

## Protection, Trade Liberalization and Resource Allocation in a Small Open Economy: A General Equilibrium Simulation Analysis

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The effects of alternative trade strategies on the functional distribution of income and resource allocation in the small open Haitian economy are analysed within the framework of a static 5-agent, 12-sector computable general equilibrium model. The results indicate that domestic output is not much stimulated by a protectionist strategy, because higher tariffs increase the cost of essential intermediate imports and substitution elasticities are low. An outward oriented strategy, like the one implemented during 1986-87, is shown to have a significant impact on output and employment.

### I. Introduction

Trade strategies in developing countries are generally divided into two broad groups (Krueger, 1984, 1985): outward-oriented and inward-oriented. An outward-oriented strategy (often referred to as an "export promotion" strategy) is one in which trade and industrial policies do not discriminate between production for the domestic market and exports, nor between purchases of domestic goods and foreign goods. By contrast, an inward-oriented strategy (or "import-substitution" strategy) is one in which trade and industrial incentives are biased in favor of production for the domestic over the export market. Inward-oriented regimes are generally characterized by high levels of tariff protection for manufacturing and an overvalued exchange rate.<sup>1</sup>

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<sup>1</sup> In most countries, tariffs, have not been the sole instrument of protection. Direct controls, such as import licensing and quantitative restrictions, hidden import duties (such as

Arguments for tariff protection in developing countries usually focus on the failure of foreign trade policies to promote diversification of production both for export markets and for home consumption. Four basic types of situations are generally considered. First, because of economies of scale internal to a project, or because of the learning-by-doing that will occur as a project begins operation, short-run high costs of an industry that make it unprofitable in the early years may discourage investment in lines that will be profitable in the long run. This justification for subsidy to producers in new activities is well known as the *infant-industry* argument.

Second, any particular industry may bear high costs and appear unprofitable, even though it results in lower costs or higher profits to other industries. This is the *inter-industry linkage* argument, an argument for subsidy based on externalities of the industry.<sup>2</sup> Third, because urban manufacturing wages — and often wages in the rural sector — are usually above the opportunity cost of labour to the economy, manufacturing activities that use such labour are at a cost disadvantage in competing with international prices at the existing exchange rate. The existing exchange rate may not hurt traditional exports due to lower wage rates in the traditional export sector. Further, factor incomes in the traditional export sector often adjust as international prices adjust, whereas factor incomes in the modern manufacturing sector do not. So there is an argument for protection for manufacturing activities on the grounds of *factor price disequilibrium* among sectors.

Fourth, since even small countries tend to be specialized in certain market areas, the supply of imports to them, and the demand for their exports, tends to be less than perfectly elastic, and some restriction of trade will result in gains in the terms of trade between the country and the rest of the world. This is the *optimum tariff* argument.<sup>3</sup>

stamp taxes, port duties, advance deposit requirements, administrative allocation of foreign exchange, etc.) as well as a number of quasi-tariff measures (domestic content requirements for certain industrial products, for example) have been extensively used by policy makers around the world. However, information on non-tariff barriers is scarce, and there is not even widespread agreement as to exactly what the appropriate list of non-tariff measures should include. For a recent discussion of these issues, see Corden (1987).

<sup>2</sup> However, in a world of competitive markets, the presence of externalities and learning-by-doing economies are not sufficient conditions to guarantee the need for intervention. As recently shown by Succar (1987) in a dynamic framework, an infant industry has to satisfy an additional condition: the discounted stream of productivity gains generated by learning in the infant industry should outweigh the discounted stream of subsidies.

<sup>3</sup> Protection may also be superior to 'Laissez faire' in the presence of other types of domestic distortions although tariffs will never, in a small open economy, constitute a first-

However, extensive research over the past two decades has shown that the protection associated with inward-looking trade policies imposes a variety of economic costs on the country that puts the policy into effects. The structure of incentives that result from tariffs (and other protective measures) have been shown to exert important influences on the efficiency of resource allocation. First are efficiency costs, which can be divided into consumption losses and production losses. Consumption losses refer to losses in real income of consumers of the protected product that occur because protection generally induces consumers to buy less of the protected product while paying a higher price. Producers benefit from the higher price and will often respond by increasing their output. A production loss is involved here to the extent that resources have to be drawn from other activities (including production for export), where they can be more efficiently used.<sup>4</sup>

Protection also imposes costs due to rent seeking and directly unproductive profit seeking activities (Bhagwati, 1982; Bhagwati and Srinivasan, 1983, pp. 313-334). Lobbies spend resources enacting protection. Similarly, once protection is granted, it may lead to further resource-wasting lobbying — for example, in pursuit of import quotas or licenses carrying scarcity premium. Increased awareness of these costs have led a large number of developing economies to carry out over the past few years an in-depth reform of their trade policy, as part of a broader economic program. Trade liberalization efforts have taken two directions: first, a reduction in the levels and dispersion of rates of protection and, second, a change in the *form* of protection from quantitative restrictions to tariffs.<sup>5</sup>

In this paper, the effects of tariff reform on resource allocation in a small open developing economy (Haiti) are analysed, using a Computable General Equilibrium (CGE) model. The recent literature on CEG models for developing countries has shown the inability of partial-equilibrium measures — such as effective rates of protection and domestic resource

best policy. The specification of labour markets takes on crucial importance in this context. Bhagwati (1971) and Magee (1973) provide extensive surveys of the theory of distortions and second-best remedies in a static framework.

<sup>4</sup> Apart from production and consumption losses there can also be losses associated with so-called X-inefficiency, when protection leads to domestic monopoly. For example, monopoly can permit the entrepreneur to relax and not undertake the necessary effort to minimize costs. Moreover, monopoly can also cause conventional inefficiencies by restricting output.

<sup>5</sup> The most significant experiments in trade liberalization in the 1970s took place in the countries of the Southern Cone of Latin America: Argentina, Chile, and Uruguay. For an extensive review of recent experiences in trade policy reform in LDCs, see the World Bank (1987).

costs — to correctly predict resource movements when tariffs are altered.<sup>6</sup> For example, taxes on imports raise the absolute prices of import substitutes. If we assume that substitution in production and consumption is possible to and from importables, but at the same time that domestic prices of other goods remain constant, then the focus is mistakenly only on the protection of importables and the restriction of imports achieved by a tax paid by importers and/or domestic consumers of imports but not the effects on prices, production, and consumption of the import tax outside the importables sector. A general equilibrium framework, by contrast, permits consideration of resource effects on other sectors and changes in relative prices. The relative price changes induced may mean that the protection of importables is achieved by the “implicit taxing” of other activities besides importables. Examination of the ways in which the burden of taxes is ‘shifted’ on to other groups of producers and consumers is therefore a critical element in the evaluation of trade policy, and this can best be done in a general equilibrium framework.

The rest of the paper is organized as follows. In section 2, a brief outline of the trade liberalization program recently implemented in Haiti is provided. Section 3 presents the main characteristics of the model and the important mechanisms by which changes in trade policy affect resource allocation and the distribution of income. The ‘calibration’ procedure and the solution method are discussed in section 4. In section 5 numerical results are presented for a number of simulation experiments designed to explore the impact of different policy regimes on the functional distribution of income and resource allocation. A final section summarizes the main results of the paper.

## II. Trade Liberalization in Haiti: An Overview

The current industrial and commercial policy framework in the small, open Haitian economy has evolved over a number of years and embraces a

<sup>6</sup> The recent literature on effective protection has expanded the methodology to move it closer to a general-equilibrium framework (see for instance Hartigan, 1985). Thus demand elasticities, goods- and factor-supply elasticities, elasticities of substitution, exchange rate changes and other influences have been added to the formulation of effective rates of protection. The accuracy of such “partial” adaptations to general equilibrium remains, however, dubious.

