Agricultural Trade Liberalization in a Multisector World Model: Implications for Argentina, Brazil, and Mexico

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Abstract: Impacts of agricultural and nonagricultural trade liberalization on agriculture are assessed in a multicommodity, multicountry framework. By modelling simultaneously all goods sectors of the economy, the importance of (1) relative price changes between sectors and (2) income and exchange rate adjustments that follow trade liberalization in a world of floating rates are evaluated. Specifically, four cases are compared using a static world policy simulation (SWOPSIM) model: industrial market economy agricultural liberalization, global agricultural liberalization, all-sector industrial market economy liberalization, and all sector global liberalization. Under all sector liberalization scenarios, exchange rates are allowed to float for all countries/regions. In all cases, agricultural commodity prices tend to increase, an effect that is more pronounced when currency values adjust but less pronounced under global relative to industrial market economy liberalization. Three Latin American countries are modelled individually: Argentina, Brazil, and Mexico. Argentina and Brazil have the most significant advances in agricultural trade with an all-sector global liberalization. The deterioration of the Mexican agricultural trade balance is reduced when exchange rates are allowed to vary.

Introduction

Most analyses of agricultural protectionism have been conducted in a partial equilibrium framework. OECD (1987) and World Bank studies (Tyers and Anderson, 1986; and World Bank, 1986) examine liberalization in an agricultural, multicommodity model but do not consider nonagricultural sectors, even though a reduction in protection for the nonagricultural sector can cause changes in nonagricultural and agricultural prices, changes in income, and changes in relative prices across countries via exchange rate movements. This would influence resource allocations across sectors and countries and thereby affect agricultural production, consumption, and trade. The nonagricultural component of the economy may have even more influence than sector-specific policies.

In view of the potential importance of a broad-based framework, a multicommodity, multicountry static model is developed and the effects assessed of all-sector (agricultural and nonagricultural) trade liberalization on the agricultural sector. By modelling all goods sectors of the economy, industrial market economy and global liberalization scenarios in which exchange rates are endogenous can be compared with scenarios in which only agricultural trade is liberalized and no exchange rate changes are assumed. The focus is on price, exchange rate, and trade effects in Argentina, Brazil, and Mexico.

To undertake the scenarios, a static world policy simulation model (SWOPSIM) is used (Roningen, 1986; and Dixit and Roningen, 1986), which includes eight countries/regions (USA, EC, Japan, Canada, Argentina, Brazil, Mexico, and the rest of the world), a breakdown of commodities for each country into agricultural goods (wheat, maize, soyabeans, rice, sugar, dairy, beef, and poultry), a composite "other agricultural" good, a composite nonagricultural traded good, and a nontraded good. A base level (1984) is established for demand and supply, consumer prices, producer prices, and world prices. For each country, producer and consumer prices (or the implicit per unit values) deviate from world price by an *ad valorem* rate of protection. The levels of government intervention in agriculture are measured by producer and consumer subsidy equivalents (USDA, 1987). For nonagricultural goods, *ad valorem* tariff and nontariff barrier tariff-equivalent rates are used for protection measures (Whalley, 1985 and 1986; Deardorff and Stern, 1986; and Anjaria, Kirmani, and Petersen, 1985).

Analytical Framework

The framework for this analysis has its origins in studies by Valdés (1986) and Deardorff and Stern (1986). A more complete partial equilibrium model is set up here,

with all produced and consumed goods specified in demand and supply functions. The present model falls short of a general equilibrium characterization since factor markets are not explicitly described. This approach has the advantage over agricultural sector models of accounting for feedback from one sector to another as relative prices alter. Additionally, because all goods in the economy are accounted for (and hence, the total balance of trade), income and exchange rates can be modelled endogenously, and the effects of floating rates (or exchange rate liberalization) can be evaluated.

