The Impact of Trade Policies on Income Distribution in a Planning Model for Colombia

Jaime de Melo and Sherman Robinson

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This paper develops a multisector Computable General Equilibrium (CGE) model to simulate the effects of trade on the distribution of income among socioeconomic groups defined both by the factors of production they own and the sector in which they work. The categorization of recipients includes landless rural labor, land owners, workers in the urban traditional sector, and workers in the organized sector and capitalists. Experiments are conducted with an application to Colombia, a primary-exporting economy. The results indicate that, for such an economy, outward-looking policies with increased primary exports are likely to be more detrimental for the distribution of income in the medium term than inward-looking ones.

INTRODUCTION

Policy makers now have available a large collection of comparative studies analyzing the experience developing countries have had with their foreign trade regimes. The focus of these national studies has been a detailed evaluation of the efficiency implications of industrialization policies based on a blend of inward- and outward-looking trade strategies. However, it has been difficult to distill evidence from these studies concerning the effects of trade policies on the functional or size distribution of income. In reviewing the impact of trade policies on income distribution from the country studies in the NBER project on Foreign Trade regimes, Bhagwati (1978, p. 201) concluded that "the Project evidence on the income distributional and egalitarian effects of the foreign trade regimes is somewhat sketchy and mixed." Having noted that although the functional distribution of income can be strongly related to foreign trade regimes in theoretical analysis and that the evidence from the country studies did not

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reveal a strong and predictable relationship, he concluded that the income
distributional outcome may reflect more basic underlying distributions of
wealth and power.

Lacking an adequate theory of the determinants of the distribution of
wealth and power, and in the face of inconclusive evidence from compara-
tive country studies, one can attempt to quantify the likely effects of
alternative trade strategies on the distribution of income by imposing on the
analysis knowledge based on the barter theory of trade. This is the approach
adopted here. We present a model for tracing out the effects of trade policy
on the functional distribution of income, taking into account some of the
characteristics of a developing economy where trade policy is likely to be
the main vehicle of industrial development. The model is in the tradition of
planning and trade models which focus on real flows. Prices enter
only as relative prices, and macroeconomic variables such as the money
supply and inflation are not considered. The analysis also abstracts
from Keynesian issues on the composition of aggregate demand and focuses
instead on issues of the sectoral structure of production, demand, and factor
use.

Two often-cited characteristics of a developing economy not emphasized
in trade theory but that impinge on the effects of policy on income
distribution are captured in the model. The first is the "structuralist" or
"bottleneck" phenomenon, stressed in two-gap models, which emphasizes
the difficulty of transforming foreign resources into domestic ones. This
difficulty is captured on the one hand by assuming imperfect substitution
between domestically produced goods and imported ones and, on the other,
by specifying export functions that incorporate supply limitations and the
difficulties associated with penetrating new markets. The result is that
protection raises the cost of essential intermediate inputs, which are often
imported and cannot easily be produced locally, so that domestic produc-
tion is not much stimulated by a protectionist policy. Likewise, export-
oriented sectors, though they are somewhat more responsive to policy
inducements than are import-competing sectors, will not expand much. The
second characteristic of a developing country that calls for a multisector
economy-wide model and has been the focus of much recent development
literature is based on the pervasive dualism between industry and agri-
culture. Although this dualism is not well understood and certainly not
easily quantifiable, it is probably best captured by a categorization of
income recipients along lines that would include landless rural labor,
farmers, workers in the urban traditional sector, workers in the organized
modern sector, and capitalists (perhaps further broken down by sector).
This categorization of income earners into broad socioeconomic groups
with different consumption expenditure patterns allows one to trace out the
effects of trade policy on the cost of living and hence on the real income of each of these different groups.

Following the presentation of the main characteristics of the model and the important mechanisms by which changes in trade policy affect the distribution of income, we describe the application of the model to Colombia. Results are then presented for a number of simulation experiments designed to explore the impact of different policy regimes on the distribution of income followed by our conclusions. Model specifications are summarized in the Appendix.

OUTLINE OF THE MODEL

The recent emphasis on distributional issues in developing countries has led to the resurgence of models designed to investigate the determination of the functional distribution of income. Broadly speaking, these models fall into two categories. On the one hand there are short-term aggregate macroeconomic models that focus on the determination of the wage share. These models typically investigate the effects of alternative closure rules and focus on the distributional shifts caused by changes in real incomes induced by changes in prices and wages in a world where some income flows are fixed in nominal terms (Taylor 1979). On the other hand, there are medium-term multisector microeconomic models that have been used to investigate the effects of policy on the distribution of income among socioeconomic groups (Adelman and Robinson 1978). Neither group of models has properly focused on the role of the external sector in income distribution.

The model outlined here firmly belongs to the second category. It is a microeconomic general equilibrium model in the spirit of the discussions found in the literature on planning and on the barter theory of trade, where money is a veil and the government transfers income between groups in a lump-sum, nondistortionary manner. The model allows no interaction between trade and economic growth, which significantly narrows the scope of discussion. Also, the important issues of the distributional aspects of trade-induced growth are skirted. This limits the present analysis to what is an essentially static framework and implies a closure rule whereby the aggregate level of investment is fixed in real terms.