More recently, the “true” protection concept has been developed. The technique relies upon identifying the relative price effects of protection rather than its impact on value-added. As such it focuses on ex post general equilibrium effects. See Greenaway and Milner (1987), and Milner (1985).

wide range of legislative and administrative measures (see for instance the World Bank, 1987). The legislative framework of the sixties was designed to encourage the establishment of import-substitute industries. The objective was to create employment in the manufacturing sector. Incentives included a tax holiday on corporate profits and exemption for a period from income tax on dividends. Protection from foreign competition was given via tariff and quota restrictions on imports.

Legislation enacted in the early seventies was intended rather to encourage the development of export-based manufacturing and processing industry, thorough investment by local and overseas interests. The incentives offered included again a tax holiday on corporate profits (longer than for import-substitute industries), exemption from income tax for distributed dividends, and import duty exemption on machinery, components, raw materials and semi-finished products.

A comprehensive program of economic reforms was initiated by the administration that took office in February 1986. Following a first round of trade liberalization in July 1986, trade barriers were further reduced in fiscal year 1986-87. The first action involved the removal of quantitative import restrictions on 76 out of a total of 111 items subject to import quotas or licensing requirements since 1981, and the replacement of specific tariffs on a number of products with *ad valorem* duties averaging 20 percent, with a maximum of 40 percent. In December 1986 quantitative import restrictions were eliminated on all but nine (mostly agricultural) products. In February 1987, all remaining specific tariffs were replaced by *ad valorem* ones; with the exception of five products (rice, maize, millet, flour, and gasoline), all import tariff rates were set between zero and 40 percent.<sup>7</sup> In order to allow domestic firms time to adjust to the new trade regime, the old tariff levels on domestically manufactured goods were left in place and were removed on December 31, 1987.

No comprehensive incidence analysis was made before the implementation of the new trade regime. Nominal rates were partly determined on the basis of a study on effect protection in the industrial sector carried out by the Ministry of Commerce. However, as discussed above, effective rates of protection cannot be used to answer, say, questions of distributional impact of policies nor can they be used to determine the adjustment of quantities produced or consumed. With arbitrary distortions in other markets within the economy, it cannot be asserted that reducing the tariff

<sup>7</sup> Remaining restrictions however have exacerbated price distortions with neighboring countries, and encouraged contraband in flour, rice, and many other imported consumer goods.

on a good with a positive protection rate will improve welfare. Substitution possibilities with other goods which are protected may exacerbate the distortions in those markets, making the net position worse. By the same token, priorities for liberalization cannot be made on the basis of relative effective protection rates. Decreasing a tariff on a highly protected good is not necessarily better than decreasing one on a good with a lower effective rate, again due to possible differences in elasticities.<sup>8</sup>

In what follows, a multi-sector computable general equilibrium is used to assess the potential allocational and distributional effects of the trade liberalization program implemented in 1986-87. The model distinguished 5 agents and 12 production sectors and allows therefore a fairly detailed evaluation of the reform, although it is too early to form a comprehensive view of the experiment.

### III. A Computable General Equilibrium Model

The model developed in this paper is a static general equilibrium model of the type described by Dervis, de Melo and Robinson (1982).<sup>9</sup> We start first by describing the treatment of foreign trade, which plays a crucial role in the model. We then describe the determination of domestic output and examine the adjustment of the labour market. Second, we analyse the demand side of the model, showing the determination of income and aggregate demand. Finally, the model is "closed" by considering the endogenous mechanism equating investment and saving.

#### *A. Foreign Trade*

In the classical theory of international trade, the assumptions of price-taking behaviour and perfect substitutability between domestic and foreign goods imply that the domestic price of a traded good is equal to its world price. As a consequence, if all goods produced in the economy are tradeables, the domestic price system is completely determined by exogenous factors.

However, extensive empirical research over the past two decades on "intra-trade" has produced evidence that the 'law of one price' does not

<sup>8</sup> For a further discussion on the inadequacy of effective protection measures in the presence of general equilibrium interactions, see Bhagwati and Srinivasan (1973).

<sup>9</sup> A broad survey of CGE models and applications has been provided by Borges (1986). For applications in the area of international trade, see Shoven and Whalley (1984), and de Melo (1988).

hold, even at a very fine degree of classification (see, for instance Isard, 1977). Accordingly, we assume here, following Armington (1969), that quality differences between foreign goods and domestic substitutes are important so that for any traded good  $k$  ( $k = 1, \dots, n$ , where  $n$  denotes the number of production sectors), imports,  $M_k$ , and domestically produced goods,  $D_k$ , are *imperfect* substitutes.<sup>10</sup> Domestic agents (consumers and producers) are assumed to demand a *composite commodity*  $Q_k^c$  which is a CES aggregation function over the two goods:

$$(1) \quad Q_k^c = \bar{B}_k [\Lambda_k M_k^{-\lambda_k} + (1 - \Lambda_k) D_k^{-\lambda_k}]^{-1/\lambda_k} = \Gamma_k(M_k, D_k),$$

$$0 < \Lambda_k < 1, \quad \lambda_k > 0$$

where  $\bar{B}_k$ ,  $\Lambda_k$  are constants.  $\nu_k$ , the elasticity of substitution, is given by  $\nu_k = 1/(1 + \lambda_k)$ . Assuming that consumers minimize total spending

$$(2) \quad PC_k Q_k^c = P_k D_k + PM_k M_k,$$

subject to (1), we get:

$$(3) \quad (M_k/D_k) = (P_k/PM_k)^{\nu_k} [\Lambda_k/(1 - \Lambda_k)]^{\nu_k},$$

where  $P_k$  and  $PM_k$  are the prices of the domestic and imported good  $k$  respectively, and  $PC_k$  the price of the composite commodity. Equation (3) implies that, as  $\nu_k$  gets larger, the sensitivity of  $(M_k/D_k)$  to changes in  $(P_k/PM_k)$  rises. Also, as a result of this specification,  $P_k$  is no longer equal to  $PM_k$ ; rather it is endogenously determined in the model. The variable  $PM_k$  is, however, fixed exogenously and is linked to the world price of good  $k$ ,  $PMW_k$ , (expressed in foreign currency) by the following relationship:

$$(4) \quad PM_k = (1 + \tau_k^m) \Omega \overline{PMW}_k,$$

where  $\Omega$  is the exchange rate, defined as the number of domestic currency units for one unit of foreign currency, and  $\tau_k^m$  is the tariff rate on good  $k$ . The supply of imports is assumed infinitely elastic at the (given) world price.

