# The Potential Benefits to LDCs of Trade Liberalization in Beef and Sugar by Industrialized Countries

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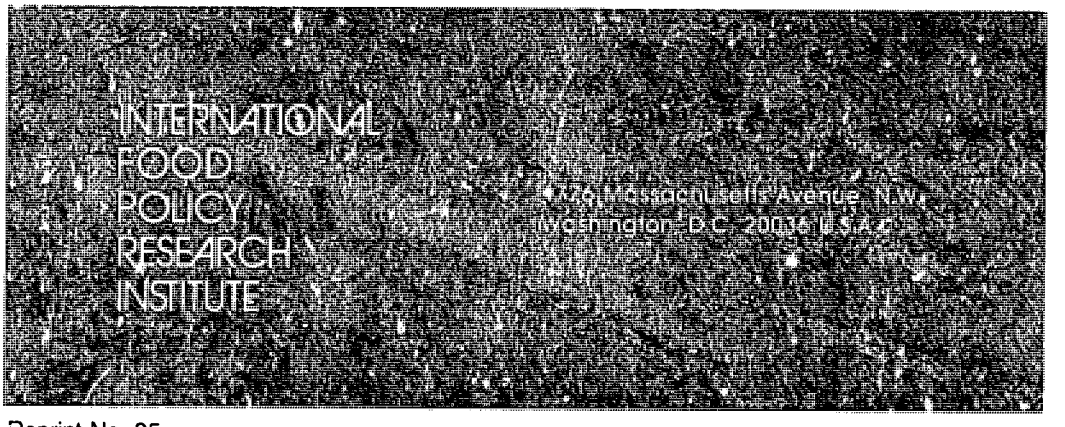


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# The Potential Benefits to LDCs of Trade Liberalization in Beef and Sugar by Industrialized Countries

By

**Joachim Zietz** and **Alberto Valdés**

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## I. Introduction

This study seeks to identify the potential change in welfare and foreign exchange earnings of less-developed countries assuming the group of industrialized countries eliminated their current trade barriers in sugar and beef. Complete removal of trade restrictions is considered to provide an order of magnitude estimate of the overall loss to developing countries of the current trade regime. Given the existence of product-specific equipment and human capital in the beef and sugar industry of industrialized countries, eliminating all trade barriers would certainly not be a short-run proposition but could probably only be effected step by step and over a longer period of time. Beef and sugar are selected for the analysis because they are among those commodities which are the most protected in many industrialized countries. This combined with the relatively large value of trade suggests that the potential gains developing countries could derive from trade liberalization in these two commodities may be particularly significant.

Of the previous studies in the area of agricultural trade liberalization, such as Valdés, Zietz [1980], Tangermann [1980], Koester, Schmitz [1982], Roberts [1982] or Anderson, Tyers [1983], most are either based on somewhat outdated protection levels and trade values or are not very comprehensive in their country coverage. Especially the former point has led some researchers [for example, Matthews, 1984] to doubt whether trade liberalization in temperate agricultural products would still seem advantageous to LDCs if more recent data were used for the analysis.

The purpose of this study is to suggest an answer to that question by using more recent data combined with a comprehensive country coverage. The basic framework of the study is a single commodity world market equilibrium

*Remark:* The authors would like to thank Ron Duncan and Sweder van Wijnbergen of the World Bank for helpful comments on an earlier version of the paper. Thanks also go to an anonymous referee for useful suggestions regarding exposition and interpretation. The usual disclaimer applies.

model. The analysis is comparative static in nature. The hypothetical case of a complete absence of tariffs and other non-tariff trade barriers in developed countries is compared with the current situation which is characterized by the existence of such impediments to trade. Post-liberalization quantities are estimated iteratively by inserting price elasticities of demand and supply in the behavioral equations and then searching for a world price increase that achieves post-liberalization equilibrium of world demand and supply. The calculations of changes in trade are based solely on domestic demand and supply elasticities. Export supply and import demand elasticities although implied are not utilized explicitly. This is to avoid a potential underestimation of the effect of trade liberalization due to values of pre-liberalization export and import quantities which are distorted by pre-liberalization barriers to trade.

The paper is organized as follows: The theoretical model is presented in the next section. it is followed by a short description of the data base. The results of the model simulations are discussed next. The paper ends with an overview of the main results.

## II. The Theoretical Model

A separate world market model is constructed for each of the two commodities being analyzed. Each model distinguishes four categories of countries, developed countries outside the European Community (DCs), the members of the European Community (EC), less developed countries (LDCs) and those countries not considered on an individual basis (ROW). Of the four country groups only the DCs and the EC-countries are assumed to remove their trade barriers. The level of protectionism in all other countries is held constant. The countries within each category are assumed to react according to the same behavioral postulates, although based on different parameter values. The behavioral postulates for each set of countries will be described next.

### 1. Developed Countries

In the pre-liberalization situation, the domestic commodity price ($p_0$) prevailing in a particular developed country can be related to the world market price prior to trade liberalization, $pw_0$, in the following way

$$(1) \qquad p_0 = pw_0\, r\, (1 + \tau)\, (1 + m)$$

where r is the market exchange rate, $\tau$ the ad valorem equivalent of a particular country's tariff and non-tariff barriers, and m a margin which incorporates insurance, freight, and marketing costs. Complete tariff elimination by all developed countries ($\tau = 0$) is assumed to change each country's

domestic price to

$$(2) \qquad p_1 = pw_1 \, r \, (1 + m)$$

where $pw_1$ is the world market price after the joint tariff reduction in all DCs. The exchange rate, r, and the marketing margin, m, are assumed to be unaffected by the changes induced by trade liberalization[1] If one expresses $pw_1$ in (2) as a function of the percentage change in world price ($p\hat{w}$) and $pw_0$, that is $pw_1 = pw_0 (1 + p\hat{w})$, then the percentage change in domestic price ($\hat{p}$) induced by trade liberalization can be written as[2]

$$(3) \qquad \hat{p} = |(1 + p\hat{w}) / (1 + \tau)| - 1$$

For a given percentage change in domestic price, consumption (C) and production (Q) in each DC are assumed to change according to the equations

$$(4) \qquad \Delta C = C_0 \, |(1 + \hat{p})^n - 1|$$

$$(5) \qquad \Delta Q = Q_0 \, |(1 + \hat{p})^\varepsilon - 1|$$

where $\Delta$ denotes absolute change and where n is the domestic price elasticity of demand and $\varepsilon$ the domestic price elasticity of supply[3].

