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# 10

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# The UNCTAD Integrated Program: Earnings Stabilization Through Buffer Stocks for Latin America's Commodities

In Latin America there is a long history of preoccupation about the impact of fluctuations and secular trends in international primary commodity markets on the domestic economies of producing nations. In Chapter 9, Lord has reviewed the recent Latin American primary commodity export experience and concludes that for a number of Latin American countries this history provides a justification for interest in international stabilization schemes for primary commodities.[1] It is not surprising, therefore, that there has been substantial Latin American support for coordinating efforts among developing nations to improve the functioning of these international primary commodity markets as part of the call for a new international economic order.[2]

The framework for the currently ongoing exploration of new international commodity market arrangements has been established by the UNCTAD IV (1976a, 1976b) proposal and resolution at the Nairobi meetings. The original UNCTAD proposal focused on ten core commodities: cocoa, coffee, copper, sugar, cotton, jute, rubber, sisal, tea, and tin. Several other commodities are also mentioned. Emphasis is on price stabilization and on increasing the real returns among developing country exporters. The UNCTAD proposal is called an integrated commodity program. The main feature of integration is the proposed establishment of a six-billion dollar common fund that would provide financing for the various individual commodity agreements and which would fulfill a catalytic role in stimulating the exploration of new commodity arrangements. It would also attempt to combine and reduce risks, to have more bargaining power in international capital markets than would a set of individual funds for the same commodities, and to require smaller total financing than the aggregate of a set of individual funds because of differences of phasing of cycles across commodity markets.

The impact of the implementation of the proposed UNCTAD integrated commodity program has been a subject of considerable debate. Largely on a priori grounds, critics have claimed that price stabilization would lead to revenue destabilization or reduction in revenues of the producing nations, that the real gainers from price stabilization programs would be consumers and not producers, and that the cost of introducing distortions into international commodity markets outweighs the potential gains. These arguments, however, seem to be based upon particular a priori assumptions about the nature of existing commodity markets and the underlying supply and demand schedules that are not obviously realistic, as is discussed in Behrman (1977). Whether or not some of these criticisms have validity cannot be determined solely on a priori grounds, but only with analysis that takes into account empirical realities of the real world.

In this chapter we investigate what would be the impact of the implementation of the UNCTAD integrated commodity program on Latin America's export earnings. We do not attempt to explore the question of what is the effect of fluctuations in such earnings on the goal attainment of the Latin American economies.[3] Our basic approach is to utilize econometric models of the primary commodity markets of interest to simulate what would happen if the UNCTAD program were implemented. Our study is organized in the following way. In the next section, we consider the role of Latin America in the world exports of the ten UNCTAD core commodities and the role of earnings from these core commodities in total Latin American exports. In the third section, we introduce the assumptions underlying our simulations of international buffer stock commodity agreements along the lines proposed by UNCTAD. In the fourth section, we give aggregate results. In the fifth section, we explore the disaggregated implications for Latin America, and in the last section, we present conclusions.

## UNCTAD CORE COMMODITIES AND LATIN AMERICAN EXPORTS

UNCTAD has placed considerable emphasis on the ten core primary commodities which are mentioned above. The question naturally arises: how important are these core commodities in the exports of the Latin American countries? Table 10–1 gives some data relevant to this question:

1) the average percentage importance in total import revenues of each of the ten UNCTAD core commodities for each of the Latin American countries over the 1970–1975 period,
2) the total percentage of each country's exports for which the ten UNCTAD core commodities account, and
3) a measure of the extent to which each country's exports are concentrated among the ten core commodities.[4]

The statistics in this table point to the relatively great importance of coffee, sugar, and copper and to the lesser importance of cotton, tin, and cocoa in Latin American exports. The other four UNCTAD core commodities are of negligible significance and therefore are not considered further in our analysis.

Coffee accounts for over 20 percent of the export value of six countries, over 10 percent of nine countries, and is 8 percent of total Latin American exports. Sugar accounts for over 33 percent for five countries and is 7 percent of the total. Copper is 73 percent of Chile's exports, 23 percent of Peru's, and 5 percent of the total. Cotton is over 10 percent for three Central American countries and 2 percent of the total. Tin is 50 percent for Bolivia and less than 1 percent of the total. Cocoa is also less than 1 percent of the total. Taken together, in the early 1970s the UNCTAD core commodities accounted for almost 25 percent of total Latin American exports.

The statistics in Table 10–1 also point to widely different degrees of importance of the UNCTAD core commodities and the export values across the Latin American economies. On the average, in 1970–1975 these core commodities accounted for almost 75 percent of the total value of exports from Cuba and Chile, over 50 percent of the value of total exports from the Dominican Republic, Bolivia, El Salvador, Guatemala, and Haiti, and over 25 percent of the total value of exports from Nicaragua, Guadeloupe, Peru, Brazil, Barbados, Guyana, Costa

Table 10–1. Average Percentage Importance and Concentration Indices for Ten UNCTAD Core Commodities in Latin American Export Revenues, 1970–1975[a]