Because the aggregation function (1) is linearly homogeneous in  $M_k$  and  $D_k$ , it can be rewritten as

<sup>10</sup> Furthermore, at the level of aggregation considered in this study (12 sectors), each sector represents a bundle of different goods.

$$(5) \quad Q_k^C = \Gamma_k(m_k, 1)D_k,$$

where  $m_k = M_k/D_k$ . Defining the *domestic use ratio*  $d_k$  as the proportion of domestic goods in total composite commodity use, we get

$$(6) \quad d_k = (D_k/Q_k^C) = \Gamma_k^{-1}(m_k, 1) = \Psi(P_k/PM_k)$$

Using  $d_k$ , the demand for the domestically produced commodity can be derived from composite commodity demand. Under the assumption of cost minimization by domestic users of imports and domestic goods, the price of each composite commodity ( $PC_k$ ) is given by the cost function corresponding to the CES aggregation function (see e.g. Varian, 1984, pp. 31-33):

$$(7) \quad PC_k = (1/\bar{B}_k)[\Lambda_k \nu_k PM_k^{1-\nu_k} + (1 - \Lambda_k) \nu_k P_k^{1-\nu_k}]^{1/(1-\nu_k)}$$

We now consider the treatment of exports. On the demand side, the distinction between tradables and imperfect foreign substitutes is reflected in the assumption of a downward-sloping foreign demand curve for exports, denoted  $X_k^d$ , where exports of tradables depend on the world price of imperfect foreign substitutes:

$$(8) \quad X_k^d = \bar{X}_k (PX_k/\overline{PXW}_k)^{-\eta_k}, \quad \eta_k > 0,$$

$\bar{X}_k$  denoting a constant term  $\overline{PXW}_k$  an (exogenous) weighted average of world prices for goods  $k$ ,  $\eta_k$  the price elasticity of the demand for exports for goods  $k$ , and  $PX_k$  the world price of domestic exports of good  $k$ , given by

$$(9) \quad PX_k = P_k(1 + \tau_k^x)/\Omega,$$

$\tau_k^x$  denoting the export tariff. In several CGE models, producers are assumed to be indifferent between sales on export and domestic markets. There is therefore no supply function for exports as such, but rather a supply function for domestic and export output as a whole, derived from producers' production function. Export supply is then determined as a residual, i.e. as the difference between domestic supply and domestic demand.

This specification implies however that export supply may exhibit an excessively strong response to changes in domestic prices. For example, with a rise in the domestic price, producers are induced to increase supply



and domestic consumers to reduce their demand. The net result may be a sharp increase in exports. However, in practice, exports may not rise very rapidly, for the domestically consumed and exported commodities in the same sector may be quite different. For example, an "intermediate goods" sector may include both electricity (which is not traded) and wood pulp (which is). Moreover, there may be a difference in the quality of exported goods vis-à-vis goods for domestic consumption in the same sector. here, to capture this feature, we postulate a trade aggregation function which takes the form of a constant elasticity of transformation function (see Powell and Gruen, 1968) between domestically consumed  $D_k$  and exported  $X_k$  good:

$$(10) \quad Q_k = \bar{H}_k [\alpha_k X_k^{-\gamma_k} + (1 - \alpha_k) D_k^{-\gamma_k}]^{-1/\gamma_k} \quad 0 < \alpha_k < 1, \gamma_k > 0,$$

where  $Q_k$  is total (composite) production, and  $\bar{H}_k$  and  $\alpha_k$  are constants.  $\zeta_k$ , the elasticity of transformation, is given by  $\zeta_k = 1/(1-\gamma_k)$ . Maximizing the revenue from a given output,

$$(11) \quad P_k Q_k = P_k D_k + P X_k,$$

subject to (10) yields the following allocation rule of supply between domestic sales and exports:

$$(12) \quad (X_k^s/D_k^s) = (P X_k/P_k)^{\zeta_k} [(1 - \alpha_k)/\alpha_k]^{\zeta_k}.$$

Using equation (12) to determine the supply of exports, the domestic supply of goods to the domestic market is given as  $D_k^d = Q_k^d - X_k^d$ . We now turn to the determination of total supply.

### B. Domestic Output and Demand for Labour

We consider an economy in which production in each sector  $k$  combines a fixed-coefficient system for intermediate inputs and a constant returns to scale Cobb-Douglas production function that generates gross output from a sector-specific factor (capital,  $K_k$ ), assumed fixed in the short-run, and three types of labour: agricultural labour ( $L_{ak}$ ), urban unskilled labour ( $L_{uk}$ ) and urban skilled labour ( $L_{sk}$ ).<sup>11</sup> Formally, gross out-

<sup>11</sup> The assumption of constant returns to scale has been subject to much criticism in the literature (it implies that the *value* share of expenditures on any given factor is constant), but so far the estimation of sectoral CES production functions using the kind of data available in most LDCs has proven intractable. For a further discussion of the issue of scale economies in CGE models, see Devarajan and Rodrick (1989).

put of sector  $k$ ,  $Q_k$ , is given by

$$(13) \quad Q_k = \bar{Q}_k L_{ak}^{v_{ak}} L_{uk}^{v_{uk}} L_{sk}^{v_{sk}} K_k^{1-(v_{ak}+v_{uk}+v_{sk})},$$

where  $\bar{Q}_k$  denotes a constant term, and  $0 < v_{jk} < 1$ , for  $j = a, u, s$ .

With fixed capital stocks, labour inputs determine output in each sector. Producers are assumed to choose the combination of primary factors that maximizes their profits ( $\Pi_k$ ), given by

$$(14) \quad \Pi_k = (1 - \tau_k^d) P_k Q_k - \left[ \sum_{j=1}^n PC_k^a a_{jk} Q_k + (\omega_a L_{ak} + \omega_u L_{uk} + \omega_s L_{sk}) \right],$$

$P_k$  denoting the product price (treated as given by firms, as a result of the assumption of perfect competition in product markets),  $PC_k$  the domestic price of composite goods, determined above (equation 7),  $\tau_k^d$  the indirect tax rate in sector  $k$ ,  $a_{ik} \geq 0$  the  $(i, k)$  input-output coefficient and  $\omega_j$  ( $j = a, u, s$ ) the wage rate of labour class  $j$ . Now, let us define the 'net price' equations (or unit value added) as<sup>12</sup>

$$(15) \quad \phi_k = P_k (1 - \tau_k^d) - \sum_{i=1}^n PC_k^a a_{ik}.$$

With perfect competition, profit maximization requires that the wage of each factor equals the value of its marginal product:

$$(16) \quad \phi_k (\partial Q_k / \partial L_{jk}) = \omega_k \quad j = a, u, s,$$

so that, using (13),

$$(17) \quad \omega_k = v_{jk} (\phi_k Q_k) / L_{jk} \quad j = a, u, s.$$

This set of equation implicitly defines labour demand. With a perfectly inelastic supply curve of each labour category ( $L_j^s$ ), the labour market clears when total excess demand (across all sectors) for each category is zero:

$$(18) \quad \sum_{k=1}^n L_{jk}^d - L_j^s = 0 \quad j = a, u, s.$$

The solution of equations (18) yields the market-clearing wage rate for

<sup>12</sup> The net price equations deduct total intermediate input costs,  $\sum a_{ik} PC_k$ , and the sale tax  $\tau_k^d P_k$  from the seller's prices of the commodities. In terms of the input-output framework, they determine, at current prices, the sectoral value-added coefficients.

each labour category.

In an alternative specification of the model, the assumption of labour market clearance for all labour categories is relaxed to allow for Keynesian-type nominal wage rigidity. Specifically, we will then assume that the supply of urban unskilled labour is infinitely elastic at a fixed nominal wage ( $\bar{\omega}_u$ ). Actual employment will, accordingly, be determined by the demand for labour, via the excess demand functions (18). In either case, substituting the solution values of  $L_{jk}$  into the production function (13) yields a unique vector of gross outputs ( $Q_1^f, \dots, Q_n^f$ ) that constitutes the supply vector associated with a given price vector ( $P_1, \dots, P_n$ ). The supply functions can therefore be written as

$$(19) \quad Q_k^s = Q_k(P_1, \dots, P_n, \Omega).$$

The exchange rate ( $\Omega$ ) also enters as an argument in the supply functions because, as shown above, it affects the price of the composite (intermediate) goods used in the production process.

### C. Domestic Demand for Composite Goods

Five categories of decision-making units are considered in the model: rural and urban households, which demand consumer goods; the government, which also demands consumer goods; firms, which demand intermediate goods and capital good; and a foreign 'consumer' that represents the rest of the world. In what follows, the different components of aggregate demand are discussed.