The post-liberalization levels of net exports ($X_1$) and net imports ($M_1$) can be derived from the equation sets (6) and (7), respectively,

$$(6) \qquad \begin{cases} X_1 = (X_0 + \Delta Q - \Delta C) & \text{if } (\,.\,.\,) > 0 \text{ and } X_0 > 0 \\ X_1 = -(M_0 + \Delta C - \Delta Q) & \text{if } (\,.\,.\,.\,) < 0 \text{ and } M_0 > 0 \\ X_1 = 0 & \text{if } (\,.\,.\,.\,) > 0 \text{ and } M_0 > 0 \end{cases}$$

$$(7) \qquad \begin{cases} M_1 = (M_0 + \Delta C - \Delta Q) & \text{if } (\,.\,.\,) > 0 \text{ and } M_0 > 0 \\ M_1 = -(X_0 + \Delta Q - \Delta C) & \text{if } (\,.\,.\,.\,) < 0 \text{ and } X_0 > 0 \\ M_1 = 0 & \text{if } (\,.\,.\,.\,) > 0 \text{ and } X_0 > 0 \end{cases}$$

Both sets of equations assume perfect substitutability between domestic and foreign goods. They explicitly allow for a trade reversal. As is evident from (3), developed countries which are net-importers before liberalization could

[1] For developed countries, this assumption seems to be justified given the relatively small share of the two agricultural products under study in the total value of trade for all countries.

[2] In those cases, in which the price faced by consumers is substantially below the governmentally subsidized producer price, $\hat{p}$ is calculated separately for consumption and production, in each case using the appropriate protection level.

[3] Both elasticities are assumed to be constant. (4) is derived by first finding the rate of change of the exponential expression $C = Ap^n$, where A is a constant, as $\Delta C/C = [(p + \Delta p)^n - p^n]/p^n$ and by subsequently simplifying and solving for $\Delta C$. The derivation is analogous for (5). In contrast to the more common derivation based on calculus, (4) and (5) give the exact changes in C and Q, even for large variations in p.

become net-exporters after liberalization if the world price increase exceeds the pre-liberalization tariff equivalent τ. Similarly, net-exporting countries could turn net-importers if the tariff equivalent is sufficiently large relative to the increase in world price.

The EC is assumed to affect the world market only as a net trading entity, similar to a large country with several regions or states. To incorporate such an effect, the sum of net imports of all EC members are subtracted from the sum of net exports to arrive at EC net exports ($X_1^{EC}$) or EC net imports ($M_1^{EC}$). For each individual EC-member country, however, the calculations equal those described above for DCs.

## 2. Less Developed Countries

The quantitative effects of trade liberalization on the LDCs largely depend on the extent to which world price changes are transmitted to domestic producers and consumers. Following the literature on trade liberalization it is assumed that the level of protection remains the same in all non-liberalizing countries. For fixed exchange rates, this implies that the internal prices prevailing in LDCs change by the same percentage as the world market price. The precondition that the exchange rate is unaffected by the export and import changes induced by trade liberalization could be considered a problem. It may seem unrealistic for LDCs which rely heavily on one of the commodities under study for the bulk of their export earnings. Fortunately, this is not the case for any of the 58 LDCs explicitly considered in this study. Even if this were different, the exchange rate could still be unaffected if one assumes that the demand for imports is perfectly elastic, i.e. rationed.

For each LDC the response of consumption and production to an increase in the world price can be calculated by making use of (4) and (5), respectively, but replacing $\hat{p}$ with $p\hat{w}$[4]. Post-liberalization exports of LDCs are then given by the equations

$$
(8)\qquad
\begin{cases}
X_1 = X_0 + \Delta Q - \Delta C & \text{if } X_0 > 0 \\
X_1 = -(M_0 + \Delta C - \Delta Q) & \text{if } (\,.\,.\,) < 0 \text{ and } M_0 > 0 \\
X_1 = 0 & \text{otherwise}
\end{cases}
$$

Post-liberalization net-import levels are derived as

$$
(9)\qquad
\begin{cases}
M_1 = (M_0 + \Delta C - \Delta Q) & \text{if } (\,.\,.\,) > 0 \\
M_1 = 0 & \text{otherwise}
\end{cases}
$$

[4] The calculations differ somewhat for the case of African, Carribean, and Pacific (ACP) countries that are given special access to the protected market of the European Community. See the appendix for a treatment of this case.

Similar to the case of DCs, the above equations allow for a trade reversal from a net-importing to an net-exporting position. Unlike the behavior of DCs, however, LDCs which are net-exporters prior to trade liberalization will remain exporters[5].

For all LDCs the foreign exchange and welfare implications of trade liberalization by industrialized countries can be summarized as follows. The change in export revenue of exporting country i (ΔVX) and in import costs of country j (ΔVM) is

$$(10) \quad \Delta VX_i = (X_{1i}\, pw_1 - X_{0i}\, pw_0)\, \varphi_i$$

$$(11) \quad \Delta VM_j = (M_{1j}\, pw_1 - M_{0j}\, pw_0)\, \theta_j$$

respectively, where $pw_1$ represents the world price after trade liberalization. $\varphi_i$ equals the ratio of the export unit value of LDC i to the world price before liberalization[6]. $\theta_j$ is the ratio of the import unit value of country j to the world price prior to liberalization.