| *Country* | *Coffee* | *Cocoa* | *Tea* | *Sugar* | *Cotton* | *Rubber* | *Jute* | *Sisal* | *Copper* | *Tin* | *Total* | *Concentration Index*[b] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | | | | | | | | | 0 | 0.00 |
| Bahamas | | | | | | | | | | | 0 | 0.00 |
| Barbados | | | | 35 | | | | | | | 35 | 0.12 |
| Belize | | | | | | | | | | | 0 | 0.00 |
| Bermuda | | | | | | | | | | | 0 | 0.00 |
| Bolivia | | | | | | | | | | 50 | 50 | 0.25 |
| Brazil | 24 | 2 | | 7 | 5 | | | | | | 38 | 0.06 |
| Chile | | | | | | | | | 73 | | 73 | 0.53 |
| Colombia | 26 | | | | | | | | | | 26 | 0.07 |
| Costa Rica | 27 | | | | | | | | | | 27 | 0.07 |
| Cuba | | | | 75 | | | | | | | 75 | 0.56 |
| Dominican Republic | 8 | 5 | | 52 | | | | | | | 65 | 0.28 |
| Ecuador | 11 | 8 | | | | | | | | | 19 | 0.02 |
| El Salvador | 38 | | | | 12 | | | | | | 50 | 0.16 |
| Grenada | | | | | | | | | | | 0 | 0.00 |
| Guadeloupe | | | | 43 | | | | | | | 43 | 0.18 |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Guatemala | 31 | | | 8 | 11 | | | | | | 50 | 0.12 |
| Guiana | | | | | | | | | | | 0 | 0.00 |
| Guyana | | | | 35 | | | | | | | 35 | 0.12 |
| Haiti | 39 | | | 8 | | | | 3 | | | 50 | 0.16 |
| Honduras | 16 | | | | | | | | | | 16 | 0.03 |
| Jamaica | | | | 13 | | | | | | | 13 | 0.02 |
| Martinique | | | | | | | | | | | 0 | 0.00 |
| Mexico | 5 | | | 6 | 7 | | | | | | 18 | 0.01 |
| Netherlands Antilles | | | | | | | | | | | 0 | 0.00 |
| Nicaragua | 14 | | | 6 | 26 | | | | | | 46 | 0.00 |
| Panama | | | | 9 | | | | | | | 9 | 0.01 |
| Paraguay | | | | | 7 | | | | | | 7 | 0.01 |
| Peru | 4 | | | 8 | 5 | | | | 23 | | 40 | 0.06 |
| Surinam | | | | | | | | | | | 0 | 0.00 |
| Trinidad and Tobago | | | | 5 | | | | | | | 5 | 0.00 |
| Uruguay | | | | | | | | | | | 0 | 0.00 |
| Venezuela | | | | | | | | | | | 0 | 0.00 |
| Total | 8 | 1 | 0 | 7 | 2 | 0 | 0 | 0 | 5 | 1 | 24 | 0.01 |

[a]Calculated from data in IMF (1976).

[b]The Herfindahl-Hirschman index is the sum of the squares of the shares. The higher the index is, the greater is the concentration. The maximum value is one.

Rica, and Colombia. The concentration index suggests a similar pattern, but one that is somewhat different for the relative vulnerability of the various Latin American economies to fluctuations in world commodity markets if those fluctuations are not perfectly correlated across commodities. By this index, Cuba and Chile are by far the most vulnerable of the Latin American economies because of their respective great dependence on sugar and copper. The Dominican Republic and Bolivia are next because of their respective dependence on sugar and tin. Although El Salvador, Haiti, and Guatemala have the same percentage of their total exports originating in the UNCTAD core commodities as does Bolivia, they are probably less vulnerable because of greater diversification among those commodities. On the other hand, Barbados and Guyana with their relative concentration on sugar may be at least as vulnerable as Guatemala, Nicaragua, and Peru, even though each of the latter group of countries has a higher proportion of their total exports accounted for by the UNCTAD core commodities. At the other end of the spectrum, whether one judges by the percentage of total exports that arise from the UNCTAD core commodities or by the index of concentration in these exports, are countries like Argentina, Bahamas, Belize, Bermuda, Grenada, Guiana, Martinique, Netherlands Antilles, Panama, Surinam, Uruguay, and Venezuela. Thus, the impact of the UNCTAD integrated commodity program would vary quite substantially across the various Latin American economies.

To explore to what extent the Latin American economies would benefit or lose from changes in the international commodity markets for the UNCTAD core commodities, it is useful to ask what proportion of total world production of these commodities originates in Latin America. Table 10–2 provides statistics germane to this question, with the percentage of total world production originating in individual Latin American countries and in all of Latin America during the half decade centered on 1970. For all of Latin America these figures are 48 percent for coffee, 26 percent for sugar, 21 percent for cocoa, 17 percent for copper, 11 percent for cotton, 14 percent for tin, and less than 2 percent for the other four commodities.

On an individual country-commodity basis, in only five cases do Latin American economies average as much as 10 percent of world production: Brazil for coffee and cocoa, Colombia for coffee, Bolivia for tin, and Chile for copper. Since the largest figure is only 18 percent for Brazil in coffee, individual Latin America economies acting alone apparently would not have great market power in the total world markets for these commodities. Also note that Brazil accounts for 5 percent or more of world production for four of the core commodities (coffee, cocoa, sugar, and cotton), but no other Latin American country

Table 10–2. Average Percentage Share of Latin American Countries in World Production of Ten UNCTAD Core Commodities, 1968–1972[a]

| *Country* | *Coffee* | *Cocoa* | *Tea* | *Sugar* | *Cotton* | *Jute* | *Rubber* | *Sisal* | *Copper* | *Tin* |
|---|---|---|---|---|---|---|---|---|---|---|
| Argentina | | | 2 | | 1 | | | | | |
| Bolivia | | | | | | | | | | 13 |
| Brazil | 18 | 12 | | 7 | 5 | | 1 | | | 1 |
| Chile | | | | | | | | | 12 | |
| Colombia | 14 | 1 | | | 1 | | | | | |
| Costa Rica | 3 | | | | | | | | | |
| Cuba | | | | 8 | | | | | | |
| Dominican Republic | | 2 | | 4[b] | | | | | | |
| Ecuador | | 4 | | | | | | | | |
| El Salvador | 5 | | | | | | | | | |
| Guatemala | 4 | | | | | | | | | |
| Jamaica | | | | 1[b] | | | | | | |
| Mexico | 4 | 1[b] | | 4 | 3 | | | | 1 | |
| Peru | | | | 2[b] | 1 | | | | 4 | |
| Venezuela | | 1 | | | | | | | | |
| Total | 48 | 21[b] | 2 | 26[b] | 11 | 0 | 1 | 0 | 17 | 14 |

[a]Calculated from data in Jiler et al. (1975). Countries are excluded if they did not average at least 1 percent for one core commodity.

[b]Based on export data, rather than production data, for the countries indicated. Therefore, this is a lower bound.

averages as much as 5 percent for more than one of these commodities. Thus, only Brazil in Latin America would seem to be an important factor in more than one of the possible international agreements for the core commodities.

## ECONOMETRIC MODELS OF THE CORE COMMODITY INTERNATIONAL MARKETS AND ASSUMPTIONS UNDERLYING THE SIMULATIONS OF THE UNCTAD COMMODITY PROGRAM

One of the advantages of using model simulations as a tool of policy analysis is that the assumptions underlying the analysis are very explicit. We first describe the econometric models of the UNCTAD core commodity international markets that are the basis of our simulations. We then list and discuss a number of the assumptions underlying the simulations that are presented in the next two sections.