Given the specified technology and behavioral rules, the model endogenously determines wages, profits, product prices, and the exchange rate; sectoral production, employment, consumption, investment, exports, and imports; the nominal flow-of-funds, including both the government and private sector accounts; and, finally, the distribution of income to socioeconomic groups and the overall size distribution by individuals.
Production Technology and Factor Markets

Each sector produces output with a two-level Cobb–Douglas production function. Different categories of labor are combined via a Cobb–Douglas function into a sectoral labor aggregate. Capital goods are combined in fixed proportions (that vary by sector) into aggregate capital. Sectoral output is a Cobb–Douglas function of the sectoral labor and capital aggregates. Intermediate inputs are required according to fixed input–output coefficients.¹

Each sector is assumed to maximize profits and thus hires labor until the wage equals its marginal revenue product. Thus nonlinear labor demand functions by sector and skill category are given by the first-order conditions for cost minimization. Coupled with fixed aggregate labor supplies by skill category, the model solves for a set of average wages that equate the aggregate supply of and demand for labor.

We distinguish three categories of labor in the model. The first is agricultural landless labor, which is tied to agriculture, i.e., is mobile only across the two agricultural sectors. The second is unskilled labor, which is perfectly mobile across all sectors. The third is skilled (or “modern” sector) labor, which is mobile across the urban sectors only. The rather limited mobility of labor between the agricultural and nonagricultural sectors is a reasonable specification for a medium-term model of a developing country.

The capital stock in each sector is assumed to be fixed during a given period and hence is not mobile across sectors. The rental rates of capital (or the profit rates) will not generally be equal across sectors. They are thus sector specific and are computed residually for each sector.

Income Distribution and Product Markets

The model determines all the flow-of-funds accounts within the economy. The model distributes factor income—payments to labor and capital—to the three types of labor, land owners of three different farm sizes, owners of capital in the manufacturing sectors and in the service sectors, and government. For all of these socioeconomic groups, the model determines both income and number of members. The model thus solves for the functional distribution and also for what might be called the socioeconomic distribution of income. The latter is interesting in its own right because the groups, if appropriately defined, reflect social and political divisions in the society that are especially relevant for policy analysis.

One might argue that given the political significance of the groups, the

¹The Cobb–Douglas specification abstracts from distributional shifts caused by changes in the wage rate.
socioeconomic distribution is more important than either the aggregate functional distribution (to capital and labor) or the overall size distribution of personal or household income. Such an emphasis, however, neglects the interest policy makers have in questions such as How many people are living in poverty? What is the socioeconomic composition of the poverty group? and What is the degree of inequality in the overall size distribution? We approach these questions by incorporating a technique for generating the overall size distribution from information about the socioeconomic distribution and separate information about the within-group distributions.

The model determines the overall size distribution of income in two steps. First, the distribution of income within each socioeconomic group is described by a two-parameter lognormal probability distribution function. The logvariance for each group is specified exogenously and the logmean is computed given the logvariance and group mean income (which is solved endogenously). Second, the overall size distribution of income is then computed by aggregating the set of within-group distributions.\footnote{This technique for generating the size distribution of income is used in Adelman and Robinson (1978). The algorithm is described in Robinson (1976).} Statistics describing the overall distribution, such as the Gini coefficient, number of people in poverty, socioeconomic composition of the poverty group, and so forth, are all computed numerically from the aggregated distribution. Thus, a particular functional form is not assumed for the overall distribution, but only for the separate within-group distributions.

This technique for generating the overall size distribution involves a number of important assumptions. Most important, it is assumed that the policies whose impact is being analyzed do not affect the within-group distributions (since the logvariances are assumed fixed). Thus experiments only affect the intergroup distribution. For the range of trade policies being considered in this paper, such an assumption seems reasonable. The assumption that the within-group distributions are described well by lognormal distributions is a testable hypothesis, given data. We were forced to rely on secondary sources for our within-group logvariance estimates [Berry and Urrutia (1976), and Cordoba et al. (1971)], and so were not able to test the hypothesis statistically. However, we are most concerned with comparing the socioeconomic composition of the poverty group across experiments, a result that is likely to be quite robust to the exact specification of the within-group distributions.

The behavior of the government sector is simulated by the closure rules, which require that expenditure and investment add up to total net government revenue (including direct and indirect taxes). It is assumed that government consumption and investment remain fixed in real terms.
(deflated by the overall price index) at their values in the reference solution to which all trade policies are compared. This is achieved by a system of proportional (to income) transfers between the government and each socioeconomic group. Finally, to isolate the analysis from the interactions between trade policies and growth via changes in the level of investment (determined by the propensities to save of the different groups and the government), a fixed level of aggregate real investment is maintained throughout all experiments. Group savings rates are adjusted proportionately to validate the fixed investment level.

Each socioeconomic group is assumed to have different consumption patterns and hence different expenditure equations, which are based on Stone's linear expenditure system (LES). Hence consumer demand is a function of relative prices as well as of the distribution of income. Prices are then solved so that demand equals supply in each sector. As discussed below, the exchange rate is endogenously determined to maintain the balance of trade.

**Foreign Trade**

The mechanisms whereby a change in trade policy affects the distribution of income between factors of production is well understood under the assumption that domestically produced and foreign goods are perfect substitutes in use. If factors of production are perfectly mobile and world prices are given, the percentage change in the domestic price for each sector is equal to the percentage change in the tariff which, in turn, is equal to a weighted sum of changes in factor prices, with the weights given by the distributive shares of each factor in the total product of that sector. Consider, for instance, the case where there are two sectors, agriculture and manufacturing, and let the capital stock in each of these sectors be fixed. Then capitalists' rents are determined residually. What happens to the wage of the mobile factor, labor, depends both on the factor intensities (as measured by distributional shares) and on the elasticity of substitution between capital and labor. If the elasticity of substitution is high in agriculture and low in industry, the wage will closely follow the price behavior of industry. The wage will thus be related to the effective rate of protection in industry.