#### (1) Intermediate Demand

Let  $A_k$  denote the intermediate inputs requirements for sector  $k$ . As a result of the fixed-coefficient assumption,  $A_k$  is given by

$$(20) \quad A_k = \sum_{i=1}^n a_{ki} Q_i,$$

where  $0 < a_{ki} < 1$ , and  $\sum_{i=1}^n a_{ki} = 1$ .

#### (2) Consumer Demand

We consider two categories of households, rural and urban. Rural households receive total value added of the "primary" sectors (agriculture, fishing, etc.) — which are numbered consecutively from 1 to

q-1 — and pay no income tax. Urban households include both wage earners — who supply labour and receive wages — and “capitalists” — who represent the owners of capital and receive a proportion  $(1-\varphi_k)$  of the non-wage component of value added generated by sector k.<sup>13</sup> To simplify the algebraic expressions somewhat, it may be noted that only the q-1 “primary” activities use agricultural labour. Income of rural households ( $R_h^r$ ) is therefore given by

$$(21) \quad R_h^r = [\omega_a \sum_{k=1}^{q-1} L_{ak} + (\sum_{k=1}^{q-1} (\Phi_k Q_k - \omega_a L_{ak}))] = \sum_{k=1}^{q-1} \Phi_k Q_k,$$

while disposable income of urban households ( $R_h^u$ ) is given by

$$(22) \quad R_h^u = (1 - \tau_h^u) [\sum_{k=q}^n (\omega_u L_{uk} + \omega_s L_{sk}) + \sum_{k=q}^n (1 - \varphi_k) (\Phi_k Q_k - \omega_u L_{uk} - \omega_s L_{sk})],$$

where  $0 < 1 - \varphi_k < 1$  denotes the (before tax) proportion of non-wage value added of sector k distributed by firms ( $\varphi_k$  denotes therefore the proportion of retained earnings), and  $\tau_h^u$  the average tax rate.

Households are assumed to save a fixed proportion ( $\alpha_h^r, \alpha_h^u$ , respectively, for rural and urban households) of their net income and spend the remaining income on composite goods.<sup>14</sup> The consumption demand functions are derived from the Stone-Geary *Linear Expenditure System* (see for instance Theil and Clements, 1987, pp. 9-11):

$$(23) \quad C_k^j = C_{jk}^o + (\beta_{jk} / PC_k) [(1 - \alpha_h^j) R_h^j - \sum_{k=1}^n C_{jk}^o], \quad j = r, u$$

<sup>13</sup> For simplicity, it is assumed that the government does not own any capital. We also abstract from transfer payments other than interest payments and dividends paid by firms to urban households. These extensions are dealt with in the empirical implementation of the model.

<sup>14</sup> This simplicity assumes separability of the savings decision. For an alternative treatment, see Lluch (1973). It should also be kept in mind that the Keynesian assumption of fixed saving rates, although standard in the literature, is not well founded in microeconomic theory. The specification of disposable income as the sole determinant of saving, even as a macroeconomic assumption, is questionable. Since the saving decision is a decision to add to the stock of wealth, theory suggests that it should depend in part on the expected rates of return of alternative assets. This, however, would require modelling alternative asset markets (monetary and financial), which is beyond the scope of this paper.

where  $(1-\alpha_j^c) R_j^c$  is total nominal expenditure by household group  $j$ ,  $C_{jk}^c$  the committed expenditures or *subsistence minima* in physical terms, and  $\beta_{jk}$  the marginal budget shares that determine the allocation of *super-numerary* income (i.e. expenditure above that required for purchasing the subsistence minima).

(3) Government Demand

The government, in the model, collects taxes, pays transfers, and purchases commodities. There are three kinds of taxes: income taxes, indirect taxes on domestic sales, and taxes on external trade. The income tax is paid only by urban households and firms in the non-agricultural sectors. We also assume for simplicity that corporate firms are allowed to deduct interest and dividends from taxable income, and that corporate profits distributed to (urban) shareholders are taxed only once, at the personal income level. Indirect taxes are levied on sales of domestic output, imports, and exports. Abstracting for the time being from transfer operations other than those between firms and (urban) households, the government's total revenue ( $R_G$ ) is given by

$$(24) \quad R_G = \tau_h^u \sum_{k=q}^n (\omega_u L_{uk} + \omega_s L_{sk}) + \sum_{k=q}^n [\tau_h^u (1 - \varphi_k) + \tau_f \varphi_k] [\Phi_k Q_k - (\omega_u L_{uk} + \omega_s L_{sk})] + \sum_{k=1}^n \tau_k^d P_k Q_k + \sum_{k=1}^n \tau_k^m \overline{PMW}_k \Omega_k M_k + \sum_{k=1}^n \tau_k^x PX_k \Omega_k X_k,$$

$\tau_h^u$  and  $\tau_f$  denoting the tax rates on urban households' income and firms' profits, respectively, and  $\tau_k^d$ ,  $\tau_k^m$  and  $\tau_k^x$  the average (effective) tax rates on domestic sales, imports and exports, respectively.  $\overline{PMW}_k$  and  $PX_k$  denote price indices, defined in paragraph (1) above.

Considering now the expenditure side of the budget, we assume that the government purchases goods and services in fixed volume shares:

$$(25) \quad C_k^G = \bar{g}_k C^G, \quad \sum_{k=1}^n \bar{g}_k = 1,$$

where  $C^G = (1-\alpha_G)(R_G/P_G)$  denotes (real) total consumption spending,  $\alpha_G$  the proportion of income saved by the government, and  $P_G$  an implicit deflator defined as a weighted average (under the assumption that the

government maximizes a Cobb-Douglas utility function) of the prices of composite goods.

#### (4) Investment Demand

To close the model, it remains to discuss how the savings investment equality is realized. For simplicity, let us identify firms' savings with (after-tax) retained profits. We assume that the level of investment is determined by the level of saving, defined as the sum of private, public and foreign savings:

$$(26) \quad I_T = \alpha_h^r R_h^r + \alpha_h^u R_h^u + \alpha_G^R G + \Omega \cdot F \\ + (1 - \tau_f) \sum_{k=q}^n \varphi_k [\Phi_k Q_k - (\omega_u L_{uk} + \omega_s L_{sk})],$$

F denoting the value of the net foreign resource inflow (foreign saving), expressed in foreign currency. The closure rule adopted in the model is thus *classical* in spirit: given the fixed savings rates, the endogenously determined volume of aggregate domestic savings together with net foreign capital inflows determines the volume of aggregate investment  $I_T$ .<sup>15</sup>

Once aggregate investment is established, its sectoral allocation must be specified. Fixed coefficients are used in the model to divide up the total volume of investment among sectors. Denoting by  $\vartheta_k$  the share of investment going to sector  $k$ ,

$$\vartheta_k = PK_k (\Delta K_k / I_T),$$

and so

$$(27) \quad \Delta K_k = \vartheta_k (I_T / PK_k),$$

$PK_k$  denoting the price of capital and  $\Delta K_k$  is real investment in sector  $k$ . Since capital is assumed to be a fixed-proportions composite commodity, its price is simply the weighted average of its components:

$$(28) \quad PK_k = \sum_{i=1}^n b_{ik} PC_i,$$

<sup>15</sup> For a discussion of alternative closure rules in CGE models, see Dewatripont and Michel (1987), and Rattso (1982).

where  $b_{ik}$  are the shares in the capital composition matrix. The sectoral investment volumes  $\Delta K_k$  are therefore determined uniquely by the price system, which determines uniquely the capital prices  $PK_k$  and total savings.