### Econometric Models of the UNCTAD Core Commodity International Markets

The econometric models of the UNCTAD core international commodity markets derive from the earlier work of Adams and Behrman (1976), Agosin (1976), and Behrman (1975). The models are quite simple and are estimated from annual data for the 1955–1972 period.[5] They generally have production and demand relations for each kind of economy in each of the major economic groupings: the developed economies, the developing economies, and the centrally planned economies. There is also a global inventory function estimated by Tinakorn (1978) that attempts to capture better speculative inventory behavior than did the comparable functions in the original models of the three sources listed above. Finally, the market price is solved from the short-run equilibrium condition, that is, supply equals demand for current use plus inventory changes.[6] To simulate international buffer stock policies, it is assumed that the buffer stock buys or sells, when the price would fall outside of predetermined price limits. Any such buffer stock activity affects the price through the short-run equilibrium condition just mentioned.

A discussion of the structure of the full set of commodity models is beyond the scope of this chapter, and interested readers are referred to Behrman and Tinakorn (1978b) and to Tinakorn (1978). Instead the structure of only one model, that for coffee, is presented as an example.

**Production:** The theory underlying the supply side assumes the existence of pressures leading to competitivelike behavior for a large number of relatively small producers. Short-run production (*PRO*) depends on the stock of trees, a time trend (*T*) to represent secular shifts because of technological change, development of supporting infrastructure, and so on, dummy variables for unusual weather conditions (*DS* followed by the relevant years), the expected real coffee price (*PDF*), and a disturbance term. The stock of trees is unobservable, however, and thus the long-run response to the expected real coffee price $PDF_{-i}$, where $i$ refers to the number of years in a lagged response, is substituted into the relation. For the developing (sole producer) countries[7] the relation obtained is:[8]

$$
\begin{aligned}
\ln PRO = &- \underset{(-0.3)}{0.023} \ln PDF_{-6} + \underset{(1.0)}{0.054} \ln PDF_{-7} + \underset{(5.0)}{0.142} \ln PDF_{-8} \\
&+ \underset{(3.2)}{0.153} \ln PDF_{-9} + \underset{(3.9)}{0.024}\, T + \underset{(5.2)}{0.25}\, DS\, 6566 \\
&+ \underset{(3.1)}{0.24}\, DS\, 60 + \underset{(69.5)}{10.470}
\end{aligned}
$$

$$\bar{R}^2 = 0.87,\ SE = 0.068,\ DW = 2.81,\ 1956 - 1973$$

This relation is consistent with a substantial part of the variance in the dependent variable over the sample. There is no evidence of a significant short-run price response, but there is evidence of a significant long-run price response with a long-run price elasticity of 0.33. It is through this long-run price response that the buffer stock program would affect coffee production. Because of the gestation period for new trees, this response occurs only after several years. The pattern of price response reflects the combination of the time required for the formation of price expectations and the gestation period between planting and mature bearing. In addition to the price response, there also is evidence of a significant secular trend and weather impact (as represented by dummy variables for the particularly good conditions in 1960 and 1965–1966).

**Demand:** The per capita demand for coffee for current use (*D/POP*) is formulated in the traditional manner as a function of deflated coffee prices (*PDF*) and per capita product in the consuming area (*GDP/POP*).[9] Because of differential responses across country types, three such functions are estimated:

Developed economies

$$ln\ (D/POP) = \underset{(10.3)}{3.264} + \underset{(3.0)}{0.197} ln\ (GDP/POP) - \underset{(-6.1)}{0.237} ln\ PDF_{-1}$$

$$- \underset{(-3.9)}{0.198}(ln\ DPF_{-1} - ln\ PDF_2)$$

$$\bar{R}^2 = 0.94, SE = 0.030, DW = 2.00,\ 1955\text{–}1972$$

Developing economies

$$ln(D/POP) = \underset{(0.5)}{0.567} + \underset{(1.8)}{0.400} ln(GDP/POP)_{-1} - \underset{(-3.4)}{0.314}[ln\ PDF_{-1}$$

$$+ ln\ PDF_{-2})/2.0] - \underset{(-2.2)}{0.242}(ln\ PDF_{-2} - ln\ PDF_{-3})$$

$$\bar{R}^2 = 0.88,\ SE = 0.060,\ DW = 2.41,\ 1955\text{–}1972$$

Centrally planned economies

$$ln(D/POP) = \underset{(-6.3)}{-6.380} + \underset{(7.0)}{1.447} ln(GDP/POP) - \underset{(-5.3)}{1.247}\ [(ln\ PDF$$

$$+ ln\ PDF_{-1})/2.0]$$

$$\bar{R}^2 = 0.97,\ SE = 0.049,\ DW = 1.92,\ 1955\text{–}1972$$

These relations, once again, are quite consistent with fluctuations in the dependent variables over the sample period. The determinants are per capita income and deflated prices. The pattern of income elasticities is 0.20, 0.40, and 1.45, respectively. The largest value is for the medium-income country group, which suggests an $S$-shaped income response with most future potential for expanded demands in the centrally planned[10] and developing regions. The short-run (defined as current year or with one year lag) price elasticities are −0.44, −0.31, and −1.25, respectively. The long-run (defined as complete adjustment) price elasticities are −0.24, −0.31, and −1.25, respectively. It is through these price responses that the hypothetical buffer stock program would affect coffee demands.

**Inventories:** The level of world desired inventories ($STK$) adjusts slowly from earlier levels, and therefore the coefficient on the lagged inventory level is significant and fairly large (0.81). In addition there are included possible responses to the level and change in world coffee demand ($D$), the current deflated cost of acquiring coffee stocks ($PDF$), the expected deflated price of coffee as represented by lagged values ($PDF_{-i}$), and dummy variables for unusual speculative activities in 1964 and 1970 (D6470):

$$\underset{}{ln\,STK} = \underset{(3.5)}{0.814 ln\,STK_{-1}} + \underset{(.08)}{0.917 ln\,D} - \underset{(-1.8)}{1.371 ln\,D_{-1}} - \underset{(1.8)}{1.052 ln\,PDF}$$

$$+ \underset{(0.9)}{0.508 ln\,PDF_{-1}} + \underset{(1.2)}{0.109\,D6470} + \underset{(1.0)}{7.05}$$

$$\bar{R}^2 = 0.95,\ SE = 0.20,\ DW = 1.43,\ 1952\text{–}1973$$

This relation is also fairly consistent with fluctuations in the dependent variable during the sample period. Next to the slow adjustment of past desired inventory levels noted above, the most important response appears to be the negative one to the current cost of acquiring inventories (with a unitary elasticity). In addition there is some evidence of (probably weaker) responses to changes in world demand ($D - D_{-1}$),[11] the unusual market conditions in 1916 and 1970 ($D$ 6470), and the expected deflated price (with a positive elasticity of 0.5, but with a large standard error). A hypothetical buffer stock program would alter other desired coffee inventories through the cost of acquiring them and possibly through the effect on price expectations and on changes in world coffee demands.