The model is developed for m countries/regions ($i=1$ *to* m), producing and trading n goods ($j=1$ *to* n) and a nontraded good, k. The traded goods include a breakdown of agricultural goods (1, ..., $n-2$), a composite "other agricultural" good ($j=n-1$), and a composite nonagricultural good ($j=n$).

The demand and supply functions, assumed to be derived from consumer and producer maximizing behaviour, depend on all prices and income as delineated below:

$$(1)\ DA_{ij} = DA_{ij}\,(PA_{ij}, PT_{in}, PH_{ik}, Y_i),$$

$$(2)\ DT_{in} = DT_{in}\,(PA_{ij}, PT_{in}, PH_{ik}, Y_i),$$

$$(3)\ DH_{ik} = DH_{ik}\,(PA_{ij}, PT_{in}, PH_{ik}, Y_i),$$

$$(4)\ SA_{ij} = SA_{ij}\,(PA_{ij}, PT_{in}, PH_{ik}),$$

$$(5)\ ST_{in} = ST_{in}\,(PA_{ij}, PT_{in}, PH_{ik}),\ \text{and}$$

$$(6)\ SH_{ik} = SH_{ik}\,(PA_{ij}, PT_{in}, PH_{ik}),$$

where D and S are demand and supply equations, respectively, P is prices, Y is income, A denotes agricultural goods, T represents the nonagricultural traded products either exported or imported, and H represents the nontraded good. Farm input prices are included implicitly in the price of nonagricultural goods faced by agricultural producers; likewise, agricultural prices represent both prices of inputs and prices of alternative outputs to nonagricultural producers.

Expenditure is defined as:

$$(7)\ Y_i = \sum_{j=1}^{n} P_{ij} D_{ij} + P_{ik} D_{ik}.$$

Alternatively, expenditure equals the value of production plus (minus) the change in foreign borrowing.

The domestic economy reaches an equilibrium when domestic goods have an excess supply equal to zero and when net traded goods (including agricultural goods) equal "net capital flows" (F). F is defined as including capital and service accounts and accommodating changes in international reserves. For country i,

$$(8)\ ESH_{ik} = SH_{ik} - DH_{ik} = 0,\ \text{and}$$

$$(9)\ \sum_{j=1}^{n} ES_{ij} P_{ij} = \sum_{j=1}^{n} S_{ij} P_{ij} - \sum_{j=1}^{n} D_{ij} P_{ij} = F_i.$$

World markets clear when excess supply of a good across all countries is equal to zero. For agricultural commodities, this occurs when:

$$(10)\ \sum_{i=1}^{m} ESA_{ij} = \sum_{i=1}^{m} SA_{ij} - \sum_{i=1}^{m} DA_{ij} = 0,$$

for each j, ($j=1, \ldots, n-1$). For the traded nonagricultural good n, equilibrium occurs when:

$$(11)\ \sum_{i=1}^{m} EST_{in} = \sum_{i=1}^{m} ST_{in} - \sum_{i=1}^{m} DT_{in} = 0.$$

The traded good price in each country's domestic currency is:

$$(12)\ P_{ij} = E_i\, PW_j(1+t_{ij}),$$

where E_i equals domestic currency per US dollar, PW_j is the world dollar price of good j for all traded js, and t_{ij} can be interpreted as an export subsidy or import tariff ($t_{ij}>0$), or export tax or import subsidy ($t_{ij}<0$) and is assumed to be exogenous.

A shock to the system—in terms of a change in protection in either sector of the economy in any country or commodity market—leads to changes from base values in quantities produced, consumed, and traded and world and domestic prices. The system also determines either (1) changes in each country's balance of trade under the assumption of fixed exchange rates and the availability of external financing or (2) changes in each country's exchange rate under the assumption of floating rates that return all countries' trade balances to their initial equilibria:[2]

$$(13)\ (\Gamma_1+\Gamma_2)Et^* + \Gamma_1[PWA^*+(1+tA_i)^*] + \Gamma_2[PWT^*+(1+tT_i)^*] = F_i^*,$$

where * indicates percentage change in the variable and Γ is a parameter consisting of supply and demand elasticities, sector expenditure shares, and agricultural and nonagricultural trade shares.