The key component in the mechanism just described is the domestic price system, which in a small open economy is entirely determined by world prices. Furthermore, as Samuelson (1953) has shown, the country will specialize and produce at most as many goods as it has factors of production. At the other extreme, some sectors, such as services where quantities traded are usually a small fraction of total supply, are classified

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3 An analysis of this mechanism is provided by Mussa (1974).
as nontraded goods and their price is assumed to be entirely determined on domestic markets. From an empirical point of view, this traded/nontraded good dichotomy is too coarse, and the assumption that domestic and foreign goods are perfectly interchangeable inevitably overestimates the distributional effects of changes in trade taxes.

Following Armington (1969), we assume that domestic and foreign goods are imperfect substitutes in use and can be aggregated into a composite commodity. Under this assumption, which helps capture some of the structural characteristics of a developing economy, the demand for imports and domestically produced goods are derived demands, analogous to those for factor inputs in a traditional model. In contrast with the standard trade model, in which the domestic price system is entirely determined through foreign trade, domestic prices are endogenously determined by the model and acquire a substantial degree of autonomy.

On the export side, the ratio of exports to domestic production is assumed to be a decreasing function of the ratio of the domestic price to the export price. The functional form adopted for the export function is an asymmetric logistic function with the inflection point at the base-year export ratio, an upper asymptote of 1, and a lower asymptote of 0. As with the import demand functions, this specification precludes complete specialization since sectoral exports can neither disappear nor include all production (in those sectors for which there were some exports in the base-year data).

Although this specification is somewhat restrictive, it is plausible for an empirical study where the degree of sectoral aggregation is high and one could reasonably expect intra- (rather than inter-) industry specialization. It is also a specification that could be justified on the basis of placing reasonable constraints on potential increases in export supplies due to rising selling costs for export sales (relative to domestic sales).

The implications of our specification of trade for the autonomy of the domestic price system are important. Sectors are no longer either traded or nontraded; rather, they are characterized by their degree of tradability, according to whether changes in the domestic price are closely linked to, or relatively independent of, changes in the export and import price. For example, a 10% tariff on machinery imports will affect the price of domestic machinery through its effect on the price $P$ of aggregate machines. In another paper (de Melo and Robinson 1978) we show that the responsiveness of the price of domestic machinery to a change in the import price is an increasing function both of the elasticity of substitution between imported and domestic machines and of the share of imported machines in

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4Note that if the logistic is very steep, then the model approaches an assumption of no supply constraint. In this extreme case, if $p^d > p^e$, there are no exports at all. If $p^d = p^e$, then exports are residually determined as the difference between domestic demand and domestic supply.
the aggregation function. In this model, the only pure nontraded sectors are those for which the import shares are zero and there are no exports (e.g., construction and housing in the Colombian application).

What is the exchange rate in this model, and what does an adjustment in its value mean? First, as in the barter theory of trade, only relative prices are determined in the model. Some numeraire or normalization rule is therefore required. We choose to normalize around the aggregate value of all composite goods, using base-year quantity weights in the index [see Appendix, equation (12)]. Therefore the exchange rate in this model is the relative price of imports and domestic goods. For instance, a tariff leads to an improvement in the trade balance matched by an increased demand for domestic goods. Therefore, the price of domestic goods would tend to rise relative to that of imports. With a fixed price level, this may be translated into an appreciation of the exchange rate.

APPLICATION OF THE MODEL TO COLOMBIA

We now turn to a simulation of alternative trade strategies on the distribution of income in Colombia. Three alternative policy regimes have

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5 For an interesting study simulating the likely effects of growth on income distribution and employment using a multisector framework, see Thorbecke and Sengupta (1972).

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Table 1: Structure of the Colombian Economy in the Free Trade Base Run

<table>
<thead>
<tr>
<th>Sectors</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Gross Outputs&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Value Added&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Output Ratios (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(10&lt;sup&gt;6&lt;/sup&gt; pesos)</td>
<td>(10&lt;sup&gt;6&lt;/sup&gt; pesos)</td>
<td>Exports</td>
<td>Imports</td>
<td></td>
</tr>
<tr>
<td>Coffee</td>
<td>8.6</td>
<td>6.9</td>
<td>90.0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Agriculture</td>
<td>43.0</td>
<td>38.3</td>
<td>9.5</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>Food industries</td>
<td>32.9</td>
<td>11.7</td>
<td>1.8</td>
<td>2.6</td>
<td></td>
</tr>
<tr>
<td>Consumer goods</td>
<td>21.5</td>
<td>10.7</td>
<td>5.3</td>
<td>4.9</td>
<td></td>
</tr>
<tr>
<td>Intermediate products</td>
<td>22.5</td>
<td>11.3</td>
<td>4.3</td>
<td>23.7</td>
<td></td>
</tr>
<tr>
<td>Machinery and transport</td>
<td>8.2</td>
<td>4.6</td>
<td>1.6</td>
<td>90.4</td>
<td></td>
</tr>
<tr>
<td>Construction and housing</td>
<td>21.9</td>
<td>15.6</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Utilities and services</td>
<td>55.3</td>
<td>32.6</td>
<td>4.9</td>
<td>3.9</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>214.0</td>
<td>131.7</td>
<td>8.5&lt;sup&gt;b&lt;/sup&gt;</td>
<td>8.6&lt;sup&gt;b&lt;/sup&gt;</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Current prices.

<sup>b</sup>Average.
been modeled and compared with a free trade alternative (FT). The first is an inward-looking strategy (ILS) with a 50% tariff on the manufacturing sectors (rows 3–6 in Table 1). The second is an outward-looking strategy (OLS) with a 50% subsidy to agricultural and manufacturing exports (excluding coffee, which has an export quota). The third is a direct-subsidy strategy (DSS), which provides a 50% value-added subsidy to manufacturing sectors.