**Short-Run Equilibrium:** The following short-run equilibrium condition is that total supply ($PRO$) equals total demand for current use ($D$), nonbuffer stock inventory additions ($STK - STK_{-1}$), and buffer stock additions ($BS$):

$$PRO = D + STK - STK_{-1} + BS$$

This is a short-run equilibrium condition because, in addition to some current price responses, there are expectational and adjustment lags in all of the above relations that determine production, demand for current use, and nonbuffer stock inventories. By changing $BS$ the buffer stock agency can alter the current price, which is solved from this short-run equilibrium condition. When the price would fall below (above) a predetermined floor (ceiling) price, the buffer stock agency is assumed below to purchase (sell) enough coffee so that the current price is at the floor (ceiling) level. Because of the lags, in so doing, the buffer stock agency affects not only the current situation, but also the subsequent history of production demands, and thus prices. For this reason the incorporation in the econometric models of the best available estimates of lagged adjustment and expectational formation processes is very important.

### Assumptions Underlying Simulations of the UNCTAD Integrated Commodity Program and Its Implications for Latin American Commodity Exports

We now list and discuss a number of the assumptions underlying the simulations presented in the next two sections.

a. *Our econometric models of the international commodity markets approximate well the structures of the markets despite the operations of the UNCTAD integrated commodity program buffer stock.* More explicit implications of this assumption are that limit pricing and the threat of substitution in use continue to make aggregate supply and demand response relations sufficiently good approximations despite the existence of new market power. National policies that alter the relations between international and domestic prices (e.g., marketing boards, export taxes, and import taxes) continue to have the same effects. Nonbuffer stock inventory behavioral relations remain the same despite the existence of buffer stock arrangements. Other parameters and lags remain the same despite the reduction in price instability.

Some of these implications are strong. For example, a priori private inventories might be expected to fall because of reduction in downward speculation (assuming that the buffer stock had sufficient financial reserves) and the assurance of extra supplies from the buffer stock. On the other hand, the reduction in risks of carrying inventories may cause them to rise *ceteris paribus* if inventory holders are risk averse. The sensitivity of the simulations to structural changes in either direction for inventory behavior (or for any other aspect of the model) in principle could be explored, although such an exercise is beyond the scope of this chapter.[12]

b. *Nonstochastic simulations over a recent particular historical period (1963–1975) provide useful information about likely orders of magnitude associated with the operation of buffer stock arrangements.* It would be preferable to calculate the effective values of various policies by conducting Monte Carlo studies drawing on the estimated distributions of the disturbance terms. To do so, however, would involve a large number of simulations and would require resources far beyond those currently available for this work. Therefore, nonstochastic simulations are utilized. Some preliminary work, reported in Behrman and Tinakorn (1977), suggests that ignoring these disturbance terms in the simulations probably is not too misleading because the underlying relations in the models generally have relatively small unexplained variances.

The use of a thirteen-year period starting in 1963 ties the results to a particular historical experience. However, that period is long enough to encompass a wide range of economic conditions (e.g., substantial fluctuations in the world economy). The length of the period, therefore, lessens the extent to which the total results are conditional on the particular choice of years, although the details of the time sequences obviously reflect that choice.

A simulation period as long as thirteen years is also useful because it permits covering enough years to encompass several commodity price cycles of historical duration. Smith and Schink (1976) emphasize the importance of having sufficiently long simulation periods for this very reason, based on their econometric explorations of the tin market. UNCTAD (1975) gives the lengths of price cycles in the 1960–1974 period for nine of the ten core commodities (not including tea). Across all commodities the average is 22 months, but the means for individual commodities range from 13 months for sugar to 34 months for coffee.[13] The maximum length ranges from 26 months for sugar to 79 months for coffee, but for no other commodity is it greater than 51 months. A thirteen-year simulation period thus should cover enough time for several price cycles of the duration historically experienced—although fewer for coffee than for the other commodities. It should be short enough, on the other hand, so that structural changes caused by reduced price fluctuations are not overwhelming. This is so since many of those changes relate to variations in capital stock that require long gestation periods both for decisionmaking and for implementation.

c. *The buffer stock managers operate with sufficient financial reserves and sufficient commodity reserves so that they can buy or sell to keep the annual deflated commodity prices within a ±15 percent bandwidth of the known secular price trends for the 1950–1975 period. No export or production quotas are utilized by the commodity agreements.*[14] This assumption about the operation of the buffer stock has a number of subcomponents that merit comment. The existence of sufficient financial reserves means that the buffer stocks always can buy to defend the price floor, which should discourage destabilizing speculation. The existence of sufficient commodity reserves always to be able to defend the price ceiling should discourage destabilizing upward speculation. The reason for this assumption is to permit the simulation of the ongoing behavior of buffer stock stabilization without overemphasis on the end points of the scheme. However, for some commodities, it does imply that the buffer stock must start the period with initial commodity reserves in order always to have stocks at nonnegative levels.

The presumed knowledge of the secular price trends tends to reduce the cost and increase the profitability of the buffer stock operation in comparison to situations in which large errors are made about secular trends. In our simulations errors are not made because of the confusion between short-run and long-run price movements. In principle, alternative target pricing rules could be examined with these models (lagged moving averages, fixed prices, etc.), but we do not do so in this chapter. Smith (1975), for example, in conducting such explorations for the copper market has concluded that five-year lagged moving averages result in too great cyclical fluctuations and give a poor estimate of the trend. As a result, the buffer stock model follows some bizarre behavior that causes substantial losses. Much better performance occurs when the price target is fixed for long periods of time (e.g., ten years). Of course, such a rule, like the trend rule used here, can be implemented only with very good ex ante expectations about price movements. We report elsewhere on explorations that led to similar conclusions (see Behrman and Tinakorn, 1977, 1978a).

