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Tariffs, Agricultural Performance, and Regional Disparities within a General Equilibrium Framework: Brazilian Case

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Abstract: The purpose of this study is to assess quantitatively the impact of a tariff cut on agricultural performance and intersectoral and interregional disparities in Brazil. A general equilibrium model was built, nonlinear and dynamic, in which the price mechanism plays an important role. The model is disaggregated in such a way as to permit the analysis of the agricultural sector within the context in which it is inserted. Special attention is given to the effects of urban protection on growth and welfare variables, and strong emphasis is put on the role played by rural-urban interactions. The simulation of the model shows that tariffs constitute a burden to the rural sector as they benefit urban activities. Protection, through rural-urban links, also exacerbates regional disequilibria as they worsen the situation of the poor, agricultural Northeast region.

Introduction

In developing countries, trade policy discriminates heavily against agriculture. Positive urban tariffs together with several price distortions that keep rural domestic prices below world prices reduce rural profitability and imply a transfer of the agricultural surplus to urban areas. In the case of Brazil, if one considers that most of the low income population is concentrated in primary activities, then traditional trade policy can have strong implications for income distribution. Also, the existence in Brazil of two distinct regions—the primary exporter, poor Northeast and the rich, industrialized South—accentuates the impact of urban protection on growth and welfare variables, as the rural-urban duality could be an important determinant of regional disparities. Tariffs, by discriminating against the rural sector, contribute to regional inequalities in Brazil. That could be a serious indirect cost of protection, as Brazil is one of the countries where income is the most concentrated. One thus needs to examine the way protection policies affect rural-urban relations and through them interregional and intersectoral income distribution.

This question has usually been discussed in a partial equilibrium framework, an approach that is restrictive as it does not take into account the complex supply and demand interactions among economic sectors and regions. Nor does it consider that the immediate effects of protection could be different from long-run effects. Those questions can be better answered within a general equilibrium approach.

The purpose of this paper is to assess quantitatively the impact of protection on agricultural performance and intersectoral and interregional income inequalities using a computable general equilibrium model.

Model

The model presented here belongs to the family of computable general equilibrium models developed by Adelman and Robinson (1978). It is formed by two regional models describing the interrelationships between the Northeast and the Centre-South regions in Brazil. The regional models are linked by trade and migrations. In each region, two production sectors are defined: rural and urban sectors. They produce different products and are connected through a regional input-output matrix obtained using Chenery's (1953) method. Each sector was split into two parts according to the regional origin of production.

Three production factors are considered: urban capital, urban labour, and an aggregated rural factor. An important hypothesis in this study is that a good produced in a given region is not a perfect substitute for the same good produced in the other region; i.e., different prices exist in the regions considered.

Producers in the urban sector maximize profits subject to a CES production function of labour and capital. In agriculture, maximizing behaviour applies only to products; for production factors, the model does not imply the classical matching between marginal costs and prices.

Consumers are aggregated into rural and urban groups; they receive all the income generated by production in the different sectors and use an extended linear expenditure system to choose between consumption and saving. Government behaviour does not imply any maximizing behaviour; it receives direct taxes, tariffs, gives subsidies, and saves what remains after subtracting exogenous public consumption. In the urban sector, *ad valorem* tariffs are differentiated by products. In the agricultural sector, implicit tariffs are calculated as the difference between domestic and world prices.

In the agricultural sector, imports are perfect substitutes for domestic production. Hence, a unique price exists for both variables. Net exports/imports is simply the difference between production and domestic demand; any production increase in the short run means higher net exports, as the economy is assumed to be "small" and the elasticity of the foreign demand for rural products infinite. In the urban sector, substitution between domestic production and imports takes place within an Armington system that defines a composite good and its price as a CES function of quantities and prices of domestic and imported goods. Exporters face a foreign demand that is not perfectly elastic.