The main characteristics of the Colombian economy captured by the model are presented in the FT base run reported in Table 1 and obtained by removing sectoral tariffs, subsidies, and indirect taxes.

Sectoral employment of the three categories of labor (agricultural landless labor, unskilled labor perfectly mobile across all sectors, and skilled labor mobile across urban sectors only) is given in columns 6–8. Wage differentials are incorporated as constants of proportionality depending on the location of labor and are related to the economy-wide average wage for that category of labor which is endogenously determined by the model. Data on capitalist nonwage income indicate that the income dispersion is greatest among manufacturing and agricultural capitalists and least among capitalists in the small-scale service sectors, which include small-scale manufacturing. Accordingly, capitalists are subdivided into three categories (agricultural, manufacturing, and service sector). The

<table>
<thead>
<tr>
<th>Labor (10^3 person years)</th>
<th>Capital Stocks (10^6 pesos)</th>
<th>Trade Substitution Elasticity</th>
<th>Capital/Labor</th>
<th>Unskilled/Skilled Labor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rural Unskilled Skilled</td>
<td>Stock</td>
<td>Substitution</td>
<td></td>
<td></td>
</tr>
<tr>
<td>184 187 0</td>
<td>21.5</td>
<td>-</td>
<td>57.9</td>
<td>-</td>
</tr>
<tr>
<td>1016 1034 0</td>
<td>75.6</td>
<td>5.0</td>
<td>36.9</td>
<td>-</td>
</tr>
<tr>
<td>0 56 18</td>
<td>13.8</td>
<td>4.0</td>
<td>188.3</td>
<td>3.1</td>
</tr>
<tr>
<td>0 118 22</td>
<td>8.1</td>
<td>2.0</td>
<td>58.0</td>
<td>5.4</td>
</tr>
<tr>
<td>0 60 21</td>
<td>9.5</td>
<td>0.5</td>
<td>118.1</td>
<td>2.9</td>
</tr>
<tr>
<td>0 50 12</td>
<td>7.0</td>
<td>0.2</td>
<td>113.1</td>
<td>4.2</td>
</tr>
<tr>
<td>0 225 21</td>
<td>80.0</td>
<td>-</td>
<td>326.4</td>
<td>10.7</td>
</tr>
<tr>
<td>0 2271 247</td>
<td>85.0</td>
<td>2.0</td>
<td>33.8</td>
<td>9.2</td>
</tr>
<tr>
<td>1200 3999 341</td>
<td>300.5</td>
<td>-</td>
<td>54.2</td>
<td>8.1</td>
</tr>
</tbody>
</table>

*Average, nonagricultural sectors.*
within-group logvariances range from 0.18 (agricultural labor) to 1.38 (manufacturing capitalists).

There are six consumer groups corresponding to the three labor categories and the three categories of capitalists described above. The total population is exogenously given and is fixed for all but two groups: rural (which includes unskilled labor employed in agriculture and rural labor) and unskilled. It is assumed that when unskilled labor moves between rural and urban areas its pattern of consumption is altered so that rural-urban migration reduces the size of the rural socioeconomic groups by the number of migrants (which are added to the urban unskilled labor group).

Table 1 also describes the particular characteristics of Colombia's foreign trade (cols. 4 and 5). It is evident that Colombia is a primary-export-oriented economy. Imports are concentrated among intermediate products and the size of the manufacturing sector is still quite small, with the bulk of domestic supply accounted for by imports. Note also that in six of the eight sectors there is two-way trade, an important feature captured by the model. Our best guesstimates of the elasticity of substitution between imports and domestically produced goods are given in column 10.

TRADE ORIENTATION AND THE DISTRIBUTION OF INCOME: SOME NUMERICAL RESULTS

This section summarizes the effect of the three trade policies described above (ILS, OLS, DSS) on the distribution of income between socioeconomic groups within a static framework. Because only selected macroeconomic indicators are reported in the following tables, it is important to remember that the crucial link in the mechanism whereby a change in trade policy affects the distribution of income is the change in relative gross and net prices. Changes in relative net prices are translated into changes in relative factor rewards, and changes in relative gross prices affect the cost of living (and hence real incomes) of the various groups. Table 2 provides the main aggregate indicators from the experiments: wages, profit rates, transfers indicating the burden of financing policies, the agricultural terms of trade (TOT), the exchange rate to maintain internal-external balance, the structure of employment, and GDP. Table 3 compares mean net incomes and group shares of income along with a selection of aggregate measures of the distribution of income.

ILS. Consider first the inward-looking strategy with fixed aggregate employment for agricultural and unskilled labor. Imposing a tariff on imports of manufactures leads to a balance-of-trade surplus with matching excess demand for domestic goods. This imbalance results in an appreciation of the exchange rate of 17% (with the exchange rate in Table 2 falling from 1.31 to 1.09). Consequently, in equilibrium, the price of imports in the manufacturing sectors rise by only 24%, considerably less than the 50% tariff.
The impact of the tariff on factor remuneration works through changes in the net prices. A tariff on manufactures causes the net prices in the manufacturing sectors to fall because intermediate goods’ costs rise, with a decline in factor remuneration. The fall in the agricultural terms of trade results from higher prices for domestic manufactures. The net-price agricultural terms of trade also fall, with a corresponding fall in relative factor remuneration.