The welfare gain of trade liberalization to LDC exporter i can be approximated by[7]

$$(12) \quad \Delta WX_i = (pw_1 - pw_0)\, 0.5\, (X_{0i} + X_{1i})\, \varphi_i$$

Similarly, for importing LDC j, one can approximate the welfare loss incurred by the world price increase owing to trade liberalization as[8]

$$(13) \quad \Delta WM_j = (pw_1 - pw_0)\, 0.5\, (M_{0j} + M_{1j})\, \theta_j$$

## 3. Model Closure and Solution

Closure of the world market equilibrium model requires some assumptions regarding the behavior of those countries which are not explicitly modeled (ROM), i.e. the centrally planned economies (CPEs) and small developing countries (SDCs) with less than 5 million inhabitants. For this category of countries, the post-liberalization level of exports is derived as a weighted average of the export level of the group of CPEs and the group of SDCs as

[5] The situation is different for ACP countries.

[6] Since there does not exist a pre-liberalization export unit value for countries incurring a trade reversal, the regional average $\bar{\varphi}$ substitutes for $\varphi_i$.

[7] For developing countries with a trade reversal from a net-importing to a net-exporting status, (14) is replaced by an equation that calculates ΔWX as the sum of the welfare gain to producers and the welfare loss to consumers. See the appendix for details.

[8] For the case of beef, the determining equations of ΔVM and ΔWM have to be modified somewhat for certain developing countries. This is to account for some price distortions introduced into the beef market by the Australian export behavior. The authors thank Ron Duncan of the World Bank for pointing out this special case. Details are given in the appendix.

$$X_1^{ROW} = w\, X_0^{CPE} (1 + \varepsilon_X^{CPE}\, p\hat{w}) + (1-w)\, X_0^{SDC} (1 + \varepsilon_X^{SDC}\, p\hat{w})$$

where w is the pre-liberalization share of the centrally planned economies in the net-exports of the ROW category of countries and where $\varepsilon_x$ denotes the price elasticity of export supply. An analogous equation is utilized for post-liberalization imports ($M_1^{ROW}$).

The model is solved iteratively by searching for a value of the world price increase, $p\hat{w}$, which achieves post-liberalization equilibrium in the world market. Such an equilibrium is realized if the following equation holds

$$\sum_{DC} X_1 + \sum_{LDC} X_1 + X_1^{ROW} + X_1^{EC} = \sum_{DC} M_1 + \sum_{LDC} M_1 + M_1^{ROW} + M_1^{EC}$$

## III. Data

Two commodities are analyzed: total sugar measured in raw equ valents (FAO Trade Yearbook classification number 061) and beef and veal (FAO Trade number 011.1)[9]. The study explicitly incorporates all market-economy, less developed countries with a 1980 population of more than 5 million; the total is 58 countries. 17 OECD member countries are considered. All the remaining countries of the world, i.e. small market-economy, developing countries (SDCs) as well as centrally planned economies (CPEs), are lumped together in a category identified as Rest of the World (ROW).

Data on domestic production ($Q_0$), consumption ($C_0$), net-exports ($X_0$), and net-imports ($M_0$) are taken from the Preliminary Food Balance Sheets of the Food and Agriculture Organisation of the United Nations. The figures are averages for the years 1979-1981.

The pre-liberalization world market price ($pw_0$) in 1980 U.S. dollars equals the average deflated world export unit value for the years 1979-1981. The value of $pw_0$ for sugar is derived by excluding Cuba and the major ACP exporters of sugar[10] from the value and quantity of world exports. Cuba is excluded from the calculations because it is exporting most of its sugar to the Soviet Union at prices far in excess of those found in the "free market". A similar argument can be made for the ACP countries, which are selling under a preferential quota system on the high-price European market. Because detailed country data on sugar exports are lacking for 1983, the same method could not be used for that year. Instead, the world price of sugar for 1983 was derived from its 1979-1981 average, multiplied by the factor 0.54.[11] The

[9] A more detailed description of the data base as well as tables of the basic input data can be found in Zietz, Valdés [1986].

[10] The following ACP countries are excluded from the calculation of the world export unit value: Barbados, Fiji, Guyana, Jamaica, Mauritius, Trinidad and Tobago.

[11] This factor results if one divides the average deflated export unit value of Brazil, the Dominican Republic, and the Philippines, for 1979-1981, into the corresponding average for 1983.

1979–1981 prices which are used for the term $pw_0$ throughout the study are \$ 396.7 and \$ 2513.7 for total sugar and beef and veal, respectively. The 1983 value of $pw_0$ for sugar is \$ 214.2. All prices are expressed in 1980 U.S. dollars per metric ton. For each commodity and LDC, unit values of trade are simple averages of the deflated unit values of the years 1979–1981. The raw data come from the 1981 FAO Trade Yearbook. Average regional unit trade values are substituted whenever a country's trade value was judged unreliable because of a very small level of trade. Lack of data made it necessary to construct the 1983 export and import unit values of sugar from their average 1979–1981 levels.

Values for domestic demand and supply elasticities are taken from the following sources: Askari, Cummings [1976], Caspari *et al.* [1980], Koester, Schmitz [1982], Stern *et al.* [1976], Tyers [1982], Tyers, Anderson [1983], and Valdes [1975]. In all cases where country estimates could not be obtained from the above sources default values were substituted similar to those values available. The elasticity assumptions are summarized in Tables 1 and 2 for the sugar and beef models, respectively. They all represent long-run elasticities.

