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AGRICULTURAL TRADE LIBERALIZATION FOR THE LOW INCOME COUNTRIES: A GENERAL EQUILIBRIUM-MULTIMARKET APPROACH

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While progress in the Uruguay Round of the general agreement on tariffs and trade (GATT) toward agricultural trade liberalization in the OECD countries is currently marred with difficulties, liberalization remains a goal for the United States and many other GATT members. Recent studies edited by Maunder and Valdés and by Goldin and Knudsen are generally consistent in predicting that liberalization would lead to higher world market prices for cereals and animal products. Concerned with the impact that liberalization may have on the poorer countries, most of which are highly dependent on cereals imports, and on the poor within these countries, who spend a high share of their incomes on foodgrains, we focus on simulating the affects of liberalization on these vulnerable groups. The objective is to assist the more developed countries' negotiators in designing complementary developmental assistance and food aid programs for the less developed countries (LDCs) and for the poor in these countries.

The approach we follow consists in constructing archetype multisector and multiclass computable general equilibrium (CGE) models for groups of countries with similar structural features. In international development, the archetype approach derives from the tradition of Kuznets and Chenery in seeking regularities in the economies of the very large number of LDCs according to their levels of per capita incomes, market sizes, and other structural features. Because it is too costly to construct complete models for every country and to derive from this average policy guidelines by structural group, de Melo and Robinson have pioneered the opposite approach of constructing country averages (archetypes) and deriving policy guidelines for the corresponding country group. Loo and Tower have used an archetype approach to analyze agricultural trade liberalization, but their models include only one agricultural sector and no social disaggregation. In the present paper, we use a multimarket specification of agriculture in order to capture the richness of substitution effects among products and factors, as well as the role of nonallocatable fixed factors. We also stress the differential roles of public and private investment, how they are affected by changing fiscal revenues from higher food import prices, and the short- and long-run effects these effects have on growth and welfare. Country groups are constructed on the basis of explicit structural criteria. The social accounting matrix for each archetype is rigorously quantified from the national accounts data for the countries in the group and parameters of the models are as much as possible estimated as average values for the countries in the group. From a methodological standpoint, this paper shows how a CGE-multimarket archetype approach, rigorously quantified, provides a very effective tool for the analysis of complex agricultural policy decisions.

We start by grouping the LDCs according to a number of criteria to establish the relevant structural and behavioral characteristics that the archetypes must reflect. In the following sections, we construct social accounting matrices (SAM) for archetype low-income African and Asian countries and explain the features of the CGE models specified. We then use these models to simulate the effects of rising international prices of cereals and livestock products induced by OECD agricultural trade liberalization. Finally, we analyze how complementary measures could be introduced to shelter the poor in both the short and the long run.

Country Classification

We focus on low income countries which, in the World Bank classification, had per capita incomes below $500 in 1985. We exclude from this group the net cereals exporters, who gain from higher cereals prices, and the mineral exporters (with a share of minerals in total exports above 75%), who have no difficulty in importing food, even at a higher price. We also exclude China and India, which are so large as to require country specific modeling. This leaves a set of countries classified by continent (Africa and Asia, since there are no Latin American countries left in that group) and by degree of substitution in consumption between imported cereals and domestic food crops production.

The degree of substitution in consumption between imported cereals (principally wheat, rice, and corn) and domestic food crops production (which may include wheat, rice, and corn plus other food crops) is a fundamental determinant of the impact of an increase in imported cereals prices on domestic producer and consumer food crops prices.[1] Producer prices of wheat, rice, and corn follow the price of imports. What happens to the prices of other food crops and of the food crop aggregate, however, depends on the elasticity of substitution in consumption between domestically produced food crops and cereal imports, as well as on supply and demand elasticities and the import dependency ratio of food crops. This can be seen in a simplified one-sector model as follows.

Let D be the domestic production of food crops and M the cereals imports, and p_d and p_m their respective prices. If they are imperfect substitutes and aggregate in a CES utility function with elasticity σ, a cost-minimizing consumer will purchase the two products in a share that depends on their relative prices:

$$\frac{D}{M} = \frac{1-s_m}{s_m}\left(\frac{p_d}{p_m}\right)^{-\sigma},$$

where $s_m = M/C$ is the initial share of imports in consumption and $C = D + M$ is total consumption.