The final effects of the inward-looking strategy on the distribution of income are given in Table 3. Even though agricultural wages fall, there is a slight increase in the net real income of rural workers. This increase comes from two sources: (1) The tariff collections result in a proportional income transfer to all households, increasing their income by 1.3%. (2) The fall in the terms of trade increases the relative real income of those groups, such as rural labor, that consume relatively more agricultural goods. The result is a slight decline in the share of agricultural groups in poverty. In the contracting sectors, fixed factors lose the most, whereas, in the expanding ones, they gain the most.

**OLS.** The outward-looking strategy consists of providing incentives to exports by giving a 50% subsidy to manufacturing and noncoffee agricultural exports. The export supply functions determine the degree of responsiveness of the affected sectors to the incentive. Since the coffee and service sectors are excluded from the subsidy, and they account for 64% of total exports, there is less impact on the balance of trade than in the inward-

### Table 2: Aggregate Indicators for a Model of Colombia

<table>
<thead>
<tr>
<th></th>
<th>FT</th>
<th>ILS</th>
<th>OLS</th>
<th>DSS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Wages (10³ pesos)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agricultural</td>
<td>6.46</td>
<td>6.04</td>
<td>6.90</td>
<td>7.54</td>
</tr>
<tr>
<td>Skilled</td>
<td>10.85</td>
<td>10.46</td>
<td>11.14</td>
<td>13.64</td>
</tr>
<tr>
<td>Unskilled</td>
<td>31.16</td>
<td>30.79</td>
<td>31.98</td>
<td>45.04</td>
</tr>
<tr>
<td>Profit rate (%)</td>
<td>25.56</td>
<td>23.89</td>
<td>26.72</td>
<td>33.67</td>
</tr>
<tr>
<td>Transfer/income (%)</td>
<td>-3.20</td>
<td>1.30</td>
<td>-6.90</td>
<td>-25.60</td>
</tr>
<tr>
<td>Exchange rate (pesos/$)</td>
<td>1.31</td>
<td>1.09</td>
<td>1.23</td>
<td>1.32</td>
</tr>
<tr>
<td><strong>Agricultural TOTb (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output Prices</td>
<td>106.40</td>
<td>101.70</td>
<td>111.10</td>
<td>131.10</td>
</tr>
<tr>
<td>Net Prices</td>
<td>174.70</td>
<td>169.00</td>
<td>180.90</td>
<td>157.70</td>
</tr>
<tr>
<td><strong>Employment (10³ person-years)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural</td>
<td>2421</td>
<td>2400</td>
<td>2467</td>
<td>2404</td>
</tr>
<tr>
<td>Urban</td>
<td>3119</td>
<td>3140</td>
<td>3073</td>
<td>3136</td>
</tr>
<tr>
<td><strong>GDPc (10⁶ pesos)</strong></td>
<td>138.60</td>
<td>138.90</td>
<td>138.70</td>
<td>142.40</td>
</tr>
</tbody>
</table>

*a*Share of total personal income that is transferred from (+) or to (−) the government.

*b*Ratio of agricultural to nonagricultural price indices.

*c*Rural employment includes unskilled labor and agricultural labor.

*d*Constant prices.
Table 3: Income Distribution Measures for a Model of Colombia

<table>
<thead>
<tr>
<th></th>
<th>FT</th>
<th>ILS</th>
<th>OLS</th>
<th>DSS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Net mean real income</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural labor</td>
<td>5.55</td>
<td>5.60</td>
<td>5.53</td>
<td>4.88</td>
</tr>
<tr>
<td>Unskilled urban labor</td>
<td>11.82</td>
<td>11.89</td>
<td>11.79</td>
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<tr>
<td>Skilled labor</td>
<td>25.72</td>
<td>26.44</td>
<td>25.46</td>
<td>30.39</td>
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<tr>
<td>Rural capitalists</td>
<td>37.47</td>
<td>36.75</td>
<td>38.62</td>
<td>33.55</td>
</tr>
<tr>
<td>Mfg. capitalists</td>
<td>160.85</td>
<td>166.50</td>
<td>159.02</td>
<td>204.82</td>
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<tr>
<td>Svc. capitalists</td>
<td>67.68</td>
<td>66.30</td>
<td>66.14</td>
<td>63.12</td>
</tr>
<tr>
<td>Economy-wide $\bar{Y}$</td>
<td>19.00</td>
<td>19.09</td>
<td>19.00</td>
<td>19.47</td>
</tr>
<tr>
<td><strong>Group shares (%)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rural labor</td>
<td>7.7</td>
<td>7.6</td>
<td>7.9</td>
<td>6.5</td>
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<tr>
<td>Unskilled urban labor</td>
<td>30.2</td>
<td>30.5</td>
<td>29.6</td>
<td>30.1</td>
</tr>
<tr>
<td>Skilled labor</td>
<td>8.4</td>
<td>8.6</td>
<td>8.3</td>
<td>9.7</td>
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<td>28.6</td>
<td>30.2</td>
<td>25.6</td>
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<td>18.2</td>
<td>17.5</td>
<td>22.0</td>
</tr>
<tr>
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<td>6.7</td>
<td>6.5</td>
<td>6.5</td>
<td>6.1</td>
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<tr>
<td><strong>Aggregate measures</strong></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>$\bar{Y}$ (top 10%)</td>
<td>98.09</td>
<td>98.36</td>
<td>98.44</td>
<td>104.86</td>
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<tr>
<td>$\bar{Y}$ (bottom 10%)</td>
<td>2.90</td>
<td>2.93</td>
<td>2.88</td>
<td>2.69</td>
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<tr>
<td>Rural poverty (%)</td>
<td>58.51</td>
<td>58.05</td>
<td>59.53</td>
<td>62.92</td>
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<tr>
<td>Urban poverty (%)</td>
<td>41.48</td>
<td>41.95</td>
<td>40.47</td>
<td>37.08</td>
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<tr>
<td>Total poverty (%)</td>
<td>29.90</td>
<td>29.40</td>
<td>30.30</td>
<td>32.10</td>
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<tr>
<td>Gini coefficient</td>
<td>0.581</td>
<td>0.580</td>
<td>0.583</td>
<td>0.601</td>
</tr>
</tbody>
</table>

*Real income is net of taxes and is computed by deflating net nominal income for each group by the corresponding group cost-of-living index. Units are in thousands of pesos.