The sectoral pattern of capital accumulation must now be translated into demands for investment goods by sector of origin. This is achieved by using the elements of the capital composition matrix. Let  $Z_k$  denote total investment demand by sector of origin, we have

$$(29) \quad Z_k = \sum_{i=1}^n b_{ki} \Delta K_i$$

These demand functions depend solely on product prices, in similar fashion to the consumer demand equations.

#### D. Supply and Demand Equilibrium

From (8), (20), (23), (25) and (29), demand functions for domestically produced commodities are given as

$$(30) \quad Q_k^d = d_k [C_k^r + C_k^u + C_k^g + Z_k + A_k] + X_k.$$

The domestic use ratio  $d_k$ , given by equation (6), transforms the composite demands for intermediate goods ( $A_k$ ), consumer goods ( $C_k^r + C_k^u + C_k^g$ ) and investment goods ( $Z_k$ ) into demands for domestically produced commodities. Inspection of (8), (20), (23), (25), and (29) shows that the demand functions depend on the domestic prices and the exchange rate:

$$(31) \quad Q_k^d = Q_k^d (P_1, P_2, \dots, P_n, \Omega).$$

The supply and demand equations for product markets (equations 19 and 31) yield a set of simultaneously market clearance conditions, the solution of which provides market-clearing relative prices. To this set of equations must be added the balance-of-payments constraint, which defines the trade deficit as being equal to the level of foreign saving:

$$(32) \quad \sum_{k=1}^n \overline{PMW}_k M_k - \sum_{k=1}^n PX_k X_k = F.$$

Therefore, a solution to the model is given by a price vector  $(P_1, \dots, P_n, \Omega)$  such that excess demands ( $ED_k$ ) equal zero in all sectors

$$(33) \quad ED_k = Q_k^d - Q_k^s = 0,$$

and excess demand for foreign currency (EF) is also equal to zero:

$$(34) \quad EF = \sum_{k=1}^n \overline{PMW}_k M_k - \sum_{k=1}^n PX_k X_k - F = 0.$$

The system has thus  $n + 1$  equations in  $n + 1$  variables. But the excess demand functions are homogeneous of degree zero in all prices and must satisfy *Walras's Law*,

$$(35) \quad \sum_{k=1}^n P_k (Q_k^d - Q_k^s) = 0,$$

implying that there are only  $n$  independent excess demand equations to determine  $n + 1$  relative price ratios. A price-normalization equation is therefore required to close the system. In the empirical implementation of the model, we have chosen the exchange rate as the *numéraire*, so that all domestic prices are measured relative to world prices.

#### IV. Calibration and Solution of the Model

The data used to calibrate the CGE model described above can be presented within the framework of a social accounting matrix (SAM). A SAM is essentially a consistent presentation of the accounting identities that describe an economy. Since a SAM includes in a consistent framework the complete economic structure of a country, it provides an extremely useful tool for analyzing the overall economy at a point in time. Furthermore, its intrinsic format ensures consistency between the various macroeconomic accounts and data sources, which is a fundamental prerequisite to any modelling effort.<sup>16</sup> The SAM built for the Haitian economy is structured around a (condensed) 12x12 input-output Table for fiscal year 1984-85 and includes basically summary statistics on consumption and production patterns, foreign trade, investment and savings, income distribution, and the tax structure. The rationale for the level of aggregation chosen is as follows. Forestry (silviculture) differs from the other agricultural sectors in its production structure. In the secondary sectors, food processing has a very distinct pattern of intermediate consumption, and construction materials is important for industrial policy analysis. Activity in the textiles sector is highly dependent upon foreign demand. Finally, in the tertiary sectors, public and private services are treated separately to allow for differences in their composition of demand. This

<sup>16</sup> For a detailed description of the SAM approach, see Keunig and Ruijter (1988). The use of the SAM as a macroeconomic modeling framework is discussed by Thorbecke (1985) and Drud, Grais and Pyatt (1986).



distinction also allows an analysis of the competition in factor markets between the government and the private sector. The share of GDP at factor cost accounted for by each production sector in the base year is given in Table 1.

Following the methodology described by Drud, Grais and Pyatt (1986), the data SAM is related to the algebraic model by expressing the later in TV (*Transactions Value*) form. Briefly, instead of presenting the model as a set of equation showing how prices and quantities are determined, the TV approach consists in modelling prices and value flows instead. Since quantities are implied by value flows and prices, these two formulations are logically equivalent but the TV form of a model facilitates the relationship between the SAM and the system of equations.

The model is solved using the HERCULES system, which is part of the PC-GAMS software (see Drud and Kendrick, 1986). The program uses a Newton-type solution algorithm<sup>17</sup> and automatically calibrates all the parameters (value flows, input-output coefficients, capital composition coefficients, expenditures shares, constant terms, average tax rates, etc.) of the model using the base year data, except elasticities.<sup>18</sup> The set of elasticities used in the experiments described below are shown in Table 1. Due to the lack of data availability proper econometric procedures could not be used. The coefficient values have been chosen mainly on the basis of discussions with sectoral experts at the Ministry of Planning.<sup>19</sup>

17 Newton-type methods and other local linearization techniques are widely used, and appear as efficient as Scarf-type methods (see Cornwall, 1983, Manne, 1985, and Scarf, 1984), although they do not guarantee convergence.

It must also be kept in mind that there is no theoretical argument that guarantees uniqueness in CGE models, although most models have been shown to be fairly robust from this point of view. For further discussion, see Kohoe and Whalley (1985), and Kehoe (1985).  
18 The calibration procedure ensures that a solution of the model exists for the base year. This is done by finding values of shift and share parameters for production functions, etc. that are consistent with the base year data. For example, in the model the production functions are Cobb-Douglas (equation 13). The corresponding first-order conditions for profit maximization (16) can be written as

$$v_{jk} = \omega_j L_{jk} / \bar{Q}_k Q_k \quad j = a, u, s$$

since the base year data contain information on  $Q_k$ ,  $L_{jk}$ ,  $K_k$ , and because prices are set to unity,  $v_{jk}$  can be determined from the above equation.  $\bar{Q}_k$  (the constant term in the production function for sector  $k$ ) can then be determined by re-writing equation (13) as

$$\bar{Q}_k = Q_k / [L_{ak}^{v_{ak}} L_{uk}^{v_{uk}} L_{sk}^{v_{sk}} K_k^{1-(v_{ak}+v_{uk}+v_{sk})}]$$

19 The full estimation of CGE models by econometric methods has so far proven intractable in most cases. See Mansur and Whalley (1984), and Whalley (1985) for a complete discussion of the methodological aspects of calibration in CGE models.

**Table 1**  
 STRUCTURE OF GDP AT FACTOR COST<sup>1</sup>  
 AND SUBSTITUTION AND PRICE ELASTICITIES<sup>2</sup>

Production sector	Share of GDP	Elasticities		
		$\xi_k$	$\nu_k$	$\eta_k$
1. Agricultural products	27.3	-0.7	0.9	5.7
2. Livestock, forestry and fishing	5.1	-0.7	1.1	6.0
3. Food processing	5.9	-0.9	1.5	2.1
4. Beverages and tobacco	1.2	-0.8	1.1	2.4
5. Textiles, footwear and leather products	2.5	-1.5	1.6	2.8
6. Chemicals, plastic and petroleum products	1.1	-0.8	1.2	1.6
7. Water and electricity	1.9	—	—	—
8. Miscellaneous industrial products	6.8	-1.7	1.4	2.3
9. Construction and public works	5.4	—	—	—
10. Transport and communications	1.9	-0.6	1.5	1.7
11. Private services	30.2	—	2.7	—
12. Government services	10.7	—	—	—
Total	100.0			

1 Base year (1984-85).

2  $\xi_k$ : elasticities of transformation;  $\nu_k$ : domestic-imported goods substitution elasticities;  $\eta_k$ : price elasticities of export demand.