The price target and floors and ceilings are in real terms which is the normal approach. In the absence of money illusions, moreover, long-run equilibrium prices are also in real terms, and the aim of pure price stabilization schemes is to limit the fluctuations around long-run real equilibrium prices.[15]

All of the variables in the models are annual averages. The use of these annual averages may understate somewhat the cost of buffer stock operations. Transaction costs may be incurred during the year because the price otherwise would move above or below the allowable range, and yet the average price may be within the allowable range (thus indicating no transaction costs). This problem probably is more important for agricultural products with strong seasonal cycles (e.g., cocoa).

The bandwidths around the secular price trends that are maintained by the buffer stock operations and the simulations ±15 percent. The choice of bandwidths is important. Credible narrow bandwidths increase price stability, but they may destroy future markets and much of the motive for holding private inventories. They may also reduce (perhaps to large negative numbers) profits from the buffer stock operations since such profits depend primarily on price differences between buying at the floor and selling at the ceiling. Broad bandwidths do not stabilize prices much. In Behrman and Tinakorn

(1977), some results are reported that explore the sensitivity of the outcomes to different bandwidths.

Finally, it should be emphasized that the simulated rules of operation used here for the buffer stocks are quite simple and mechanical. Buffer stock managers might well have more information than is included in these simulations. More flexible rules of operation might be desirable. To the extent that either of these possibilities is true, the mechanical procedures simulated here may overstate the cost of buffer stock operations.

d. *The distribution of benefits or losses to Latin American producers of the core commodities is assumed to be proportional to their respective shares in world production.* The models that are used for the simulations have relations only on fairly aggregative levels (i.e., for all developing county producers or for total world production). There exists a number of studies of supply elasticities at the disaggregated or country level for the UNCTAD primary products (see Labys and Hunkeler, 1974; and Askari and Cummings, 1977). However, the scope of this study did not permit such a disaggregated analysis. Moreover, it is not clear that any international commodity agreement in fact would divide marginal market shares along the lines indicated by historical price responses. Therefore, we have decided to proceed with the simple assumption that the shares indicated in Table 10–2 would prevail if there were an integrated commodity program. This assumption may bias upward our estimate of Latin America's shares in the losses or gains from the future instigation of an international commodity program, since Latin America has had declining shares in the markets of most of these products during the past several decades.

## AGGREGATE SIMULATIONS OF THE UNCTAD INTEGRATED COMMODITY PROGRAMS FOR THE CORE COMMODITIES OF INTEREST TO LATIN AMERICA

We now turn to the simulated results of introducing international commodity buffer stock agreements for the six UNCTAD core commodities of interest to Latin American producers under the assumptions discussed in the previous section. Tables 10–3, 10–4, and 10–5 summarize these simulation results. Table 10–3 gives purchases and sales in millions of 1975 dollars by buffer stocks for each of the commodities of interest and the sum of sales and of sales minus purchases across these commodities, all on a year-by-year basis. Table 10–4 gives the annual percentage changes in the quantities supplied and the

Table 10–3. Annual Purchases and Sales in Millions of 1975 Dollars for Buffer Stocks for Six UNCTAD Core Commodities of Interest to Latin America for 1963–1975

| *Commodities* | *Initial Value* | *1963* | *1964* | *1965* | *1966* | *1967* | *1968* | *1969* | *1970* | *1971* | *1972* | *1973* | *1974* | *1975* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cocoa | 0 | 53 | 0 | 295 | 92 | 27 | 0 | −8 | 0 | 24 | 246 | 0 | 0 | 0 |
| Coffee | 0 | 1387 | 0 | −114 | 548 | 0 | 0 | 0 | −914 | 0 | −77 | 0 | −434 | −1342 |
| Sugar | 148 | −224 | 0 | 806 | 965 | 762 | 879 | 794 | 1621 | 908 | 0 | 876 | 1134 | 1408 |
| Cotton | 0 | 541 | 251 | 279 | 320 | 491 | 633 | 606 | 626 | 360 | 0 | 0 | 0 | 0 |
| Copper | 414 | 193 | 0 | −52 | −178 | −123 | −395 | −307 | 0 | 0 | 976 | 0 | 0 | 0 |
| Tin | 141 | 0 | 0 | −202 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Sum of Purchases–Sales | 703 | 1950 | 251 | 1012 | 1747 | 1157 | 1117 | 1085 | 1333 | 1292 | 1145 | 876 | 700 | 66 |
| Sum of Purchases | 703 | 2174 | 251 | 1380 | 1925 | 1280 | 1512 | 1400 | 2247 | 1292 | 1222 | 876 | 1134 | 1408 |

Source: Based on the authors' computations.

Table 10–4. Annual Percentage Changes in Quantity Supplied (*Q*), Price (*P*), and Producers' Revenues (*R*) due to Operation of Buffer Stock for Six UNCTAD Core Commodities of Interest to Latin America for 1963–1975[a]