Under a fixed exchange rate system, $E_i^* = 0$, the balance of trade changes in response to changes in protection in the agricultural and nonagricultural sectors and changes in the world prices of traded goods. External financing is assumed to be forthcoming to balance the change in the value of net trade.[3] In the small country case, agricultural markets would be affected (1) directly by changes in the country's agricultural protection, (2) indirectly by changes in prices of nonagricultural and nontraded goods resulting from changes in the country's nonagricultural protection, and (3) by gains in income resulting from liberalization. In the large country case, the additional effects of changes in world prices feed back to domestic prices and affect domestic production and consumption and, consequently, trade.

Under a floating exchange rate system, the country's currency would depreciate or appreciate following liberalization until the changes in the external imbalance are eliminated; i.e., until $F_i^* = 0$. Hence, the exchange rate change causes a further feedback from world prices to domestic prices and subsequent adjustments to quantities.

If the parameters of equation *(13)*, Γ_1 and Γ_2, are positive, then a reduction in protection leads to a depreciation of the exchange rate, which offsets, to some extent, the negative impacts on domestic prices of a reduction in protection levels. If the agricultural protection levels are initially negative (e.g., most agricultural commodities in Argentina) and nonagricultural protection is initially positive, then a reduction of protection can lead to a depreciation, which would reinforce the positive impacts of liberalization on domestic agricultural prices.

Simulation Results

Although many alternative scenarios could have been simulated, four cases were chosen: (1) a 100-percent industrial market economy (USA, EC, Canada, and Japan) liberalization of agriculture under the assumption of fixed exchange rates for all countries/regions; (2) a 100-percent industrial market economy liberalization of all sectors (total liberalization) under the assumption of floating exchange rates for all countries/regions; (3) a 100-percent global liberalization of agriculture for all countries under the assumption of fixed exchange rates; and (4) a 100-percent global liberalization of all sectors for all countries under the assumption of floating exchange rates. These scenarios were designed to explore the participation compared to nonparticipation of developing countries in trade negotiations and to explore the bias in agricultural trade liberalization analyses that do not account for cross-sector linkages, income, or exchange rate effects due to changes in protection (not to predict actual outcomes of trade negotiations).

Table 1 shows that, in each scenario, world prices of all agricultural goods except soyabeans rise. Sugar prices increase the most, followed by dairy prices, reflecting the relatively high levels of industrial market economy protection in these commodity markets. All-sector liberalization (and the resulting exchange rate movements) tends to *reinforce* the price effects of liberalization confined to the agricultural sector (Case 2 compared to Case 1 and Case 4 compared to Case 3). The appreciation of the rest-of-the-world currency (and Argentine, Brazilian, and Mexican currencies in Case 2) relative to the industrial market economy currencies increases (reduces) its willingness to import (export) agricultural commodities, placing additional upward pressure on world prices. For example, consider the large differences in the world price of wheat in Case 2 compared to Case 1. The appreciation of the Argentine and Brazilian currencies reduces those countries' willingness to export wheat at the lower domestic price (in comparison to the fixed exchange rate Case 1).

Table 1—World Agricultural Prices

	Case 1	Case 2	Case 3	Case 4
	Percent change			
Wheat	2.9	7.0	1.6	5.0
Maize	1.3	5.1	0.2	2.7
Soyabeans	-0.1	2.9	-5.4	-4.9
Rice	6.7	13.6	6.6	13.2
Sugar	32.0	38.6	29.1	33.4
Dairy	18.7	24.4	20.0	25.5
Beef	13.8	17.2	12.9	14.7
Poultry	4.9	8.4	4.9	7.2

Global liberalization tends to *dampen* the price effects relative to industrial market economy liberalization (Case 3 compared to Case 1 and Case 4 compared to Case 2), reflecting the tendency for the three Latin American countries to tax their producers. This is particularly illustrated in the soyabean market where Argentina and Brazil account for 25 percent of the export market. Soyabean prices decline mainly because of the increased Argentine and Brazilian exports following the removal of producer taxes and consumer subsidies in these countries.