Although the theoretical framework of this study is the competitive model, it incorporates some rigidities that are supposed to characterize the developing economies. Factorial mobility, for example, is imperfect. Labour does not move instantaneously among sectors and/or regions. Capital mobility is also imperfect within each region, and this factor is specific to the two sectors considered. Savings generated in each sector is locally invested. Capital imports are invested exclusively in each regional urban economy. Nevertheless, the existence of capital transfers between the Northeast and the Centre-South is admitted. In the model, these flows are calculated as the difference between the value of the purchases and sales of intermediate goods for each region. This difference was added (subtracted if the region was a net exporter of intermediate products) to urban investment and constitutes an addition (subtraction) to the existing capital stock. Prices are determined in such a way as to eliminate excess demand in the different markets. In the labour market, the following hypotheses were adopted concerning urban real wage growth: (a) a fixed real wage was imposed, giving rise to unemployment, and (b) wage flexibility ensures full employment if the market real wage is higher than the minimum fixed wage; i.e., the wage constraint becomes inoperative. In the agricultural sector, the income adjusts to eliminate unemployment. This assumption reflects the idea that the subsistence production absorbs the workers who could not find a job in the urban sector or in agricultural formal employment; as a result, productivity and household per capital income are reduced.

Within periods, the model is solved for the endogenous variables, given the values of the exogenous variables and parameters used. Between periods, the dynamic adjustment is done through extrapolation of the production factor values, sectoral productivity growth rates, and labour mobility. The solution is obtained using the Gauss-Seidel algorithm to adjust prices to eliminate demand excess.

The most important equations of the agricultural part of the model are briefly described below. A complete description of the model is provided in Sampaio de Sousa (1987).

Agricultural Sector

The main advantage of the agricultural system developed in this study comes from the fact that it offers a general equilibrium framework in which one can analyze production decisions in agriculture. This approach takes into account the fact that increasing the supply of a given product requires resources that could be used elsewhere, thus reducing the supply of other crops. The agricultural system presented here distinguishes (a) supply functions disaggregated by products and a resource demand function and (b) an aggregated function representing the total availability of rural resources. Those equations are connected through

an equilibrium price P_r that assures the equality between the resource demanded with the P_r resources supplied.

Production and resource demand. Agricultural supply function by-products are described by equations (1a) and (1b):

$$(1a)\ X_i = \alpha_i (PP_i/PI_i - c_i)\beta_i, \text{ if } PP_i/PI_i > c_i, \text{ and}$$

$$(1b)\ X_i = 0, \text{ if } PP_i/PI_i \leq c_i.$$

Maximizing profits under competitive conditions requires that:

$$(2)\ PP_i/PI_i = [df_i(X_i)]/dX_i.$$

Rearranging terms in equation *(1)*, combining with equation *(2)*, and integrating over X_i yields:

$$(3)\ R_i = (1/\alpha_i)^{1/\beta i}[\beta_i/(1+\beta_i)]X_i^{\beta i/(1+\beta i)} + c_i X_i.$$

If c_i is zero, this expression corresponds to a Cobb-Douglas production function. R_i represents the aggregated resources required to produce the *i*th crop. It includes intermediate inputs as well as labour and capital inputs. Rearranging the terms in *(3)* and replacing them in equation *(1)*, one can express R_i as a function of the production level and relative prices.

$$(3a)\ R_i = \{[\beta_i/(1+\beta_i][PP_i/(PI_i - c_i)] + c_i\}\ X_i.$$

Net demand for rural resources *RND* for the whole set of agricultural products is:

$$(4)\ RND = \sum_i R_i - \sum_i \sum_j a_{ji} X_i.$$

Total resource supply. Production capacity in the rural sector is given by equation *(5)*.

$$(5)\ Y_{rr} = [a_0 + a_1(L_r/T_c) + a_2(L_r/T_c)^2 + a_3(FERT/T_c) + a_4(T_i/T_c) + a_5(T_i/T_c)^2 + a_6(DST/T_c) + a_7(LSTK/T_c)]T_c.$$

This specification comes from the work of Hellinghausen and Mundlak (1982). It takes into account the traditional agricultural production resources: labour *(L_r)*, cultivated land *(T_c)*, irrigated land *(T_i)*, livestock *(LSTK)*, tractors *(DST)*, and fertilizer *(FERT)*. Resource growth is conditioned by the availability of cultivated land and labour as well as by agricultural savings. Cultivated land grows at an exogenous rate and the labour force depends on demographic growth and intersectoral and interregional income disparities through migration. Finally, agricultural investment in irrigation, livestock, and tractors is related to rural savings.