| *Commodities* | | *1963* | *1964* | *1955* | *1966* | *1967* | *1968* | *1969* | *1970* | *1971* | *1972* | *1973* | *1974* | *1975* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Cocoa | *Q* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.2 | 0.8 | 3.0 | 7.7 | 11.9 | 11.8 | 2.7 |
| | *P* | 9.4 | 3.6 | 88.7 | 44.1 | −3.1 | −12.2 | −3.1 | −0.8 | −3.3 | 11.8 | −25.2 | −33.6 | −21.2 |
| | *R* | 9.4 | 3.6 | 88.7 | 44.1 | −3.1 | −12.2 | −2.9 | −0.0 | −0.5 | 20.5 | −16.3 | −25.7 | −19.2 |
| Coffee | *Q* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | −0.4 | 1.0 | 2.5 | 3.5 | 1.9 | 2.9 | 2.2 |
| | *P* | 20.4 | 0.8 | 12.7 | 6.3 | 7.5 | 6.4 | 6.9 | −4.8 | 1.9 | −6.7 | 1.9 | −12.0 | −18.7 |
| | *R* | 20.4 | 0.8 | 12.7 | 6.3 | 7.5 | 6.4 | 6.5 | −3.8 | 4.4 | −3.5 | −0.0 | −9.4 | −17.0 |
| Sugar | *Q* | 0.0 | 0.0 | −1.4 | −0.3 | 7.0 | 11.2 | 5.4 | −2.3 | −3.0 | 7.5 | 11.4 | 0.9 | −8.0 |
| | *P* | −9.6 | −3.7 | 54.1 | 84.5 | 24.5 | −25.1 | −23.1 | 64.8 | 92.1 | −7.2 | −46.3 | −8.0 | 102.6 |
| | *R* | −9.6 | −3.7 | 51.9 | 83.9 | 33.2 | −16.7 | −18.9 | 61.0 | 86.4 | −0.2 | −40.2 | −7.2 | 86.5 |
| Cotton | *Q* | 0.0 | 9.4 | −2.7 | 5.6 | 1.0 | 6.8 | 5.4 | 3.3 | 6.0 | 0.3 | −2.2 | −0.5 | −1.2 |
| | *P* | 24.7 | −6.7 | 6.9 | 0.0 | 14.5 | 10.7 | 2.6 | 6.9 | −3.9 | −10.7 | −2.6 | 1.3 | 4.3 |
| | *R* | 24.7 | 2.1 | 4.0 | 5.6 | 15.6 | 18.2 | 8.1 | 10.5 | 1.9 | −10.5 | −4.7 | 0.8 | 3.1 |
| Copper | *Q* | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.6 | 0.4 | 0.2 | −0.2 | −0.4 | −0.9 | −1.1 | −0.7 |
| | *P* | 4.7 | 3.0 | 2.0 | −1.9 | −3.8 | −7.2 | −8.8 | −5.6 | −2.4 | 10.5 | 8.1 | 6.2 | 4.9 |
| | *R* | 4.7 | 3.0 | 2.0 | −1.9 | −3.8 | −6.6 | −8.5 | −5.4 | −2.7 | 10.0 | 7.2 | 5.0 | 4.2 |
| Tin | *Q* | 0.0 | 0.0 | 0.1 | −0.1 | −0.1 | 0.0 | −0.1 | 0.0 | 0.0 | −0.1 | 0.0 | 0.0 | 0.0 |
| | *P* | 0.0 | 0.0 | −1.5 | 0.0 | 0.0 | −0.9 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | *R* | 0.0 | 0.0 | −1.4 | −0.1 | −0.1 | −0.9 | −0.1 | 0.0 | 0.0 | −0.1 | 0.0 | 0.0 | 0.0 |

Source: Based on the authors' computations.

[a]The comparisons are with simulations that are identical except that no buffer stock activity occurs. The averages for these thirteen years are given in columns 5, 6, and 7 of Table 10–5.

Table 10–5. Summary of Basic International Buffer Stock Commodity Program Simulations for Six UNCTAD Core Commodities of Importance to Latin America, 1963–1975[a]

| *UNCTAD Core Commodities of Interest to Latin America* | *Value of Buffer Stock Activity*[b] | | *Longest Continuous Period (in Years) of Buffer Stock Activity* | | *Mean Percentage Changes*[c] *due to Price Stabilization in:* | | | *Value of Additional Producers' Revenue*[b,c] | *Revenue Stabilization Index*[d] |
|---|---|---|---|---|---|---|---|---|---|
| | *Excluding Final Stock* | *Including Final Stock* | *Without Buying* | *Without Selling* | *Price* | *Quantity Supplied* | *Producers' Revenues* | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| Coffee | −494 | −413 | 9 | 4 | 1.5 | 1.0 | 2.4 | 1734 | 0.71 |
| Cocoa | −667 | −70 | 3 | 6 | 4.2 | 2.9 | 6.7 | 334 | 0.24 |
| Sugar | −13877 | −6309 | 12 | 2 | 23.1 | 2.2 | 23.6 | 10609 | 0.22 |
| Cotton | −3735 | −643 | 13 | 4 | 3.7 | 2.4 | 6.1 | 8241 | 0.51 |
| Copper | −508 | 382 | 8 | 6 | 0.8 | −0.2 | 0.6[f] | −188[f] | 0.94 |
| Tin | 30 | 30 | 13 | 10 | −0.2 | −0.0 | −0.2 | −21 | 1.00 |
| Average[e] | −19251[e] | −7023[e] | 9.7 | 5.3 | 5.5 | 1.4 | 6.5 | 20709[e] | 0.60 |

Source: Based on the authors' computations.

[a]Section 3 above presents the assumptions underlying these simulations.

[b]These values are present discounted values using a 5 percent real discount rate and are in millions of constant 1975 dollars.

[c]The comparisons are with identical simulations except that no buffer stock activity is allowed. These data are the averages of those in Table 10–4.

[d]This is the ratio of the standard deviation in real revenues with price stabilization to that without price stabilization.

[e]Total for columns 1, 2, and 8.

[f]The present discounted value is negative even though the mean percentage change in producers' revenues is positive because of the concentration of negative values early in the simulation period.

prices and producers' revenues due to the operation of the buffer stock for the same commodities.[16] Table 10–5 summarizes the activity of the buffer stocks and the impact of this activity on producers' revenues over the thirteen-year period of the simulations. For each of the six commodities of interest it gives: the present discounted value of buffer stock activity with and without including the value of final stocks; the longest continuous period of buffer stock activity without buying and without selling; the mean percentage changes due to the buffer stock price stabilization program in prices, quantities supplied, and producers' revenues; the present discounted value of additional producers' revenues due to the institution of the integrated commodity program; and an index of the extent of revenue stabilization that occurs because of the price stabilization program.[17]

Let us begin by considering the nature of buffer stock activity. As is indicated in Table 10–3, for three of the six core commodities of interest the buffer stock must begin with initial stocks in order always to be able to defend the price ceiling. If there were not such initial stocks for sugar, copper, and tin, the buffer stock authorities would not always be able to defend the ceilings in the initial years because to do so would require greater quantities of commodities than they would have purchased at an earlier time in efforts to defend the floors.

After establishing their initial position, in the subsequent thirteen years of simulated buffer stock operation the buffer stocks intervene in the market forty-two out of seventy-eight possible times, or slightly more than half of the years on the average for each commodity. Such activity is somewhat more frequent for sugar and somewhat less frequent for tin than for the other four commodities. Despite this frequency of intervention in the market, the buffer stocks would, for long periods of time, not be on one side of the market. Columns 3 and 4 in Table 10–5 give the longest continuous period in years of buffer stock activity, respectively, without buying or without selling. The longest period without buying ranges from three years for cocoa to thirteen years for cotton and tin, with an average of 9.7 years. The longest period without selling ranges from two years for sugar to ten years for tin, with an average of 5.3 years. These long periods without being on one side of the market suggest that it might be quite difficult to be sure that the target prices around which the buffer stocks are attempting to stabilize are related to long-run equilibrium values. These long periods also suggest that if international commodity agreements are in effect only for the five-year period suggested by the Havana Charter, in many cases activity might be heavily concentrated on one side of the market.[18] Such considerations suggest that it might be desirable to have buffer stock agreements with longer lives than generally has been proposed.