If ε is the price elasticity of demand for C and μ is the price elasticity of supply for D, the market for food crops is written as:

$C = p^{-\varepsilon}$, where $p = \dfrac{p_m M + p_d D}{M + D}$ is the consumer price and

$D = p_d{}^{\mu}$.

These equations can be solved for quantities C, D, and M, producer price p_d, and consumer price p as a function of import price p_m. Differentiating the system around the initial point where, by proper normalization, all prices are equal to 1 gives the following relations for rates of change in equilibrium prices:

$$(1) \quad \dot{p}_d = \frac{s_m(\sigma - \varepsilon)}{s_m(\sigma - \varepsilon) + \mu + \varepsilon} \dot{p}_m \quad \text{and} \quad \dot{p} = \frac{s_m(\sigma + \mu)}{\sigma + \mu + (1 - s_m)(\varepsilon - \sigma)} \dot{p}_m .$$

This shows that the elasticities of transmission of the import price of cereals on domestic producer and consumer prices of food crops are less than one for all finite values of the elasticity of substitution σ. The change in producer price is negative if σ is lower than the elasticity of demand ε. This comes from the fact that aggregate consumption decreases in response to the aggregate consumer price increase and, with the low substitutability between imported and domestic commodities, consumption of both components decreases. For σ greater than ε, the elasticity of transmission to the producer price increases with the initial share of imports s_m and decreases with the supply elasticity μ. Thus, an increase in international cereal price will have a relatively small effect on the producer price of food crops if domestic production is a poor substitute for imports, if the share of imports is small, or if the supply elasticity is large. Consumer price, by contrast, always increases. The rise in consumer price is greater with higher substitutability σ, with lower demand elasticity ε, and with a greater share s_m of imports in total supply. If there is sufficient substitutability (σ greater than ε), then a higher supply elasticity μ reduces the magnitude of price transmission.

Starting from an exhaustive list of 73 countries, for which World Bank and FAO data are available for 1985, the selection criteria mentioned above give us 26 low income countries which are neither cereal nor major mineral exporters. To separate those in which domestic food crop production is competitive with imported cereals from those in which it is not competitive, we use an index of competitiveness defined as the share of wheat, rice, and corn (the three cereals whose prices are most affected by OECD trade liberalization) in total domestic food crop production. The index threshold is 25%. The resulting three groups of low income countries that we model as archetypes are:

1. African countries with noncompetitive cereal imports (Africa I): Burkina Faso, Mozambique, Togo, Burundi, Central Africa Republic, Rwanda, Sudan, Senegal, Ghana, Mauritania, and Lesotho.

2. African countries with competitive cereal imports (Africa II): Ethiopia, Mali, Madagascar, Benin, Somalia, Kenya, Tanzania, Guinea, Sierra Leone, and Liberia.

3. Asian low-income countries: Bangladesh, Sri Lanka, Pakistan, Philippines, and Papua New Guinea.

These three country groups together account for only 14.3% of LDC population, 7.7% of LDC gross domestic product (GDP), and 14% of LDC cereal imports (table 1). While marginal in terms of grain trade, they are, together with India and China, the countries where the bulk of world absolute poverty is located and, as such, deserve special attention.

Data in table 1 show that the two groups of African low income economies have very similar structural and behavioral characteristics. For this reason, we model these two archetypes with the same social accounting matrix and the same elasticities of supply response and factor demand in agriculture. We, however, impose different elasticities of substitution between imported cereals and domestic food crops in order to reflect the fact that the index of competitiveness is low in the Africa I group (10%) and high in the Africa II group (45%).

The low-income Asian countries import mainly wheat, and some countries import rice as well. Most of these countries are themselves important producers of wheat (Pakistan) or rice (Bangladesh, Philippines, and Sri Lanka), while coarse grains are secondary. Cereal imports are for this reason highly competitive with domestic food crops, resulting in an index of competitiveness of 94%. Even though cereal import dependency is not high (8%), domestic prices are very much influenced by international prices. The population's diet is based largely on cereals (70% of dietary energy), with the result that a rise in the consumer cereal price has a strong incidence on the consumer price index (CPI) and on the welfare of net buyers.

In the low-income African countries, cereals are less important in the diet: 47% of dietary energy in Africa I and 48% in Africa II. Consumers are consequently more sheltered than in Asia from a rise in cereal prices, particularly in countries with noncompeting imports. Countries in Africa I produce mostly coarse grains, root crops, and plantains and import wheat and rice. Domestic food production is thus quite isolated from international cereal prices. Countries in Africa II produce coarse grains and rice and import rice, coarse grains, and wheat in approximately equal shares. International cereal prices consequently strongly affect the domestic food price.