Price Determination

Equilibrium between total demand of net resources defined by equation *(4)* and production capacity given in equation *(5)* determines P_r, the resource price that relates the supply system by-products to the aggregated supply of resources. All producers face the same resource price.

P_i, the price of the aggregated input R_i, is a weighted average of the intermediate and factor prices:

$$(6)\ PI = (\sum_i \sum_j a_{ji} X_i Pd_j + P_{rr} Y_{rr}) / \sum_i R_i .$$

Finally, equation *(7)* defines agricultural producer prices:

$$(7)\ PP_i = \phi 1_i Pw_i + \phi 2_i PI_i + \phi 3_i P_{GDP}, \text{ with } \sum_j \phi j_i = 1,$$

where Pw_i is the world price of the *i*th good, PI_i is the equivalent input price, and P_{GDP} is the implicit GDP deflator. Parameters ϕ_1, ϕ_2, and ϕ_3 reflect price policies adopted for the different products. They are chosen in such a way as to reconcile the need to obtain foreign exchange through exports with the requirements of the urban economy in terms of food and raw materials. The price of export crops is supposed to be more linked to international prices, while food crops are protected to preserve urban purchasing power and prevent industrial costs from rising.

Simulation Results and Conclusions

The following is a description of the impacts of a 50-percent tariff reduction for all urban products. Special attention is given to the effects on sectoral production, intersectoral terms of trade, and intersectoral and interregional income distribution. The results are shown in Tables 1 and 2 and represent percentage change in relation to the base case for 1976 (initial year) and 1990 (final year).

Table 1 shows that protection has a negative impact on production in both regions. Indeed, in 1990, lower urban tariffs increase GDP by 3.45 percent and 0.52 percent, respectively, for the Northeast and Centre-South regions. As concerns income, the tariff cut reduces regional inequalities. The interregional income differential diminishes by 5.4 percent compared with the base-case level, which could be explained by the fact that the increase in rural real revenue does not offset the reduction of urban income in the Centre-South region, while in the Northeast, real revenue grows in the two sectors. This phenomenon can be better understood if one distinguishes between the short-run and long-run effects of this policy.

Table 1—Impact of a 50-Percent Urban Tariff Cut: Selected Results*

Variables	Northeast 1976	Northeast 1990	Centre-South 1976	Centre-South 1990
	- - - - - *Percent* - - - - -			
Value added				
Rural	0.16	3.45	0.05	1.94
Urban	-0.77	2.10	-0.70	0.39
Total (GDP)	-0.62	2.27	-0.61	0.52
Disposable real income				
Rural	14.35	7.80	10.37	10.39
Urban	-2.73	7.25	-3.87	-2.97
Rural-urban income differential (per capita)	-15.63	5.21	-14.53	-11.63
Resource prices				
Rural *(P_r)*	22.38	0.31	5.09	-3.72
Urban *(P_u)*	-8.55	3.85	-9.72	-9.50
Rural-urban terms of trade	33.82	-3.41	16.44	6.39
Agricultural prices				
Producer prices *(PP)*	-1.84	1.94	-2.81	-3.12
Input prices *(PI)*	-1.96	-4.70	-2.93	-5.04
PP/PI	0.12	2.89	0.13	2.01
Urban consumer price	-8.53	-0.57	-9.40	-8.69
Urban real wage	0.00	7.95	0.00	0.56

*Percentage change with respect to the base case.

In the short run, lower urban prices caused by lower urban production improve agricultural terms of trade as rural prices are partially linked to fixed world prices and so diminish more slowly. As a result, rural profitability increases, resulting in excess demand

Table 2-Protection and Regional Imbalances: Selected Indicators*

Indicators	1976	1990
	- Percent -	
Regional income differential (per capita)	0.01	-6.40
Interregional migrations	-1.23	-12.73
Interregional capital transfers	-11.76	-31.95

*Percentage change with respect to the base case.

for agricultural resources. Higher rural resource prices accentuate the initial improvement in the agricultural terms of trade. This effect is more important in the Northeast region, as protection discriminates mainly against agricultural export activities that constitute the economic basis of this region.