As a check on the sensitivity of the results with respect to the assumed supply elasticities, four alternative model runs are reported for the sugar model, two for the beef model. The first alternative model simulation for sugar, identified as Sugar2, uses a supply elasticity of 0.06 rather than 0.6 for all EC member countries. This simulation reflects the view that sugar production in the EC would actually react very little if at all to a removal of trade barriers. A second alternative model run is based on the opposite

Table 1 – *Price Elasticities of Domestic Supply and Demand for Sugar*

| Country or country group | Supply elasticities | | | | Demand elasticities |
|---|---|---|---|---|---|
| | Sugar1 | Sugar2 | Sugar3 | Sugar4 | |
| LDCs | | | | | |
| Sub-Sahara Africa | 0.6 | 0.6 | 0.6 | 1.2 | - 0.4 |
| Asia | 0.6 | 0.6 | 0.6 | 1.2 | [- 1.75; - 0.4] |
| North Africa/ Middle East | 0.6 | 0.6 | 0.6 | 1.2 | [- 0.8; - 0.4] |
| Latin America | 0.6 | 0.6 | 0.6 | 1.2 | [- 0.6; - 0.4] |
| DCs except Australia | 0.6 | 0.6 | 4.0 | 0.6 | [- 1.0; - 0.25] |
| Australia | 0.6 | 0.6 | 0.6 | 0.6 | - 0.39 |
| EC | 0.6 | 0.06 | 6.0 | 0.6 | [- 0.85; - 0.24] |

*Note*: Sugar1 to Sugar4 identify alternative model runs. The demand elasticities are not varied between these model runs. The numbers in brackets give the range of elasticities within a country group

Table 2 – *Price Elasticities of Domestic Supply and Demand for Beef*

| Country or country group | Supply elasticities | | Demand elasticities |
|---|---|---|---|
| | Beef1 | Beef2 | |
| LDCs | | | |
| Sub-Sahara Africa | 0.4 | 0.4 | - 0.4 |
| Asia | [0.38; 1.0] | [0.38; 1.0] | [- 1.0; - 0.4] |
| North Africa/ Middle East | 0.4 | 0.4 | - 0.4 |
| Latin America | [0.6; 1.0] | [0.6; 1.0] | [- 0.5; - 0.4] |
| DCs except Japan | [0.35, 0.5] | [0.35, 0.5] | [- 1.2; - 0.4] |
| Japan | 0.8 | 0.4 | - 1.2 |
| EC | [0.62; 1.02] | 0.4 | [- 1.7; - 0.37] |

*Note:* Beef1 and Beef2 identify alternative model runs. The demand elasticities are not varied between these model runs. The numbers in brackets give the range of elasticities within a country group.

assumption that sugar production in the EC as in all developed countries would react very sharply to an elimination of trade barriers. For that purpose, the supply elasticity of all EC member countries is raised to 6.0. A supply elasticity of 4.0 is assumed for all other developed countries with significant protection levels, which includes all producers with the exception of Australia. For a third alternative model run, the supply elasticity of all LDCs is doubled from 0.6 to 1.2. The higher supply elasticity is meant to incorporate the possibility that a removal of all trade barriers in developed countries could effectively eliminate the consequences of what may be called "export pessimism" of developing countries[12] and spark a considerable expansion of the sugar industry in LDCs, at least in the longer run. The long-run supply elasticities of beef for Argentina, Brazil, Chile, Colombia, and Venezuela are adapted from Valdés [1975], whose estimates are close to 1.5. Thus the value of 1.0 used in this study is rather conservative. For an alternative run of the beef model, identified as Beef2 in Table 2 , the somewhat more conservative value of 0.4 is substituted for the supply elasticities of all EC member countries and Japan.

The calculation of post-liberalization export and import levels of the ROW category of countries requires a value for the share of the centrally planned economies in the net-exports and net-imports of the ROW countries. These market shares are derived from the export and import data reported in the FAO Preliminary Food Balance Sheets. All Eastern European countries as

[12] See also Peterson [1979] for a strong argument in favor of an aggregate supply elasticity around 1.2 for developing countries.

well as the USSR are included in the CPE category. The import demand elasticity for beef for the USSR as reported by Tyers [1982], – 0.46, is assumed to represent the corresponding elasticities for the CPEs as a whole. The corresponding elasticity for sugar is set at – 1.0. The export supply elasticity of the CPE countries is assumed to be 1.0. A corresponding value for sugar is not needed because the export share of CPE countries is zero for this commodity. The trade elasticities for the SDC's are calculated as a weighted average of the trade elasticities of those LDCs which are explicitly considered in the study and which have no more than 8 million inhabitants[13]. The trade elasticities of the LDCs included in the study are derived using the well known excess demand elasticity formulas for import demand and export supply.

Ad valorem equivalents of tariff and non-tariff trade barriers are derived from a comparison of domestic wholesale prices and the corresponding import unit values or border prices for each trade liberalizing country and commodity[14]. The calculations are based on the nominal protection coefficient (NPC), 1 + t, which is defined as the ratio of the domestic to the c.i.f. or border price with both prices expressed in the same currency units. Wherever necessary, a distinction is made between the protection afforded to producers and the level of protection relevant to consumers.

## IV. Results

Table 3 provides an overview of the effects on LDCs[15] of a complete removal of trade barriers for sugar and beef by developed countries. It also gives the model's predictions of the changes in the world market price and in world exports. World exports are defined as the sum of the net-exports of all exporting countries. Several results are presented for each of the two commodities analyzed in this study. Superscripts identify alternative sets of elasticity assumptions which were summarized in Tables 1 and 2. Sugar83 stands for the model runs with 1983 protection levels for sugar.

For the model simulations based on 1979–1981 protection levels, the sugar price increases predicted by the model are roughly between 13 and 30 percent depending on the assumptions used. The percent increases are quite sensitive to the underlying domestic supply elasticities. As can be expected, the world price is predicted to rise the most if the trade liberalizing countries are assumed to have a very high price elasticity of supply. Doubling instead

[13] If larger LDCs were included, the weighted trade elasticities would likely be inflated because of the generally large trade elasticities of large countries.

[14] The world price, $pw_0$, is not used for the calculation levels because it does not allow for differences in transport costs or the composition of imports from country to country. The latter is very relevant since the commodity definitions used in this study are quite broad.

[15] Unless otherwise noted, "LDCs" refers to those 58 LDCs included in the study.