Source: Haitian Institute of Statistics, and author's estimates.

Finally, a normalization rule must be defined, since the model can only be solved for relative prices. As already mentioned, we have here chosen the exchange rate as the *numéraire*. All prices are therefore measured in terms of world prices. Consequently, the excess demand function for foreign currency (34) is solved for the level of foreign capital inflow (foreign saving).

## V. Policy Experiments with the Model

We now turn to an analysis of alternative trade strategies and their allocation effects. Two alternative policy regimes have been modelled and compared to the base-run solution. The first is an inward-looking (protectionist) strategy, with a tariff increase in all manufacturing sectors except beverages and tobacco (sectors 3, 5, 6, and 8). The second is an outward-looking strategy with an elimination of all export taxes on agricultural

products (basically coffee) and a reduction of tariffs on all imports. Table 2 provides a summary of assumptions regarding (average) effective tariff rates on imports under the alternative regimes. The protectionist experiment describes a hypothetical case; figures corresponding to the outward-looking strategy represent sectoral estimates of the new tariff rates implemented during the 1986-87 reform.

World prices remain constant throughout the analysis. All experiments are conducted under two alternative assumptions: flexible and

**Table 2**  
NOMINAL TARIFF RATES ON IMPORTS

	Base simulation	(unit: %) Experiment	
		P	L
1. Agricultural products	1.6	1.6	0.0
2. Livestock, forestry and fishing	18.0	18.0	10.0
3. Food processing	19.2	30.0	10.0
4. Beverages and tobacco	70.3	70.3	30.0
5. Textiles, footwear and leather products	10.1	20.0	10.0
6. Chemicals, plastic and petroleum products	8.0	20.0	5.0
7. Water and electricity	—	—	—
8. Miscellaneous industrial products	6.3	20.0	—
9. Construction and public works	—	—	—
10. Transport and communications	—	—	—
11. Private services	—	—	—
12. Public services	—	—	—

P: Increased protection experiment.

L: Trade liberalization experiment.

Source: Haitian Institute of Statistics.

rigid nominal wages for agricultural labour and urban unskilled labour. In the first case, wage rates are fully flexible, while in the second the supply of labour for these two categories is assumed to be perfectly elastic at the specified wage. In this second, "Keynesian" case, nominal wages are exogenous.

#### A. Increased Protection Experiment

Simulation results for both policy experiments are reported in Tables 3

**Table 3**  
SIMULATION RESULTS, 'INCREASED PROTECTION' EXPERIMENT  
(percentage changes from the base)

Production sector	Net output	Price of value added	Price of composite goods	Foreign trade			
				Export prices	Export volumes	Import prices	Import volumes
Flexible wages							
1. Agricultural products	0.006	-10.718	-8.941	-1.010	5.954	0.000	-9.207
2. Livestock, forestry and fishing	-0.035	-14.441	-11.127	-1.192	4.285	0.000	-12.319
3. Food processing	0.106	-2.567	-4.305	-1.577	3.395	9.026	-19.144
4. Beverages and tobacco	-2.079	-4.785	-1.906	0.108	-0.259	0.000	-4.439
5. Textiles, footwear and leather products	-0.822	-3.698	7.064	1.222	-2.400	9.015	-4.877
6. Chemicals, plastic and petroleum prod.	2.468	7.678	9.387	0.251	-0.400	11.130	-3.076
7. Water and electricity	-0.967	-5.157	0.025	—	—	—	—
8. Miscellaneous industrial products	-0.122	-2.921	10.707	1.696	-3.795	12.892	-3.321
9. Construction and public works	-0.389	-3.138	3.806	—	—	—	—
10. Transport and communications	-1.847	-4.440	0.710	1.007	-1.689	0.000	-0.783
11. Private services	0.005	-2.765	-1.857	—	—	0.000	-4.974
12. Government services	0.728	-2.413	-1.803	—	—	—	—

Table 3 (continued)

Production sector	Net output	Price of value added	Price of composite goods	Foreign trade			
				Export prices	Export volumes	Import prices	Import volumes
Fixed wages							
1. Agricultural products	-0.295	-10.856	-8.960	-0.965	5.681	0.000	-9.503
2. Livestock, forestry and fishing	-0.156	-16.253	-12.223	-1.287	4.638	0.000	-13.640
3. Food processing	-0.236	-1.154	-4.005	-1.365	2.934	9.026	-19.007
4. Beverages and tobacco	-2.335	-2.823	-1.456	0.322	-0.768	0.000	-4.134
5. Textiles, footwear and leather products	-1.835	-2.564	7.258	1.727	-3.367	9.015	-5.233
6. Chemicals, plastic and petroleum prod.	1.937	7.792	9.434	0.529	-0.841	11.130	-3.430
7. Water and electricity	-1.362	-3.923	0.881	—	—	—	—
8. Miscellaneous industrial products	-1.245	-1.574	10.958	2.236	-4.961	12.892	-3.447
9. Construction and public works	-0.484	-0.829	4.877	—	—	—	—
10. Transport and communications	-2.273	-3.422	1.315	1.357	-2.265	0.000	-0.298
11. Private services	-0.345	-2.304	-1.386	—	—	0.000	-4.063
12. Government services	0.220	-1.601	-1.067	—	—	—	—

to 6 for quantities and prices, at both the sectoral and aggregate levels. Consider first the results of the protectionist strategy with flexible wages (Tables 3, 5 and 6). The rise in tariff rates for sectors 3 (food processing), 5 (textiles, footwear and leather products), 6 (chemicals, plastic and petroleum products) and 8 (miscellaneous industrial products) generates an increase in the domestic price of imports. As a consequence, consumers substitute domestic goods to foreign goods on the demand side, and this implies a reduction in volumes of goods purchased abroad, particularly pronounced for agricultural and food items. Consumers however do not only substitute domestic to foreign goods in the same sector. Inter-sectoral substitution effects tend also to develop, since the relative structure of domestic prices has changed. Overall, therefore, intra- and inter-sectoral substitution effects imply that movements in the price of composite goods are subject to two conflicting forces: on one hand, the domestic price of imports rises, and on the other the price of domestic goods may rise or fall. Depending on which of these two opposite effects dominates, composite prices either fall (agricultural products; livestock, forestry and fishing; food processing) or rise (textiles, footwear and leather products; chemicals, plastic and petroleum products; miscellaneous industrial products).

The initial upward pressure on the price of composite goods (through higher domestic prices for imports) generates further adjustment on the supply side, because composite goods are used as intermediates in the production process. The higher the rise in the (composite) price of intermediate inputs (and, also, the more input-intensive the production process is), the greater the fall in the sectoral net price, and the greater the fall in output. This is, of course, partly a consequence of the fixed coefficients assumption for intermediate input requirements in each sector. Table 3 shows that output rises only slightly in the food processing industries and even falls in the production of textiles, footwear and leather products, as well as miscellaneous industrial products, despite the sharp increase in nominal tariff rates in these sectors. The only sector where output rises strongly is the chemicals, plastic and petroleum products, the sector where the net price increases most. Moreover, the rise in output in the food processing industries does not come as a result of a rise in net prices; indeed, net prices *fall* in this sector, as well as in the agricultural and livestock, forestry and fishing sectors. Output rises because the negative effect due to the sharp drop in the net price is dampened by the fall in domestic prices relative to world prices for exports, which stimulates sales of agricultural products abroad, as well as exports of the livestock, forestry and fishing sector, and exports of the food processing industries. This exerts a positive effect on real output which overall rises in

agriculture and food processing, two sectors that are closely linked through input-output relationships.