In all four scenarios, substantial changes occur in foreign exchange earnings or costs in agricultural trade following liberalization (Table 2). If agricultural liberalization occurs in industrial market economies only (Case 1), then Argentina and Brazil improve their agricultural trade balances by about 20 percent, and Mexico is no longer a net agricultural importer, but a net exporter of beef, poultry, and sugar, while decreasing its imports of grains and dairy.

An industrial market economy all-sector liberalization (Case 2) reduces the gain in agricultural exports for Argentina and Brazil relative to Case 1, while Mexico incurs increases in net agricultural imports. The removal of nonagricultural import barriers and, to a lesser extent, the elimination of agricultural support contribute to a deterioration of the industrial market economies' overall trade balances. With endogenous exchange rates, industrial market economy currencies are pressured to depreciate relative to other nations in order to offset the decline in the trade balance. Argentine, Brazilian, and Mexican currencies, therefore, appreciate by approximately 5 percent relative to the US dollar The agricultural competitiveness of these countries is diminished.

Table 2–Changes in the Value of Trade and Exchange Rates*

	Argentina	Brazil	Mexico
	– – *Percent change* – –		
Case 1:			
Agriculture	21	22	252
Nonagriculture	-3	1	0
Total	33	16	5
Case 2:			
Agriculture	9	4	-79
Nonagriculture	-23	-8	1
Total	0	0	0
Exchange Rates	5	6	5
Case 3:			
Agriculture	70	29	-828
Nonagriculture	0	0	0
Total	121	21	-19
Case 4:			
Agriculture	74	66	-188
Nonagriculture	-186	-136	4
Total	0	0	0
Exchange Rates	-2	-9	-11

*A minus sign represents depreciation relative to the dollar.

Analysis of global liberalization in agricultural commodities (Case 3) reveals export revenue gains for Argentina and Brazil of 70 and 28 percent, while Mexico's agricultural costs rise by over 800 percent.[4] The removal of taxes on producers, especially in Argentina, combined with higher world prices (relative to the preliberalization base), spurs increases in soyabean, sugar, and beef exports. However, increases in production and exports modify the world price increases (Table 1), indicating that these two Latin American countries' agricultural policies have some influence on world markets. As for Mexico, where agricultural policies tend to subsidize producers, particularly in grains and dairy, the removal of support reduces the implied domestic price, and the demand for imports rises.

In the all-sector global liberalization scenario (Case 4), Argentina and Brazil post agricultural trade balance gains of 74 and 66 percent, respectively, as the volume of soyabeans, sugar, dairy, and beef exports expand by a minimum of 60 percent. Eradication of the high levels of nonagricultural import protection encourages new nonagricultural imports and leads to a decline in the trade balance; and currency values depreciate (in contrast to case 2). The lower valued Brazilian and Argentine currencies reinforce the export-stimulating effect of removing these countries' agricultural producer taxes. For Brazil, particularly, this gain in agricultural export revenues is significantly larger than in agricultural trade liberalization (Case 3), due to the 9-percent exchange rate depreciation. Protection of the nonagricultural sector has generally represented a strong bias against agricultural exports.

When currency values are allowed to vary (Case 4), the Mexican peso depreciates 11 percent and net expenditures on agricultural imports are much smaller than in the fixed exchange rate case (Case 3). Moreover, Mexico registers a 140-percent rise in foreign exchange earnings from "other agricultural" goods (such as tomatoes and fresh vegetables) over the base period and becomes a net exporter of sugar.