Another important point about the simulated operation of these buffer stocks is that the magnitude of financing becomes fairly large after several years, even though there are significant advantages from pooling finances across these six core commodities. For example, the sum of purchases minus sales in the penultimate row of Table 10–3 indicates that, on the average, a total of about one billion dollars per year would be expended. Thus, in about six years the buffer stocks would exhaust the six-billion dollar fund mentioned in the UNCTAD proposal, even if only these six of the ten core commodities were included. This occurs despite a gain from pooling across commodities of about 30 percent by letting sales in a given year offset purchases of other commodities in the same year. For example, the sales of coffee in 1975 would offset almost all of the purchases of sugar in that year.[19] Large required access to financing despite such pooling may make it necessary at least politically to establish such programs initially on a shorter term basis than the considerations in the previous paragraph would indicate are desirable.

Now let us consider the impact on producers' revenues of the operation of the buffer stock programs. It is useful to break down revenue between the quantities supplied and the price received. For the quantity supplied, the results in Table 10–4 indicate initial periods of no response for cocoa, coffee, and copper. These initial periods of four or five years of no supply response reflect the relatively long gestation required to bring newly planted trees or expanded mine capacity into operation. Subsequently, however, fairly large supply responses are induced, at least for the agricultural products. Increases over 11 percent occur for cocoa and sugar, over 6 percent for cotton, and over 3 percent for coffee. Changes of these magnitudes imply that it may be quite misleading to consider the impact of international commodity agreements within a framework that assumes no supply responses. In fact, in some respects the existence of supply responses with long lags may make stabilization more difficult. For example, the simulation for cocoa indicates a fairly large supply increase in the 1970s in response to the much higher price received for cocoa because of the simulated buffer stock program rather than market conditions in 1965 and 1966.

With the exception of tin, the simulated buffer stock program has much larger percentage effects on prices than on quantities supplied. Tin is an exception because actual prices were fairly stable during the simulation period, perhaps due to the international tin agreement,[20] so relatively little simulated additional buffer stock activity is indicated. For the other five core commodities of interest, in almost every year the price is affected either upward or downward. Note that the price is changed in many years in which no buffer stock activity occurs because of the dynamic impact of past buffer stock purchases or sales. Under the particular assumptions of these simulations, the average price impact is by far the largest for sugar, in which case the average increase is 23.1 percent (see column 5 in Table 10–5).[21] For cocoa and cotton the average annual percentage increases are 4.2 and 3.7 percent, respectively. For coffee it is 1.5 percent. For the two minerals it is less than 1 percent in absolute value. It is interesting to note that in every case except for tin, however, in some years the price stabilization program leads to prices higher than otherwise would exist, whereas in other years it leads to prices lower than those that would prevail without the program.

Altered dynamic price paths induce changes in supplies, as has been noted above, and in demands. The combination of the impact on prices and on quantities results in changes in producers' revenues. In some cases, the movements in prices and quantities reinforce each other, such as in 1967 through 1970 for cotton. In other cases they are opposing, such as in the next two years for cotton, or in 1973 through 1975 for cocoa. The total effects are fairly significant revenue gains for agricultural commodities and much smaller revenue losses for the two minerals (columns 7 and 8 in Table 10–5). For sugar alone the estimated annual average revenue gain is 23.6 percent, which implies a present discounted value of additional producers' revenues of over ten billion dollars.[22] For the other three agricultural commodities the average annual revenue gains range from 2.4 percent for coffee to 6.7 percent for cocoa. The total 6.1 percent average annual revenue gain for cotton, however, implies a present discounted value of total producers' revenue gains of approximately eight billion dollars over the simulation period. Across all six commodities the total simulated present discounted value of additional producers' revenues is somewhat over twenty billion dollars. This gain is fairly substantial, with most of it accruing to sugar and cotton producers and less so to coffee producers.

On the other hand, there are simulated small losses for the two mineral products. Of course, these results are conditional on the particular assumptions discussed in the third section. They would change with different assumptions. However, it well might be the case that under any set of assumptions for a particular time period there would be some losers among the producers (such as the minerals in this case) as well as some gainers. This possibility may make it quite difficult to hold together an integrated arrangement.

These comments refer to what happens to the level of revenues. But some critics of the UNCTAD program have claimed that under reasonable assumptions increases in revenues will be accompanied by decreases in the stability of those revenues. For example, see Johnson

(1976) where this argument is made using linear supply and demand curves with additive disturbance terms and elastic price responses. However, as is indicated in Behrman (1977), whether or not there is a tradeoff between the level and the stability of revenues cannot be settled a priori. It depends upon the elasticities of the underlying curves and the natures of shifts in those curves. It is basically an empirical issue. The results in the last column of Table 10–5 indicate that only for copper is there evidence of a tradeoff between the stability and the level of revenues. For copper, the price stabilization program stabilizes revenues slightly, but with a result of a somewhat lower present discounted value. For the four agricultural commodities, revenues are increased fairly substantially, and instabilities of revenues are reduced significantly. For tin there is a slight reduction in revenues with almost no change in the degree of stability of the revenues. At least for the agricultural commodities, the strong critique that Johnson (1976) has made about the tradeoff between the level and stability of revenues does not seem warranted.

## THE IMPLICATIONS OF THE SIMULATED UNCTAD INTEGRATED COMMODITY PROGRAM FOR REVENUES OF LATIN AMERICAN PRODUCERS

In the previous section we discussed the aggregate implications of the proposed UNCTAD program for the six core commodities of interest to Latin American producers. We now turn to the distribution of changed revenues for Latin American producers that would result from this program. Table 10–6 gives the present discounted values of real revenue changes that would accrue to each of the major Latin American producing countries from each of the six UNCTAD core commodities, the total present discounted additional value for each major Latin American producing country, and the ratio of that total value to the average export value in 1970–1975.