The impact of the protectionist strategy on factor remuneration (Table 5) works through changes in net prices. As discussed above, increased taxation of imported manufactured goods causes the net price in most manufacturing sectors (except chemicals and plastic products) to fall because the cost of intermediate goods rises, and this is associated with a fall in output and a decline in factor payments. Indeed, the strong rise in the output of chemicals and plastic products, a relatively capital intensive sector, generates a sharp increase in the rental rate of capital in that sector, and a fall in all other sectors. This reflects of course the sectoral immobility of capital stocks.

Aggregate or 'macroeconomic' effects are summarized in Table 6. Overall, consumption, output, imports and exports fall in real terms, but nominal government revenue increases while the current account balance improves.<sup>20</sup>

Results obtained with a fixed nominal wage for rural and urban unskilled labour (see Tables 3, 5 and 6) are qualitatively similar to those discussed above. The major difference is that now net output in the agricultural sector and the food processing industries *falls*, as well as output of private services. The reason is the following. With flexible wages, an increase in labour demand resulting from higher output raises the nominal wage, and this tends to increase factor payments to labour and therefore aggregate demand. Now, with fixed wages, labour income rises less than before, and lower demand implies a stronger downward pressure on prices of domestic and composite goods. As a result, net prices fall more in sectors where rural labour is used intensively (agriculture; livestock, forestry and fishing). However sectors where unskilled urban labour is used most (construction and public works, private services) are less affected because of the greater importance of skilled labour. Again, macroeconomic effects are qualitatively similar (see Table 6), although the fall in consumption, output, exports and imports are larger compared to the flexible wages case.

<sup>20</sup> Given our assumptions of fixed capital stocks and a fully employed fixed labour supply with flexible wages, the *total* change in real output is insignificant in both the inward-looking and outward-looking experiments. Gross domestic product at factor cost remains constant in real terms. Therefore, with flexible wages, only the changes in the inter-sectoral structure of output need be considered.

### *B. Trade Liberalization Experiment*

Consider now the effects of the outward looking strategy, which consists of removing all export taxes and reducing tariff rates in all sectors, except textiles, footwear and leather products. Results obtained under the assumption of flexible wages for all labour categories are reported in Tables 4, 5 and 6. The export supply functions determine the degree of responsiveness of the affected sectors to this policy measure. The fall in import tax rates entails a fall in the domestic price of imported goods, which exerts a downward effect on the price of composite goods. Consumers increase their demand for foreign goods, and tend to reduce demand for domestic goods. Impact effects on the price of composite goods depend on the degree of substitutability between domestic and foreign goods.

In sectors where the price of composite goods falls initially (as a result of the fall in import prices), net prices rise and stimulate output, and this in turn exerts a downward effect on domestic and composite prices. Final effects show that net prices fall significantly in only three sectors: beverages and tobacco (the sector for which the fall in the tariff rate is highest and the rise in import volumes strongest); textiles, footwear and leather products; and miscellaneous industrial products. Output tends to fall also in these sectors. In agriculture, output rises because of greater incentives to produce for the domestic market (higher net prices) and because of higher export prices, which increases the share of output sold abroad. Agricultural exports rise, and this causes a relative decline in the domestic supply of agricultural goods. Domestic prices of agricultural products go up, and this implies that the terms of trade (both gross and net prices) move in favour of agriculture. As a result, rural households increase their share in national income relative to other institutional groups in the economy. At the same time, the relative increase in agricultural prices raises the cost of living for the rural households more than other groups because they consume relatively more agricultural products.

Despite the sharp rise in import volumes, output in the livestock, forestry and fishing sector rises slightly because of the increase in the net price brought about by the fall in import prices. Output in the food processing industries rises also despite the increase in imports, as a result of close inter-selectoral relationships with the agricultural sector.

Factor price movements for this experiment are reported in the third column of Table 5. Wages and the rental rate of capital rise sharply in the agricultural and livestock, forestry and fishing sectors. At the same time, the rental rate of capital falls in all sectors where output falls.



Macroeconomic results are again reported in Table 6. Output, exports and imports expand, considerably so for imports. The current account deteriorates, although the growth in exports tends to dampen the negative effect of increased imports on the external balance. Nominal government revenue also falls, despite increased tax receipts due to higher domestic activity.

Results obtained with a fixed wage for rural and urban unskilled labour are reported in Tables 4, 5 and 6. Qualitatively they look similar to those reported for the flexible wages case. Fixed wages generate now negative income effects. Lower labour income generates downward pressure on demand for agricultural products, livestock, forestry and fishing, and food processing industries. This entails a lower rate of increase in composite goods prices as well as net prices in these sectors. Output growth in the agricultural sector is however higher than previously obtained, because of a higher rate of growth of export volumes and lower rate of increase of imports. Output of private services also rises more, because of a slight rise in the price of value added. As a result, real gross domestic product at market prices rises more than was previously the case, and the deterioration in the current account balance is less pronounced.

Overall, it appears that the crucial link in the mechanism whereby a change in trade policy affects the allocation of resources is the change in relative gross and net prices. Changes in relative net prices ( $\Phi_k$ ) are translated into changes in relative factor rewards, and changes in relative gross prices ( $P_k$ ) affect the price of composite goods, and therefore the real purchasing power of the various groups. The responsiveness of the domestic price system to changes in trade policy is linked both to the openness of the economy and to the degree of substitutability between domestic and imported goods.

The results also show that protection raises the cost of essential intermediate inputs, which are often imported and cannot easily be produced locally, so that domestic production is not much stimulated by a protectionist policy. The difficulty to alter the composition in use of domestic and foreign goods, implies that there is little switching toward domestic production, so that protection raises the cost for users of commodities that are import intensive without increasing the income of factors employed in those sectors. By contrast, an outward oriented strategy has a significant effect on output and (with fixed nominal wages for agricultural and urban unskilled labour) employment.

Finally, it should be noted that the results depend, to a large extent, on the values assumed for the parameters. For example, if the elasticities of substitution between home and foreign goods are under-estimated, this

**Table 4**  
**SIMULATION RESULTS, 'TRADE LIBERALIZATION' EXPERIMENT**  
 (percentage changes from the base)

Production sector	Net output	Price of		Foreign trade			
		value added	composite goods	Export prices	Import prices		
Flexible wages				Export volumes	Import volumes		
1. Agricultural products	0.104	6.111	5.230	-1.479	8.862	-1.551	7.081
2. Livestock, forestry and fishing	0.032	10.364	7.802	0.771	-2.651	-6.815	17.597
3. Food processing	0.128	0.895	2.441	0.906	-1.877	-7.747	18.903
4. Beverages and tobacco	-0.717	-0.126	-2.394	0.537	-1.276	-23.616	35.378
5. Textiles, footwear and leather products	-0.509	0.015	0.281	0.368	-0.731	-0.070	1.300
6. Chemicals, plastic and petroleum prod.	-0.778	-2.677	-2.180	0.183	-0.292	-2.779	1.646
7. Water and electricity	0.971	3.035	1.356	—	—	—	—
8. Miscellaneous industrial products	-0.967	-0.215	-0.878	-0.005	0.012	-1.220	0.490
9. Construction and public works	0.114	0.668	-0.032	—	—	—	—
10. Transport and communications	1.632	2.186	0.598	-0.554	0.949	0.000	2.592
11. Private services	0.266	1.862	1.578	—	—	0.000	4.636
12. Government services	-0.354	0.461	0.514	—	—	—	—

Table 4 (continued)