The African and Asian SAMs (tables 2 and 3, respectively) replicate as closely as possible the aggregate values reported in table 1 for the structures of production, demand, international trade, and government revenues. Other values (input-output coefficients, distribution of value added to factor incomes, transfers, and consumption shares) are drawn from different sources, mostly from a Kenya SAM (Republic of Kenya) for Africa and from a Sri Lanka SAM (Pyatt and Roe) for Asia. The size of the country has no influence, and the data are reported in 1985 U. S. dollars per capita to allow comparison between the two SAMs.

An Integrated CGE-Multimarket Approach[2]

The model used here integrates the standard specification of the neoclassical CGE with multimarket models (Quizon and Binswanger). We use a Generalized Leontief profit function from which are derived output supplies for the three agricultural products and factor demands for the two labor categories. For nonagricultural sectors, we use the traditional multi-level CES production function for primary factors and fixed coefficients for intermediate inputs.

For labor markets, we assume urban labor in Asia and unskilled labor in Africa are in surplus and hired at an exogenous real wage. For rural labor in Asia and skilled labor in Africa, wages are, by contrast, flexible and clear a competitive market. Public service employees receive an exogenous real wage. On the foreign exchange market, country indebtedness currently is limited by the global context of the debt crisis. The foreign exchange constraint forces a flexible real exchange rate, endogenously determined, to equilibrate in the foreign exchange market at a given level of capital inflow.

The numéraire used in the model is the average producer price index. The transmission mechanism between international cereal prices and domestic food crop prices is a key feature of the analysis. It is specified through CES aggregation in which imported cereals and domestic food production are substitutes with an elasticity σ. The resulting shares determine the consumer food price.

As with any other CGE model, calibration is based on exact replication of base year data compiled in the SAM. All share parameters in the different aggregation functions are derived from the SAM. Complementary information is necessary only for elasticities, as follows:

i) The demand system is an LES, with parameters derived from observed average consumption shares (in the SAM), estimated income elasticities by income class (from econometric estimates available in the literature, calibrated to satisfy the additivity constraint), and income-class-specific values for the flexibility of money. The latter are well established from international comparisons and range from -4 for the poorer to -2 for the richer groups of these low income countries.

ii) On the supply side, all nonagricultural production functions are CES in capital and labor, with a standard medium value of substitutability between factors equal to 0.8. With respect to agricultural sectors, base values for supply and demand elasticities were taken from Sullivan, Wainio, and Roningen. These elasticities were forced to satisfy additivity and symmetry constraints by minimizing the sum of the squares of the distances to the base values while maintaining the base values of the direct price elasticities. The base values and the initial structure of shares, which places constraints on the elasticities, differ between African and Asian archetypes. Resulting elasticities are given in table 4.

iii) For aggregation elasticities between imports and domestic consumption, a relatively low substitution elasticity (0.5) has been assumed for the nonagricultural products. This assumes differentiation between domestically produced commodities and imports within these large aggregates.[3] For the other agricultural sector (predominantly animal products), high substitution elasticity (3.0) is assumed. However, with the observed low share of imports in domestic Asian consumption, the transmission of an external price increase to domestic price is still low. For the African archetype, foreign price changes are irrelevant since there are no imports. Substitution elasticity between imported cereals and domestic food crops, a key to our analysis, has been calibrated as follows. In the Asian archetype, a very high substitutability (30) is chosen to characterize the observed high degree of competitiveness. In the Africa I archetype, where domestically produced food crops are different from imported cereals, choice of σ is based on the relation between the elasticities for these crops and their cross price elasticities of demand with respect to the price of the imported cereals. Based on Sullivan and others, cross-price consumption elasticities are approximately equal to zero for Sub-Saharan African countries, indicating, in equation (1), that substitution elasticity σ equals the direct price elasticity of consumption ε for the aggregate food crop. Although these direct price elasticities vary across households, they are all close to 0.6 for the majority of consumers, and σ was thus set to 0.6 for this archetype. In the Africa II archetype, where the degree of competitiveness is similar between domestic production and imports, an intermediate value of 3 was chosen for σ.[4]

iv) On the export side, transformation elasticities are evidently dependent on the homogeneity of the sectors and, on the consumption side, these elasticities must be of medium values at the high level of aggregation considered here. Thus, a medium-high