Finally, a word about the rest of the world. The rest of the world improves its net export position in all agricultural goods except soyabeans and "other agriculture." This is not surprising since the rest of the world, in net terms, is assumed to have no trade barriers. With agricultural prices generally rising and perfect price transmission assumed, the rest of the world increases its agricultural production and decreases its consumption. The improved net trade position of the rest of the world, which is biased because of the lack of protection measures, enhances any decline or diminishes any improvement in other countries' commodity trade balances. In the global liberalization case, appreciation of the rest of the world's currency causes its exports to be higher priced in dollar terms and therefore mitigates some of the bias.

Conclusion

This paper illustrates the value of a broader approach to analyzing agricultural trade liberalization issues. Substantial differences for individual countries arise when results of an

industrial market economy liberalization scenario are compared with the results of a global liberalization scenario. Similarly, substantial differences arise when results of agricultural liberalization are compared with all-sector liberalization. The model indicates that these differences may be especially large for developing countries where the protection of the nonagricultural sector remains relatively high. Some of the main findings are:

1. Simultaneous reductions in agricultural and nonagricultural protection, allowing exchange rates to vary, tend to reinforce the upward pressure on agricultural prices that follows from agricultural liberalization.
2. For some countries—those that experience the largest exchange rate movements following all-sector trade liberalization, such as Brazil and Mexico—the two simulations produce significantly improved impacts on agricultural trade values relative to agricultural global liberalization.
3. Global liberalization relative to industrial market economy liberalization provides greater impetus to Argentine and Brazilian agricultural exports and Mexican imports. In general, developing countries that remove producer taxes (subsidies) could experience an expansion (contraction) of foreign exchange earnings from agricultural trade.

Notes

[1]Economic Research Service, US Department of Agriculture.

[2]In the second case, changes in trade protection are assumed to be able to change currency values depending on the elasticities of demand and supply for traded and nontraded goods. Since the elasticities approach does not consider a world with capital flows, the shock is implicitly assumed to have an impact only on the trade balance and not to induce changes in capital flows. Corden (1987) argues that the capital account depends on savings and investment decisions and he is ambiguous as to whether a capital-flows effect would obtain with implementation or removal of protection measures. While one could have arbitrarily selected to limit the *change* in the trade balance so that it did not always equal zero, no rigorous criterion to do so exists.

[3]Trade policy changes do not directly influence capital flows but do so indirectly in order to balance the trade account.

[4]Mexico's agricultural trade balance (net importer) is small, so even modest absolute changes in Mexican agricultural trade balance lead to large percentage changes.

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DISCUSSION OPENING—*Thomas W. Hertel* (Purdue University)

The authors have extended previous studies of agricultural trade liberalization by developing a global trade model with both farm and nonfarm sectors and with endogenous exchange rates. Most of the previous work in this area has either focused solely on agriculture or has treated the farm sectors in insufficient detail to allow anything to be concluded about the effects of agricultural trade liberalization. Krissoff and Ballenger's research thus focuses on an important gap, particularly since the current GATT negotiations are not limited to agriculture and many opportunities exist for trading reductions in nonfarm protection in one country for farm support cuts in another.

Some good reasons exist to explain the limited amount of work of this sort in the past. To do an adequate job on agriculture is difficult enough, let alone attempting to treat nonagricultural trade as well. In this regard, the authors have benefited by building upon the SWOPSIM framework developed by Vernon Roningen and his associates at USDA for the analysis of global agricultural trade. This assures a certain degree of comparability between their results and those of a wide range of global agricultural models. This is very important, since, as a consumer of this research, I am particularly interested in obtaining some general rules of thumb for adjusting the results of those models that do not treat nonagricultural sector liberalization and that assume fixed exchange rates.

As a fellow modeller, I am all too aware of how easy it is to criticize specific aspects of any ambitious modelling effort. To be constructive is much more difficult. What I will try to do here is identify some of this model's limitations—which should be borne in mind when interpreting the results.