Production sector	Net output	Price of value added	Price of composite goods	Foreign trade			
				Export prices	Export volumes	Import prices	Import volumes
Fixed wages							
1. Agricultural products	0.131	5.213	4.511	-1.573	9.455	-1.551	6.491
2. Livestock, forestry and fishing	0.085	10.174	7.583	0.736	-2.534	-6.815	17.392
3. Food processing	0.247	0.750	2.172	0.782	-1.623	-7.746	18.521
4. Beverages and tobacco	-0.632	-0.482	-2.499	0.479	-1.140	-23.617	35.310
5. Textiles, footwear and leather products	-0.324	-0.223	0.251	0.278	-0.556	-0.070	1.382
6. Chemicals, plastic and petroleum prod.	-0.651	-2.582	-2.187	0.117	-0.187	-2.779	1.751
7. Water and electricity	1.090	2.884	1.249	—	—	—	—
8. Miscellaneous industrial products	-0.771	-0.497	-0.914	-0.096	0.221	-1.230	0.528
9. Construction and public works	0.153	0.221	-0.243	—	—	—	—
10. Transport and communications	1.732	2.033	0.528	-0.615	1.054	0.000	2.583
11. Private services	0.375	1.976	1.654	—	—	0.000	4.963
12. Government services	-0.246	0.369	0.417	—	—	—	—

**Table 5**  
**FACTOR PRICE MOVEMENTS**  
 (Percentage changes from the base)

Factor	Policy Experiment			
	Increased Protection		Trade Liberalization	
	(1)	(2)	(1)	(2)
Agricultural labour	-10.943	—	6.367	—
Urban unskilled labour	-3.040	—	0.631	—
Urban skilled labour	-2.321	-1.887	0.440	0.440
Capital:				
1. Agricultural products	-10.712	-11.118	6.105	5.350
2. Livestock, forestry and fishing	-14.473	-16.384	10.396	10.268
3. Food processing	-2.464	-1.387	1.024	0.999
4. Beverages and tobacco	-6.764	-5.091	-0.841	-1.113
5. Textiles, footwear and leather products	-4.490	-4.352	-0.495	-0.547
6. Chemicals, plastic and petroleum products	10.335	9.880	-3.434	-3.216
7. Water and electricity	-6.074	-5.232	4.035	4.005
8. Miscellaneous industrial products	-3.040	-2.800	-1.180	-1.261
9. Construction and public works	-3.516	-1.309	0.783	0.373
10. Transport and communications	-6.205	-5.618	3.854	3.798
11. Private services	-2.760	-2.641	2.133	2.357
12. Government services	-1.703	-1.385	0.105	0.123

(1): Flexible nominal wages, all labour categories.

(2): Fixed nominal wages, rural and urban unskilled labour.

**Table 6**  
**CHANGES IN MACROECONOMIC AGGREGATES, AT CONSTANT PRICES**  
 (Percentage changes from the base)

	Policy Experiment			
	Increased Protection		Trade Liberalization	
	(1)	(2)	(1)	(2)
Consumption (total)	-1.675	-1.942	1.578	1.646
Gross domestic product, fc <sup>1</sup>	0.000	-0.397	0.000	0.120
Gross domestic product, mp <sup>2</sup>	-0.226	-0.616	0.679	0.802
Exports (total)	-1.377	-2.279	0.993	1.187
Imports (total)	-4.844	-5.026	2.870	2.829
Current account deficit <sup>3</sup>	-37.278	-35.618	18.434	17.332
Government Revenue <sup>3</sup>	18.776	18.839	-6.703	-6.551

(1): Flexible nominal wages, all labour categories.

(2): Fixed nominal wages, rural and urban unskilled labour.

1 fc: at factor prices; 2 mp: at market prices.

3: At current prices.

restricts the rate at which imports can replace domestic production as local prices rise. As a comparison, we repeated the experiments described above changing two elasticities for which uncertainty was considered high, the home-foreign good substitution parameters for the good processing sector and miscellaneous industrial products. Specifically, these parameters were set to 2.4 and 2.1 respectively, instead of 1.5 and 1.4.

The results obtained are not fundamentally different from those reported in Tables 3 to 6, and so are omitted to save space. The resulting price increases display indeed a similar pattern similar to those obtained in the initial set of experiments, although their magnitude is smaller because of the greater competition from foreign goods imported at constant world prices. Those sectors whose trade substitution elasticities were raised show the most significantly smaller price increases. In the same way, the pattern of output changes obtained in the initial experiments remains broadly unchanged. The pattern of changes in imports shows that foreign goods replace more easily domestic goods in sectors where the trade elasticity has been raised. The reallocation of labour among sectors reflects the pattern of output changes, while nominal wage rises, in the trade liberalization experiment with fixed labour supplies, are lower than previously indicated.

## VI. Concluding Remarks

In this paper, we have described a CGE model for a small open developing economy emphasizing the role of relative prices in resource allocation and income distribution. The model is used for an analysis of medium-term sectoral and macroeconomic effects of a (hypothetical) protectionist strategy and a trade liberalization programme which reflects recent tariff changes recently implemented in Haiti. Overall, the results show that the tariff reform is likely to produce substantial sectoral effects as well as a significant increase on aggregate output.

One key issue with the model is how robust the results are to alternative parameter values. Because a 'calibration' procedure was used to select parameter values, meaningful statistical tests of model specification are not possible. Evaluation of the robustness of the results was carried out by taking alternative elasticity values to those used in the 'central case' specification, displacing two key values by what seem as 'large' changes. Although the limited nature of the sensitivity tests performed is clear, the results showed a reasonable degree of robustness.

However, the model can be further developed and improved in several

areas. First, the assumption of perfect competition underlying the model may not be appropriate. The degree of monopoly, oligopoly and other noncompetitive behaviour in the industrial sector of the Haitian economy may be more pronounced than actually thought. More effort should be spent upon determining actual pricing behaviour.<sup>21</sup>

Another important extension of the model developed in this paper would be to consider a dynamic framework. The analysis of trade policies in a dynamic context has produced interesting results. For example, De Melo (1978) has developed a quantitative model of the Turkish economy in which the static costs of alternative trade policies are weighted against the potential dynamic gains. They show that, with imperfect foresight and heterogenous imperfectly mobile capital, dynamic benefits are associated with protection, because investment allocation (based on the present structure of comparative advantage) can be intertemporally inefficient. This does not of course constitute a first-best argument in favour of protection. It does suggest however that protection can have a beneficial dynamic effect when compared to a free trade regime, and that this should be quantitatively weighted against the static welfare costs.

Finally, rent-seeking behavior associated with protection is worth further consideration. The quantitative significance of rent-seeking activities when they co-exist with trade-restricting policies can be significant (see Grais, de Melo and Urata, 1986). Ignoring rent-seeking and analyzing policy effects by comparing competitive equilibria implies that the economy is productively efficient. Resources diverted to rent seeking however necessarily take the economy *inside* its production frontier, and trade liberalization eliminates this loss. By ignoring rent-seeking — as is done here — the gains from liberalization can be substantially underestimated.

21 The work of Harris (1984) has highlighted the role of scale economies and imperfect competition in CGE models. For LDCs, Staelin (1976) is an early example of a general equilibrium model specifying non-competitive pricing behaviour. His model employs markup or 'administered' pricing in its description of industry pricing behaviour. Application of the model to the Ivory Coast shows quite clearly that when tariffs are altered, different assumptions about the pricing behaviour of industries do lead to different predictions of resource reallocation. The model is however based on *ad hoc* specification of pricing behaviour and on a rigid traded/nontraded goods distinction. For more recent attempts, see e.g. Taylor (1983, chapter 3) and Devarajan and Rodrik (1989).

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