*bRural labor includes all labor (agricultural and unskilled) employed in agriculture.

*cShares in total poverty population.

*dShare of total economically active population with income less than 6000 pesos.

Looking strategy; hence there is also less dampening effect from a concomitant rise in the exchange rate. The subsidy increases noncoffee agricultural exports, causing a relative decline in the domestic supply of agricultural goods. Even excluding coffee, agricultural exports are about 40% of total noncoffee exports in the base run. The result is that the terms of trade (both gross and net price) move in favor of agriculture.

The effects of this experiment on the distribution of income are predictable. Pretransfer wages rise because the export subsidy increases value-added. After transfers are taken into account, the net impact of this experiment is opposite to that of the ILS since the terms of trade now move in the opposite direction. As a result, rural labor and rural capitalists increase their shares in national income at the expense of other groups in the
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economy. There is, however, a worsening in the distribution of income reflected by a slight rise in the Gini coefficient and an increase in the spread between the top and the bottom deciles in the distribution of income. Because of the proportional transfer from households to the government necessary to finance the subsidy, and because of the relative rise in the price of agricultural products, there is a small decline in the real mean income of rural labor. As a result, although there is redistribution of income toward agriculture, the main beneficiaries are the capitalists in that sector, and the net effect of the subsidy is to increase the share of rural groups in poverty by 1%.6

**DDS.** The indirect nature of the impact of tariff changes on the domestic price system is most clearly brought out by comparing the direct subsidy strategy with the ILS. In the DDS, a 50% subsidy to value-added is given to firms in the manufacturing sectors. Abstracting from nonmanufacturing intermediate inputs into manufacturing, these two strategies would have identical effects on production if domestic and foreign goods were perfect substitutes in use. Given the specification of imperfect substitution, and in contrast to the previous experiments, the direct subsidy has a dramatic effect on economic structure and the distribution of income because it directly alters the relative net prices among sectors. The strategy drastically increases the profitability of manufacturing, as shown by a rise in the economy-wide average profit rate in Table 2.

Note that real GDP increases by 2.7%, which is surprising at first glance since one would expect the economy to be operating more efficiently in the absence of distortions. However, recall that the marginal product of labor of the same skill category is assumed to be higher (by a fixed ratio) in the manufacturing sectors, so the economy in the free-trade base run is at a distorted equilibrium. Although not optimal, the subsidy to manufacturing provides an offsetting distortion which increases efficiency.

Understandably, the effects of the DDS on the distribution of income are substantial. Although the financing of the value-added subsidy weighs heavily on the income of households (which have to give up 25% of their income in transfers), the factors of production engaged in manufacturing benefit greatly, as indicated earlier by the increase in the rental rate and by the 50% increase in the wage of skilled labor. There is therefore a redistribution of income toward skilled labor, and especially toward manufacturing capitalists, away from all other groups in the economy. Relatively, the greatest losers are rural capitalists whose share in total income decreases by 3.7 percentage points.

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6It is interesting to note that this result has been conjectured by Diaz-Alejandro (1976) and Berry and Urrutia (1976). They note that the increase in agricultural exports after the 1967 reforms worsened the distribution of income in agriculture.
The overall distribution of income becomes substantially more unequal, with a significant increase in the Gini coefficient. The number of people in poverty increases by 7.5%. The main reason for the worsening distribution is that the rural poor are doubly squeezed. The increased supply of manufactures drives the gross-price terms of trade in favor of agriculture (131.1 compared to 106.4 in the base run), thus significantly increasing the relative cost of living of the poor rural groups who spend a large share of their budgets on agricultural products. However, because of the large subsidy on manufacturing value-added, the net-price terms of trade move against agriculture (from 174.7 in the base run to 157.7), thus lowering the relative income of both labor and capital employed in agriculture. In the final equilibrium, the mean real income of rural labor decreases by 12% and their share in the total poverty group increases.

The experiments described above have been conducted under the neoclassical assumption that real wages adjust to clear the labor markets. This view of labor markets is often assumed to be unrealistic for developing countries. As an alternative, we conducted a set of experiments in which we repeated the three strategies but specified a fixed real wage for unskilled and agricultural labor—the implicit assumption being that the supply of labor is perfectly elastic at the specified real wage. Under such a formulation, whether a tariff on manufacturing increases or decreases, total employment depends on whether the protected sectors are more labor intensive (including direct and indirect effects). It turns out that the ILS reduces total employment by 5.2% from its level in the FT base, whereas the export-promotion OLS raises the level of employment by 5.0%. We do not report the detailed results due to lack of space, but it is clear that these employment effects are substantial. Since the model does not have a separate socio-economic category of unemployed, it is difficult to trace out the impact of the employment effects on the distribution of income. However, it is clear that employment effects of the magnitude we observed should have a significant impact on the extent and incidence of poverty.