Table 3 - *Effect of Trade Liberalization on World Price and Export Quantity, Trade Values and Welfare of LDCs*

| | Change in | | Absolute change in LDCs | | | |
|---|---|---|---|---|---|---|
| | world price | world exports | foreign exchange earnings | welfare (exporters only) | import bill | net welfare |
| | percent | | 1980 U.S.$ bill. | | | |
| Sugar[1] | 16.7 | 12 | 2.75 | 0.60 | - 0.33 | 0.08 |
| Sugar[2] | 13.6 | 10 | 2.19 | 0.46 | - 0.31 | 0.03 |
| Sugar[3] | 29.4 | 31 | 5.11 | 1.25 | - 0.42 | 0.39 |
| Sugar[4] | 12.9 | 17 | 3.04 | 0.49 | - 0.48 | 0.09 |
| Sugar83[1] | 39.7 | 45 | 4.15 | 1.06 | - 0.28 | 0.46 |
| Sugar83[2] | 33.1 | 36 | 3.38 | 0.82 | - 0.24 | 0.30 |
| Sugar83[3] | 64.5 | 75 | 7.39 | 2.15 | - 0.35 | 1.27 |
| Sugar83[4] | 29.2 | 56 | 4.61 | 0.86 | - 0.43 | 0.44 |
| Beef[1] | 18.5 | 168 | 5.10 | 0.54 | - 0.33 | 0.32 |
| Beef[2] | 16.2 | 143 | 4.38 | 0.43 | - 0.28 | 0.22 |

*Note*: Superscripts refer to various assumptions with respect to the supply elasticities. Details are given in the text. World exports are defined as the sum of net-exports of all net-exporting countries.

the domestic supply elasticities of all LDCs to 1.2 raises the world price by only 13 rather than by almost 30 percent. When 1983 protection levels and prices are utilized for the model runs[16], the percentage changes in world price are more than twice as large as for the 1979–1981 protection levels. The percentage changes in world exports are for the most part three times as large. In light of the historical record of sugar prices and protection levels, one can think of these results as representing an upper limit of the potential changes brought about by trade liberalization in sugar.

When compared to sugar, the percentage changes of world beef exports are predicted to increase dramatically. World exports more than double as a result of trade liberalization by OECD countries. Reducing the domestic supply elasticities of both the EC countries and Japan does not seem to change the conclusions to any appreciable degree.

The third column of Table 3 presents the predicted changes in foreign exchange earnings of LDCs. For the benchmark elasticity runs of the model and 1979–1981 protection levels, an increase of approximately U.S.$ 8 billion per year is predicted for the two commodities. This value is expressed in 1980

[16] For lack of a consistent data set on 1983 quantities, 1979–1981 quantities were used for the calculations. For those LDCs outside of the EC, lack of adequate data made the derivation of the 1983 protection levels rather tentative. 1983 export and import unit values of LDCs had to be derived from their 1979–1981 levels by means of a conversion factor.

U.S. dollars. Hence, the equivalent figure in 1984 dollars would exceed 11 billion. The change in welfare of LDC exporters is only a fraction of the foreign exchange increase. Its ratio to the change in foreign exchange earnings varies between 0.1 and 0.29, which reflects the different implicit export supply elasticities for the two commodities. The relatively low figures for the welfare gain of LDCs represent conservative estimates. They result from two important assumptions. First, as already pointed out, it is assumed that the terms of trade of other commodities remain constant. This seems reasonable given the state of foreign exchange rationing in many developing countries. Second, it is assumed that the exchange rate is not overvalued in developing countries[17]. As Chenery [1953] has pointed out, changes which generate foreign exchange yield more welfare than changes of similar magnitude in domestic currency equivalents if the exchange rate is overvalued. Hence, if one knew the degree to which the exchange rate is "unrealistic", the welfare changes could be corrected for the fact that foreign exchange is at a premium. Lack of consistent data for all of the 58 LDCs included in this study precludes this option. As a consequence, it seems that the predicted change in foreign exchange earnings may be a more useful indicator from the standpoint of policy recommendation.

For both beef and sugar, the predicted increase in world price results in an absolute decrease in the value of LDC imports because of an elastic import demand elasticity for LDCs as a whole. The reduction in the import bill, although equivalent to a saving of foreign exchange, causes a welfare loss to LDCs. This is evident from the low values of the net welfare change in the last column of Table 3.[18] Beef is the commodity for which the difference between gross and net welfare changes is smallest, both in absolute and percentage terms, the reason being that LDCs as a group import less than 20 percent of all beef entering world trade.

As already mentioned, the study includes explicitly only developing countries with a minimum of 5 million inhabitants in the base period. Many large sugar producers, however, can be found among those countries that are excluded from this study because of size. It also happens that most of these producers are exporting a considerable portion of their production under a preferential quota system to the European Community. Among this group of ACP countries are such large sugar producers as Mauritius, Guyana, Fiji, Swaziland, Jamaica, and Trinidad. A removal of all trade barriers would eliminate their monopoly rents, which they currently derive from selling their exports to the EC at internal EC prices. From data for 1978/79, Schmitz and Koester [1981] estimate that the foreign exchange equivalent of the mono-

[17] The authors thank an anonymous referee for this point.

[18] The change in net welfare is calculated as the difference between the welfare increases enjoyed by LDC exporters and the welfare losses incurred by LDC importers.

poly rent for the six countries mentioned above is about U.S.$ 380 million[19]. Given rather similar protection levels of the European Community for 1978/79 and 1983, this figure gives some indication of the likely overestimate of the foreign exchange gains of LDCs for the year 1983. The figure for the average of 1979–1981 should be somewhat smaller as a result of the smaller differences between internal EC prices and the world market price for that time period. Of the countries included in the study, several also belong to the ACP group, namely Kenya, Madagascar, Tanzania, Uganda, and India. However, for the case of sugar none of them is actually treated as an ACP country along the lines discussed in the appendix. In the case of beef, only two countries, Kenya and Madagascar, met the conditions explained in the appendix which call for special treatment of ACP countries.