First of all, the model used here is an equilibrium model. As such, it is more useful in understanding the basic market forces set in motion by a given policy change. It is appropriate for medium-run policy analysis, but not for shorter run prediction. In the short run, observed changes may well be dominated by disequilibrium forces.

Consider, for example, exchange rates. That they have been persistently in disequilibrium in many countries is well known. Furthermore, overvaluation of exchange rates often serves as an indirect tax on the agricultural sector. A recent study by Brandão and Carvalho for selected crops in Brazil indicates that this indirect effect can dominate the direct effects of farm policies. They conclude that, in the early 1980s, cotton and maize were subsidized through direct agricultural policies, but taxed when both direct and indirect effects are taken into account.

Given that we start off in a disequilibrium position, to which adjustment is still occurring, when we overlay a trade liberalization scenario, the observed changes in the exchange rate may be quite different from that simulated by a static equilibrium model.

A second qualification stems from the treatment of public policies in the model. The appropriate methodology for quantifying the effects of agricultural policies on quantities produced and consumed is the focus of considerable research by agricultural economists and a number of papers at this conference. I believe we are making progress—and that the price

wedges used for the industrial market economies in this paper are largely plausible in the direction and magnitude of their effects.

However, I am less comfortable with the treatment of policies in the rest of the world. In Brazil, for example, credit subsidies have historically been the dominant public expenditure on agriculture. But the evidence indicates that these subsidies have a relatively small impact on output, presumably because of the way in which they are administered. Treating the full amount of these subsidies as a marginal producer price enhancement thus considerably overstates their supply-inducing effects. A second example of such a limitation is the apparent absence of the Brazilian programme for encouraging the substitution of sugar-cane-derived alcohol for petrol. This has led to a massive increase in sugar cane acreage in Brazil—probably at the expense of other farm outputs.

A related concern has to do with the choices for aggregation across countries and commodities (which I recognize were largely dictated by limitations on length and research resources). The commodity aggregation scheme is motivated by industrial market economy production and public policies in agriculture. Thus, in the case of Mexico, for example, the residual "other agricultural" sector is three times as large as the remaining eight sectors. Similarly, when it comes to country aggregation, the residual "rest of the world" is a very large aggregate, which is assumed to be policy neutral with respect to world markets.

I do not have a problem with these research choices made by the authors. In fact, I think they have chosen quite wisely, given their constraints. However, all of this does lead me to prefer to focus on the industrial market economy liberalization experiments—cases 1 and 2 in their paper. Global liberalization exercises will become more credible as these authors and others in this field continue their research efforts.

These qualifications notwithstanding, the authors are to be congratulated for tackling a difficult but important problem. Furthermore, I believe they have succeeded in delivering a few handy rules of thumb for adjusting the results of existing agricultural trade liberalization studies. In particular, I conclude, after reading their paper, that those current studies that ignore nonfarm liberalization and exchange rate effects probably understate the upward farm price effects of industrial market economy trade liberalization. Since this upward movement in agricultural prices provides the main incentive for industrial market economies to include agriculture in future liberalization efforts, this is a conclusion that deserves further attention.

GENERAL DISCUSSION—*Terrence S. Veeman, Rapporteur* (Department of Rural Economy, University of Alberta)

The major concern raised in discussion from the floor was whether agricultural trade liberalization would be harmful to the less-developed countries. Given that world price levels for most agricultural commodities were predicted to rise with trade liberalization, fears were expressed that the import bill for the poor nations would rise initially or that several poor nations, especially net importers of food items, would have more difficulty in feeding their populations.

Discussion also focused on the particular conditions under which factor-biased (land-saving) technical change would lead to a lower factor share for a particular input—in this case, land; e.g., how output quantity or price changes were influencing the factor share going to land. Finally, interest was expressed in how policy reforms in the centrally planned economies, especially the USSR and China, might affect trade liberalization.

Participants in the discussion included D. Harvey, E. Liboreiro, S. Manzke, G. Peters, and I. Soliman.