CONCLUSIONS

In a structuralist environment where import substitution and export expansion are hindered by bottlenecks originating domestically and abroad, trade policy alone will not greatly stimulate domestic production since it is difficult to alter the composition in use of domestic and foreign goods. As a result, there is little switching toward domestic production, and

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7 This result is consistent with the observed decrease in the unemployment rate in Colombia after the 1967 policy reform which involved across-the-board promotion of exports. There was also an apparent worsening in the distribution of income which is consistent with results of the OLS experiment.
protection raises the cost for users of commodities that are import intensive without increasing the income of factors employed in those sectors, at least in the short run.

Factors (and socioeconomic groups) that are the least mobile across sectors experience greater relative gains and losses from a given policy than the more mobile ones. Also, it is found that the stability of aggregate measures of the distribution of income, such as the Gini coefficient, hides substantial changes in the socioeconomic composition of the poverty group. Moreover, alternative trade regimes may have a significant effect on employment insofar as one can assume that the real wage is institutionally fixed.

Changes in the rural–urban structure of employment and the agricultural terms of trade (for both gross and net prices) are important general equilibrium mechanisms by which policy impacts are transmitted across the entire economy. For two reasons, improvements in the agricultural terms of trade are not necessarily associated with increases in the real incomes of the rural poor. The first is particular to the way transfers are handled in the experiments, where the incidence of the revenues or costs of the policies is determined by transfers or taxes that are proportional to all incomes across the entire economy. The second important countervailing force arises from the fact that any relative increase in agricultural prices (excluding coffee) will raise the cost of living of the rural poor more than other groups because they consume relatively more agricultural products.

There is a progression toward more directness in terms of effects on prices and income distribution as one moves from protection by tariff to protection by subsidy to value-added. With respect to the often-suggested policy of pursuing an industrialization strategy by a direct subsidy to value-added rather than by a tariff (because it removes the by-product consumption distortion created by the tariff), there are two relevant points for policy making: First there is the cost to the government of raising the revenue, which is likely to be a severe burden even in a semi-industrialized country where the industrial sector is small. Second, and more importantly, there is the strong possibility that such a policy would catch the rural poor in a double squeeze since it improves the gross-price agricultural terms of trade but worsens the net-price terms of trade. On the one hand, it results in an increased cost of living due to rising food prices; on the other, there is less income due to falling agricultural net prices.

The degree of responsiveness of the domestic price system to changes in trade policy is linked both to the openness of the economy and to the ease with which domestic goods are substitutable for imported ones. In the application of the model to Colombia, it was found that the domestic price system is insulated from world markets due to two counteracting effects characteristic of the manufacturing sectors in many developing countries.
Although a substantial proportion of supplies of manufactures are provided by imports, these are precisely the sectors with a low elasticity of substitution in use between domestic and imported goods. In economies such as those of Korea and Taiwan, where significant shares of manufacturing output are exported, one would expect to find more trade dependence from the export markets than in a primary-exporting country such as Colombia.

The model results indicate that, in a primary-export-oriented economy, a more open development strategy is likely to be accompanied by a worsening of the distribution of income. This result depends crucially on the initial conditions, particularly the structure of exports and imports. In Colombia, exports are overwhelmingly primary goods, whereas imports are largely manufactures. Also, the country is largely self-sufficient in food production. In countries such as Korea and Taiwan, which export manufactures and import food, an export-led development strategy should help the distribution of income. There, an open development strategy would lead to a lower effective exchange rate which, in turn, would lower the relative price (and increase the magnitude) of food imports, which enters more heavily in the expenditures of the poorest socioeconomic groups. As a result, the purchasing power and real incomes of these groups will rise. The differential impact of changes in relative prices on real incomes is empirically significant and should be considered when analyzing the impact of different trade strategies.

APPENDIX

The Equations of the Model

This appendix presents the complete set of equations describing the model. Endogenous variables (except $r^i$) are denoted by capital letters, exogenous variables and parameters by capital letters with an overbar or by Greek letters, and policy variables by lower case letters. Subscripts $i$, $q$, and $g$ refer to sectors, labor categories, and socioeconomic groups, respectively. Superscripts m, d, and e are used to distinguish imported, domestically produced, and exported goods.

Trade Aggregation Functions

The composite good $Q$ in each sector $i$ is defined as a CES aggregation of domestically produced ($D^i_d$) and imported ($M^i_m$) goods:

$$Q_i = \frac{B_i}{\beta_i(M^i_m)^{\gamma_i} + (1 - \beta_i)(D^i_d)^{\gamma_i}}.$$  \hspace{1cm} (1)

Trading Price Equations

$$p^m_t = \pi^m_t(1 + t^m)R. \quad p^e_t = \pi^e_t(1 + t^e)R.$$ \hspace{1cm} (2)

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*An expanded version of this Appendix is available from the authors on request.*
TRADE POLICIES AND INCOME DISTRIBUTION

where $\pi^e_i$, $\pi^m_i$ are the exogenous world prices of exports and imports, and $t^*_i$, $t^m_i$ the corresponding export subsidies and import tariffs. The exchange rate is denoted by $R$.

**Import Demands**

$$M^m_i = (\beta_i/1-\beta_i)^{n_i}(P^d_i/P^m_i)^{\pi^m_i} D^d_i,$$

where $\alpha_i$ is the elasticity of substitution associated with the CES aggregation function. Given (1), the ratios $r^d_i = D^d_i/Q_i$ can also be determined.

**Export Supply Ratios**

$$S^e_i = \frac{E^d_i}{X^d_i} = \frac{\tilde{A}_i}{1 + \exp[B(r_i-\tilde{r}_i)]} + \tilde{C}_i, \quad r_i = \frac{P^d_i}{P^e_i}. \tag{4}$$

These equations describe the logistic function that determines the ratio of exports $E^d_i$ to sectoral output $X^d_i$.

