.

17. For the algebraic formulation see de Melo (1975).

18. Raising the elasticity of substitution between capital and labor from 0.25 to 1.50 increases GNP gains from 2.0 percent to 5.2 percent when unskilled labor is not fixed in supply, and from 1.6 percent to 2.1 percent when it is in fixed supply.
REFERENCES