When we compare the results in Table 3 with the findings of other studies, problems arise because of differences in commodity definitions, base years, the calculation of protection levels, or the general focus of studies. Hence the following comparisons are only approximate. The long-run steady-state results reported by Anderson and Tyers [1983] are similar in spirit to the comparative static results of this study. Furthermore, they choose 1980 as their base year, which is very close to the average of the years 1979–1981 utilized in the current study. They report a world price increase for ruminant meat of 16 percent, a number reasonable similar to those of Table 3. The export increase of 3.9 million tons for ruminant meat reported by Anderson and Tyers is similarly close to the 3.7 million tons found for the benchmark elasticity run in the current study. In a recent study for FAO, Tangermann [1980] constructs a model of the world beef market. According to his calculations, a complete removal of trade barriers would result in a world price increase of 47 percent, a value considerably above those reported in Table 3. In addition, Tangermann estimates that world exports would increase by 300 percent, which is about twice the size of the values found in this study. One reason for the very large percent changes predicted by Tangermann is his assumption that trade barriers are not only removed in OECD countries but also in certain developing countries with high protection levels, such as the Republic of Korea. In comparing the current results with those of Valdés, Zietz [1980], one has to keep in mind that the authors' 1980 study is based on data for the years 1975–1977. In any case, the projected increases in LDC export earnings from trade liberalization in sugar are quite similar in the two studies, around U.S.$ 3 billion in 1980[20]. The increase in LDC export earnings calculated for beef, however, are from six to seven times

[19] The figures from the authors' Table 14 are converted into 1980 U.S. dollars using the 1978 $/Ecu exchange rate and the world wholesale price index from *International Financial Statistics*.

[20] This takes into account the different assumptions regarding the percentage reduction in tariffs between the two studies.

Table 4 - *Absolute and Relative Size of Foreign Exchange Gains of LDCs*

| | Foreign exchange | | LDC foreign exchange gains as percent of | | | |
|---|---|---|---|---|---|---|
| | absolute increase (U.S.$ bill.) | percent change | gains by DCs | average 1979-1981 OECD aid | official aid to agriculture | 1979-1981 cereal imports |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Sugar[1] | 2.75 | 103 | N | 11 | 25 | 17 |
| Sugar[2] | 2.19 | 83 | N | 9 | 20 | 14 |
| Sugar[3] | 5.11 | 192 | N | 20 | 47 | 32 |
| Sugar[4] | 3.04 | 115 | N | 12 | 28 | 19 |
| Sugar83[1] | 4.15 | 289 | N | 16 | 38 | 26 |
| Sugar83[2] | 3.38 | 236 | N | 13 | 31 | 21 |
| Sugar83[3] | 7.39 | 516 | N | 29 | 67 | 46 |
| Sugar83[4] | 4.61 | 322 | N | 18 | 42 | 29 |
| Beef[1] | 5.10 | 533 | 82 | 20 | 46 | 32 |
| Beef[2] | 4.38 | 458 | 85 | 17 | 40 | 27 |

*Note*: Superscripts refer to various assumptions with respect to the supply elasticities. Details are given in the text. Sugar83 stands for the results based on 1983 protection levels. DCs in column (3) exclude the EC. The average development aid of OECD countries used in column (4) is from The World Bank [1985, p. 182]. Official aid to agriculture in column (5) refers to total official 1980 aid commitments, not disbursements, to Food and Agriculture. The raw data is from OECD [1985, p. 158]. The average 1979-1981 cereal import bill in column (6) is from FAO [1984]. It refers to imports of market economy LDCs. The individual year figures are deflated by the world wholesale price index from IMF [1984]. "N" indicates that the share going to developed countries is negligible.

greater in the present study than they are in the 1980 study, making beef rather than sugar the more promising candidate for trade liberalization.

Table 4 demonstrates the relative significance to LDCs of the foreign exchange earnings reported in Table 3. Column (2) relates the absolute increases in export earnings to their pre-liberalization levels. For both commodities, the percentage changes are quite substantial, especially for beef. Column (3) shows how LDCs would benefit from trade liberalization relative to developed countries. For sugar, almost all of the potential gains of trade liberalization go to LDCs. The only developed country also benefitting from trade liberalization in sugar is Australia. All other developed countries lose because of high current levels of protection. Trade liberalization in beef and veal, however, increases export earnings about equally for developed country exporters and LDCs. Among the developed countries, Australia and the United States have by far the most to gain from trade liberalization in beef.

Columns (4) and (5) of Table 4 compare the potential foreign exchange gains of LDCs to the inflow of official development aid. For sugar and beef together, the potential increase in LDC export earnings amounts to one

quarter of total average OECD aid for the years 1979–1981 if the calculations are based on the most conservative assumptions. The percentage rises to almost 50 percent if one assumes a strong supply response of developed countries. If the predicted increase in LDC export earnings is related to total 1980 aid commitments to food and agriculture, one can find percentages in the range from 60 to almost 120 percent depending on the assumptions. Even though the ratios in both columns (4) and (5) seem quite high as they are, they are likely to be underestimated. This is due to the fact that the foreign exchange earnings of the 58 LDCs included in the present study are compared to the development aid pledged to *all* LDCs. A similar argument applies to column (6) which relates the predicted change in the foreign exchange earnings of the 58 LDCs of this study to the cereal import bill of all LDCs classified as market economies by FAO.

The considerable increases in LDC export earnings reported in Tables 3 or 4 do not imply that all less-developed countries share equally in absolute or relative terms in the gains from trade liberalization. This fact is supported by Table 5, which lists the LDCs most affected in absolute terms. From this table, we see that, in absolute terms, the potential gains associated with trade liberalization are heavily concentrated among a few large LDCs. For the commodities under study, Argentina, Brazil, and India seem to benefit by far the most. For sugar, about two thirds of the total change in LDC export earnings accrues to three countries. For beef, this share rises to more than three quarters. Despite these large gains of a few countries, many smaller LDCs can also expect substantial increases in foreign exchange. For many of them, the relative changes are substantially greater than those for the large countries of Table 5. Moreover, a considerable number of countries turn into exporters as a result of trade liberalization[21]. In the case of sugar, i.e. model assumptions Sugar1 in Table 1, and 1979–1981 protection levels, it is 22 percent of all LDCs that are net-importers prior to liberalization. In the case of beef, i.e. model assumptions Beef1 in Table 2, even 46 percent of LDCs experience a trade reversal.