**Foreign Exchange Market**

In equilibrium, the excess demand for foreign exchange must equal zero:

$$\sum \pi^m_i M^m_i - \sum \pi^e_i E^d_i = 0. \tag{5}$$

The exchange-rate $R$ is the endogenous variable that adjusts so as to clear the market for foreign exchange. Imports are given by (3) and exports by (4); i.e., $E^d_i = S^e_i X^d_i$.

**Production Functions**

$$X^d_i = \tilde{A}_i \tilde{K}^{\alpha_i} L^{1-\alpha_i}, \quad L_i = \prod_q L^{h_{ij}}. \tag{6}$$

Technology is described by two-level Cobb-Douglas production functions. Sectoral capital stocks are fixed. Intermediate goods are required according to fixed input–output coefficients.

**Net Prices**

$$P^*_i = (1-t^d_i)[P^e_i S^e_i + (1-S^e_i)P^m_i] - \sum_j a_{ij} P^*_j, \tag{7}$$

where

$$P_i = B_i^{-1} [\beta_i \sigma_i P^m_i^{\sigma_i} + (1-\beta_i) \sigma_i P^d_i^{\sigma_i}].$$
These equations deduct the fixed intermediate input costs to provide the net receipts to the firm of selling a unit of output. \( P_i \) is the price of a unit of composite good and \( t^d_i \) is the value-added subsidy (or tax). \( P^d_i \) is the domestic price. The composite good price equation is the cost function dual to the trade aggregation function [equation (1)].

**Factor Markets**

The demand for labor of each skill category in each sector is given by solving the first-order conditions for profit maximization:

\[
W_q = P^* (\partial X^i_j / \partial L) / (\partial L_i / \partial L_{iq}),
\]

where \( L_i \) is the aggregate defined in equation (6). The aggregate supply of labor in each skill category is assumed fixed. The average wages \( W^*_q \) are determined endogenously so as to clear the labor markets, i.e., to achieve zero excess demands:

\[
\sum_i L_{i} - \bar{L}_i = 0.
\]

**Income Distribution and Macro Balances**

The average incomes of all groups—different types of wage earners, farmers, and recipients of nonwage income—are determined endogenously. The distribution of income within each group is given by a two-parameter lognormal distribution function. The logvariance is exogenous and the logmean is a function of the endogenous group mean income. The equation is

\[
\mu_i = \log(Y_i) - \frac{1}{2} \sigma^2.
\]

where \( Y_i \) is group mean income and \( \sigma^2 \) is the logvariance.

Aggregate real investment is held constant. Investment demand by sector of origin \( Z_i \) is calculated assuming fixed sectoral composition of capital goods. Savings rates are adjusted endogenously to achieve the exogenously specified investment.

Aggregate government consumption is also fixed in real terms, with direct tax rates adjusting to balance the government accounts.

**Consumer Demand Equations**

Consumer demands for composite goods are given by a separate set of linear expenditure functions for each consuming group:

\[
P_i C_{i\ell} = P_i Y_{i\ell} + \delta_{\ell}(C_{i\ell} - \sum_i P_{i\ell} Y_{i\ell})N_{i\ell}.
\]

where \( C_{i\ell} \) is aggregate group consumption, \( N_{i\ell} \) is the number of people in each group, and \( \gamma \) and \( \delta \) are parameters of the system.

**Product Markets**

Domestic prices \( P^d_i \) are determined endogenously so as to clear the product markets, making the excess demand for goods in each market equal zero:
Table A1: Endogenous Variables and Equations

<table>
<thead>
<tr>
<th>Endogenous Variable</th>
<th>Eq. Ref.</th>
<th>Endogenous Variable</th>
<th>Eq. Ref.</th>
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<tbody>
<tr>
<td>$Q_i$</td>
<td>(1)</td>
<td>$P_i^*, P_i$</td>
<td>(7)</td>
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<tr>
<td>$P_i^m, P_i$</td>
<td>(2)</td>
<td>$W_q, L_{iq}$</td>
<td>(8)</td>
</tr>
<tr>
<td>$M_i^m, r_i^d$</td>
<td>(3)</td>
<td>$Z_i, G_i, Y_g$</td>
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</tr>
<tr>
<td>$S_i^d, E_i^d$</td>
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<td>$C_{ig}$</td>
<td>(10)</td>
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<td>$R$</td>
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<tr>
<td>$X_i^d, L_i$</td>
<td>(6)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

\[
D_i^d + E_i^d - X_i^d = 0,
\]

where $D_i^d = F_i^d + C_i^d + G_i^d + Z_i^d$. The demands are solved behaviorally in terms of composite goods. The ratios of domestic to composite goods, $r_i^d = D_i^d/Q_i$, are given by an equation analogous to (3). Thus,

\[
F_i^d = r_i^d \sum a_{ij} X_j^d, \quad C_i^d = r_i^d \sum C_{ig}, \quad Z_i^d = r_i^d Z_i, \quad G_i^d = r_i^d G_i.
\]

**Price Normalization**

The normalization rule maintains a constant price level measured by a wholesale price index:

\[
\sum \Omega_i P_i = \bar{P}.
\]

where $\Omega_i$ is base-year production weights.

Table A1 summarizes the endogenous variables and the associated equations. The exchange rate, wages, and prices are determined so as to clear the foreign exchange, labor, and product markets. The system can only determine relative prices, so an additional price normalization equation is required to complete the system.

**REFERENCES**


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