In the long run, the results are different in each region. In the Centre-South, the initial rural factor price increase is completely absorbed thanks to the fast capital accumulation in agriculture; in 1990, this price is 3.72 percent lower than its level in the base case. But, as urban prices fall more, the terms of trade still benefit the country. In the Northeast, the situation is different. Reduced capital transfers hinder capital accumulation in the urban sector and transform the initial fall in the urban resource prices into a rise of 3.85 percent compared with the base run. In spite of the fact that, in the Northeast, the agricultural sector is relatively more important, the terms of trade turn against agriculture. As they are an important determinant of income distribution, rural-urban disparities are worsened. Such an effect partially offsets the reduction of regional imbalances, as one considers that changes in the income distribution are unfavourable to rural areas and increase income concentration in Brazil as a whole as the rural sector comprises most of the low-income population.

In conclusion, the results show that protection exacerbates regional disequilibria, worsening the situation of the poorest region, the Northeast. Indeed, protectionist policies imply a resource transfer from rural to urban areas. As the urban sector is more developed in the Centre-South, this region benefits from higher tariffs as it comprises most of the import-competing activities. Previous results (Reboucas, 1974) are confirmed, and the role played by rural urban interactions in strengthening the Northeast/Centre-South duality in Brazil is made explicit.

Note

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DISCUSSION OPENING—*Monika Hartman* (Frankfurt University)

Sampaio de Sousa has provided us with an interesting paper, which is based on the important and well-known observation that developing country trade policies discriminate heavily against agriculture, thus leading to adverse effects not only on the agricultural sector but on the economy as a whole. Sampaio de Sousa uses a computable general equilibrium model, which she says is also of a dynamic nature, to quantify the effects of a 50-percent industrial tariff reduction on the agricultural sector and on intersectoral as well as on intraregional income parity. Unfortunately not all the promises made in the abstract and introduction are fully met within the text.

First and foremost, no explanation is given of the model used in the paper. I understand that this might be partly due to space limitations since it is nearly impossible to give a complete picture of the model and the results in only six pages. Nevertheless, some clarification would be useful to improve our understanding of the approach. The major questions I have are: What is the data base and what are the data sources? Are the parameters empirically estimated or are they taken from literature? Are the overall results of the model robust with respect to the model parameters? Have sensitivity analyses been conducted and what results did they reveal? With respect to the missing lags, the question arises whether the model is really of a dynamic nature as stated in the abstract and introduction or is it only a sequential dynamic approach, which solves equilibrium models each year separately? Some more information about the absolute values of the results would make it easier to estimate the absolute magnitude of the documented changes of a tariff reduction comparison to the base run.

I agree with Sampaio de Sousa that a general equilibrium approach is needed to capture the complex linkages among sectors and regions. Nevertheless, the results of this model should be compared with other studies even if those studies only use a partial equilibrium approach.

In addition, other ways of discriminating against agriculture in developing countries exist beyond just sector-specific price and tax policies. As has been shown during this conference, discrimination against agriculture also encompasses macroeconomic issues like overvalued currencies and balance-of-payments and budgetary deficits. Their effects might do even more harm to the agricultural sector than the policies mentioned in Sampaio de Sousa's paper. Since the focus of the study is on politically induced intersectoral and interregional income inequality, an interesting extension would be to analyze the effect of protected urban labour markets on income parity—an economic reality in many developing countries that has been incorporated in Sampaio de Sousa's model.

GENERAL DISCUSSION—*Mathew Shane* (Economic Research Service, US Department of Agriculture)

The questions on the CGE model of Brazil related to its structural characteristics; in particular, whether changes in real wages were taken into account. The author replied that they were not, since the framework was set up as a medium-to-long-term equilibrium model.

One participant asked why the Northeast is particularly affected by the tariff reductions. The author replied that the answer was related to the intensity of agricultural activity in that region relative to other regions of the country. Since an import substitution policy tends to be an implicit tax on agriculture, this is the expected result.

Participants in the discussion included R. Ayerza and G.T. Jones.