Looking at the regional distribution of the gains from trade liberalization, Asia and Latin America could expect about equal shares in the case of sugar. Sub-Sahara Africa and, especially, North Africa/Middle East, however, would be net losers in terms of welfare. For beef, the potential gains are almost exclusively concentrated in Latin America, at least in absolute terms. All other regions suffer net-welfare losses although they are rather small in the case of Sub-Sahara Africa. The latter region can increase its foreign exchange earnings by more than 200 percent, albeit from a low initial level. A similar result applies in the case of North Africa/Middle East and Asia.

[21] For more details on these last points, the interested reader is referred to appendix B of Zietz, Valdés [1985] which provides individual country results for all model runs based on benchmark elasticity assumptions.

Table 5 – *Countries Most Affected by Trade Liberalization (1980 U.S.$ mill.)*

| Countries gaining | Increase in foreign exchange earnings | Increase in net welfare | Countries losing | Loss in net welfare |
|---|---|---|---|---|
| | | *Sugar* | | |
| India | 988 | 90 | Nigeria | 63 |
| Brazil | 617 | 177 | Korea Rep. | 56 |
| Philippines | 201 | 83 | Iraq | 42 |
| | | *Sugar85* | | |
| India | 1,263 | 202 | Nigeria | 77 |
| Brazil | 863 | 280 | Korea Rep. | 70 |
| Philippines | 275 | 120 | Iraq | 52 |
| | | *Beef* | | |
| Argentina | 2,233 | 311 | Egypt | 91 |
| Brazil | 1,370 | 97 | Iran | 29 |
| Colombia | 404 | 37 | Saudi Arabia | 20 |

*Note:* The results refer to the benchmark elasticity runs of the model.

## V. Conclusion

This study has analyzed the potential benefits to LDCs of trade liberalization in beef and sugar by the major industrialized countries. As the results suggest, trade liberalization in sugar and beef seem to be very much in the interest of LDCs. For both commodities together, a complete removal of barriers to trade could result in net welfare gains of U.S.$ 250 million to more than U.S.$ 1.5 billion per year depending on the underlying assumptions[22]. The corresponding increase in foreign exchange earnings could be anywhere from U.S.$ 6.6 billion to more than U.S.$ 12 billion per year, again depending on the assumptions regarding supply elasticities and protection levels. For just two commodities, these numbers are very large, not only in absolute terms but also when compared to the pre-liberalization export earnings of LDCs or the flow of development aid to LDCs.

Trade liberalization in sugar would benefit almost exclusively LDCs. Only a fraction of the total increase in export earnings is predicted to be captured by developed country exporters. This is somewhat different for beef, for which total benefits, if measured in terms of foreign exchange, are split about equally among DCs and LDCs. As for the regional distribution of benefits, both Latin America and Asia could expect about half of total LDC foreign exchange increases resulting from trade liberalization in sugar. Latin America has the

[22] All value terms are expressed in 1980 dollars.

most to gain from a removal of tariffs on beef. It would capture 92 percent of the foreign exchange gains going to LDCs. The countries of North Africa/ Middle East are likely to suffer a net-welfare loss from trade liberalization in both sugar and beef. Sub-Sahara Africa could expect to realize substantial percentage increases in foreign exchange earnings.

Overall, the predicted gains to LDCs from trade liberalization in beef and sugar are quite substantial. They certainly do not support some recent pessimistic appraisal of the potential benefits of trade liberalization in temperate zone agricultural products [Matthews, 1984]. Also, in putting the reported results in the proper perspective, one has to take into account that, for the most part, the reported results have to be interpreted as static gains or losses. Some rudimentary effort has been made to capture at least part of what may be called "dynamic gains" through the use of larger supply elasticities for LDCs in alternative model runs. However, it is unlikely that all of the potential benefits of trade liberalization to LDC's are captured by these model simulations. As pointed out by Valdés, Zietz [1980], "permanently reducing trade barriers would lead the LDCs to develop new export products, including the expansion of their own processing operations. In addition, it would probably encourage LDCs to concentrate more resources on increasing agricultural production". Trade liberalization is, in other words, likely to break the current climate of "export pessimism" which inhibits the adoption of export-oriented policies in the agricultural sector. As a consequence, the overall development performance of many LDCs could be expected to improve perceptively.

## Appendix

### The Special Case of ACP Countries

ACP countries currently sell part of their exports to the European Community at a price substantially above that realized by non-ACP exporters. For these countries a removal of all EC trade barriers would imply a price change that is different from $p\hat{w}$. The relevant percentage change in price for ACP country i, $p\hat{w}_i$, is given by

$$(A1) \quad p\hat{w}_i' = (\bar{\varphi}\, pw_i - p_{oi}^{\wedge})/p_{oi}^{\wedge} \qquad \text{if} \quad \bar{\varphi}\, pw_0 < p_{oi}^{\wedge}$$

$$p\hat{w}_i' = p\hat{w} \qquad \text{otherwise}$$

where $p_{oi}^{\wedge}$ is the pre-liberalization export unit value of country i and where $\bar{\varphi}$ is defined as the average regional value of $\varphi_i$, i.e. the ratio of export unit value and world price prior to liberalization. To relate $p\hat{w}_i'$ to $p\hat{w}$, (A1) can be rewritten as

$$p\hat{w}_i' = (\bar{\varphi}/\varphi_i)\,(1 + p\hat{w}) - 1$$

The "if" condition attached to (A1) implies that ACP countries are only treated differently from other LDCs if their pre-liberalization export unit value exceeds the average export unit value of other exporters in the region. This implies that a particular ACP country has to actually sell more than just a small fraction of its exports under a preferential quota system to receive special treatment in this study.

For the calculation of the changes in consumption and production, $p\hat{w}_i^I$ simply replaces $\hat{p}$ in (4) and (5), respectively. Given $\Delta C$ and $\Delta Q$, the post-liberalization levels of exports and imports of ACP countries are derived as described for other LDCs in the text. However, unlike the countries not belonging to the ACP group, it is quite possible for ACP countries to experience a trade reversal from a net-exporting to a net-importing status. In that sense, the behavior of ACP countries resembles that of DCs. The equations used are analogous to those of the regular trade reversal case of LDCs[23].

## Welfare Calculations in Case of Trade Reversal

For developing country i with a trade reversal from a net-importing to a net-exporting status, the change in welfare is derived by the equations

$$\Delta WX_i = 0.5\ [(\bar{\varphi}\ pw_i - p_{Xi}^I)\ X_{1i} - (p_i^I - p_{0i}^M)\ M_{0i}]$$

$$\Delta WM_i = 0$$

where $p_i^I$ is the price at which a trade reversal would occur in terms of import unit values; $p_{Xi}^I$ the corresponding price in terms of export unit values; $p_{0i}^M$ the import unit value prior to liberalization. $p_{Xi}^I$ is related to $p_i^I$ by the equation

$$p_{Xi}^I = p_i^I\ (pw_0\ \bar{\varphi}/p_{0i}^M)$$

The determining equation of $p_i^I$ is found by setting domestic production, $Ap^e$, equal to domestic consumption, $Bp^n$, and solving for p. The values of the constants A and B are derived for each country on the basis of pre-liberalization consumption, production and import unit values.

## Modifications of the Beef Model due to Australian Export Behavior

Since Australian exporters of beef earn quota rights to the U.S. market by selling beef to developing countries under world market level, many importing LDCs outside Latin America can buy beef at artificially low prices.

[23] See Zietz, Valdes [1986] for further details and also how to combine the special case of ACP countries with the one relating to Australian beef exports.

Trade liberalization is likely to eliminate these rents thus forcing developing countries to buy at world market prices. To incorporate this loss of rents of beef importing LDCs the determining equations of ΔVM and ΔWM have to be modified somewhat. For country j outside the ACP group of countries and Latin America, the change in the import bill is calculated as

$$\Delta VM_j = M_{1j}\, pw_1 - M_{0j}\, p_{0j}^M$$

if $pw_0 > p_{0j}^M$ holds[24]. If this last condition is not satisfied for country j, it is assumed not to benefit from sales of Australian beef below world market price in the pre-liberalization period. As a consequence, the change in its import bill is derived as discussed in the text. Similarly, the change in welfare of LDC beef importer k is

$$\Delta WM_k = -0.5\,(pw_1 - p_{0k}^M)\,(M_{0k} + M_{1k})$$

if $pw_0 > p_{0k}^M$. Again, in case the latter condition does not hold, the corresponding equations of the general case apply.

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[24] The determining equation for ΔVM implies that LDCs are forced to import at the world market price in the post liberalization period, irrespective of possible differences in transportation costs, quality and the like. This simplifying assumption is likely to overestimate the losses which would be incurred by LDCs due to a discontinuation of cheap Australian beef exports.

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Zusammenfassung: Vorteile der Entwicklungsländer aus einer möglichen Handelsliberalisierung für Rindfleisch und Zucker in den Industrieländern. – Die Studie geht von der Annahme aus, daß die Gruppe der Industrieländer ihre gegenwärtigen Handelshemmnisse für Zucker und Rindfleisch aufhebt, und versucht zu ermitteln, welche potentiellen Änderungen an Wohlfahrt und Devisenerlösen sich daraus für die Entwicklungsländer ergeben. Grundlage ist ein komparativ statisches Gleichgewichtsmodell für den Weltmarkt eines Gutes. Die Ergebnisse deuten darauf hin, daß die Entwicklungsländer für beide Produkte zusammengenommen eine Steigerung ihrer Devisenerlöse um 6,6 bis über 12 Milliarden US Dollar pro Jahr (auf der Basis von 1980) erwarten können. Das ist nicht nur absolut oder relativ sehr viel, sondern auch im Vergleich zu der laufenden Entwicklungshilfe.

Resume: Bénéfices potentiels des PVD à cause d'une libéralisation de commerce en viande de boeuf et sucre par les pays industrialisés. – Cette étude essaie d'identifier le changement potentiel de bien être et des revenus en devises des PVD en supposant que le groupe des pays industrialisés éliminent leurs obstacles commerciaux actuels pour la viande de boeuf et le sucre. Le cadre essentiel est un modèle du type comparatif statique d'équilibre

de marché mondial d'un seul bien. Les résultats suggèrent que pour les deux biens ensemble les PVD pourraient attendre une augmentation des revenus en devises entre 6,6 et plus que 12 milliards US $ par annee (base 1980): un montant très grand non pas seulement en terme absolu ou relatif mais aussi en comparaison avec l'aide de développement pour les PVD.

Resumen: Los beneficios potenciales de la liberalización de las importaciones de carne y azúcar en los países industrializados para los países en desarrollo. - Este trabajo intenta estimar el cambio en el bienestar y en el ingreso de divisas de los países en desarrollo, asumiendo que el grupo de países industrializados elimina las barreras al comercio actualmente vigentes para el azúcar y la carne. El marco teórico lo constituye un modelo de equilibrio de mercado para una materia prima de tipo comparativo-estático. Los resultados sugieren que para ambas materias primas los países en desarrollo podrían registrar un aumento en le ingreso de divisas entre 6,6 y 12 mil millones de dolares por año (a precios de 1980). Estas cifras no solo son muy altas en terminos absolutos o relativos, sino también si se las compara con los flujos de la ayuda al desarrollo.

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