The present discounted values of gains to producers in an individual country depend upon the total present discounted value of additional producer revenues (column 8 in Table 10–5) and the country's share in world supply (Table 10–2). These simulated gains are gross values that do not include any contributions to the financing of the buffer stock operations (columns 1 and 2 in Table 10–5). If the producing countries contributed half of the net cost of buffer stock operations, the aggregate producer net gains would be from 17 to 46 percent lower, depending on the evaluation of final buffer stocks held at the end of 1975. In order not to become too complex because of alternative schemes for distribut-

Table 10–6. Present Discounted Values of Gains to Latin American Producers of Simulated UNCTAD Commodity Program over 1963–1975 Period[a]

| *Latin American Countries* | *Present Discounted Values of Additional Revenues to Producers (millions of 1975 dollars)* | | | | | | | *Ratio of PDV of Additional Producer Revenues to Average Annual Export Value in 1970–1975 (percentages)* |
|---|---|---|---|---|---|---|---|---|
| | *Coffee* | *Cocoa* | *Sugar* | *Cotton* | *Copper* | *Tin* | *Total* | |
| Argentina | | | | 82 | | | 82 | 3 |
| Bolivia | | | | | | −3 | −3 | −1 |
| Brazil | 312 | 40 | 743 | 412 | | | 1507 | 28 |
| Chile | | | | | −23 | | −23 | −2 |
| Colombia | 243 | 3 | | 82 | | | 328 | 29 |
| Costa Rica | 52 | | | | | | 52 | 16 |
| Cuba | | | 849 | | | | 849 | 55 |
| Dominican Republic | | 7 | 424 | | | | 431 | 97 |
| Ecuador | | 13 | | | | | 13 | 2 |
| El Salvador | 87 | | | | | | 87 | 28 |
| Guatemala | 69 | | | | | | 69 | 17 |
| Jamaica | | | 106 | | | | 106 | 22 |
| Mexico | 69 | 3 | 424 | 247 | −2 | | 741 | 33 |
| Peru | | | 212 | 82 | −8 | | 286 | 26 |
| Venezuela | | 3 | | | | | 3 | 0 |
| Total | 832 | 70 | 2758 | 907 | −32 | −3 | 4532 | 16 |

Source: Based on the authors' computations.

[a]Calculated by distributing the simulated present discounted values of additional revenues for producers in column 8 of Table 10–5 by the proportions in Table 10–2. For the last column the total export values are from the United Nations (1976) with the OECD deflator used to convert into millions of 1975 dollars.

ing the net costs of buffer stock operations among producers and consumers and the question of how to value the final stocks, we focus here on gross producer gains without subtracting their contributions to the buffer stock operations. The present discounted value of gains net of contributions for the costs of buffer stock operations would be lower, with the amount of the reduction depending on the exact assumptions about the funding arrangements and the evaluation of final stocks.

The largest simulated gainers in absolute terms are the sugar and cotton producers (because of the large simulated overall gains for those producers in Table 10–5) and the coffee producers (because of the moderate overall simulated gain in Table 10–5 and the large Latin American share in world production in Table 10–2). The gains for the other three commodities are much smaller and negative for the two minerals.

Therefore, in absolute terms, the big simulated gainers include 1,507 million 1975 dollars for Brazil, 849 for Cuba, 741 for Mexico, 431 for the Dominican Republic, 328 for Colombia, 286 for Peru, and 106 for Jamaica. Smaller gainers include Argentina and the Central American countries. Bolivia and Chile are small losers. The total present discounted value of these revenue gains to Latin American producers is about 4.5 billion 1975 dollars.

To put these numbers in perspective, it is useful to consider them as ratios to the average annual value of exports in 1970–1975 (the last column in Table 10–6). In percentage terms, these ratios range from −2 to 97. The big relative gainers are the Dominican Republic with almost a year's export value (97 percent) and Cuba with over half of a year (55). Mexico, Colombia, Brazil, El Salvador, Peru, and Jamaica all gain from a fifth to a third of a year's export value. For all of Latin America the estimate is a gain of about one-sixth (16 percent) of an average year's export value.

Are such gains for Latin America small or large? The answer depends upon the point of comparison. A total of 4.5 billion 1975 dollars is not so small as to be irrelevant. On the other hand, to obtain it requires the operation of the buffer stock programs for a fairly long period of time. It is small, moreover, in comparison to the transfers of roughly 65 billion dollars per year engendered by the OPEC petroleum price increases. Furthermore, some of the poorer Latin American countries (e.g., Bolivia and Paraguay) would not benefit from such a program.

## CONCLUSIONS

Latin Americans long have been concerned about effects of price fluctuations and downward secular trends in international primary commodity markets on the economies of producing nations. This preoccupation has led to some important policy decisions about the internal allocation of resources and international cooperation.

Recently, discussions about possible international cooperation have been very active, not only among Latin American nations, but also among other producing and consuming countries. The framework for this discussion has been set by the UNCTAD proposal for an Integrated Commodity Program for ten core commodities. These commodities account for about one-fourth of total Latin American exports, with coffee, sugar, and copper being of particular importance and cotton, tin, and cocoa less so.

We have simulated the operation of the UNCTAD buffer stock price stabilizing commodity program over the 1963–1975 period, using econometric models for each of the core UNCTAD commodities of interest to Latin America. Based on these simulations, we have a number of qualifications about the program. The financing required probably would exceed the six billion dollars mentioned in the UNCTAD proposal. It would be difficult to identify the underlying secular price trends because of long periods not on one side of the market by the buffer stocks. The producers of some of the core commodities well might lose because of the operation of any specific program in a particular time period. The gainers from such a program might not include some of the poorer nations, such as Paraguay. Even in the nations that do gain, it is not clear that the poorest part of the population will benefit.

Despite such reservations, we conclude that supporting the development of such a program possibly is in the Latin American interest. The simulated resource gain of 4.5 billion dollars is not insignificant. The development of such a program might also increase the extent of control of the Latin American economies, together with the other developing nations, over the international markets in which they operate. In the long run, such increased control may be more important than the simulated producer revenue gains from price stabilization.

## NOTES

1. Lord focuses on the 1960–1975 period. From a long run point of view considerable Latin American interest in fluctuations and trends in international primary commodity markets is understandable. Brazil, for example, has received the gains and suffered the losses from a number of different commodity booms and busts for sugar, rubber, and coffee over the past decades. Throughout Latin America, moreover, previously existing worries about the dependence on international commodity markets were intensified greatly by the devastating experience of the Great Depression. According to the League of

Nations, one of the Latin American economies, Chile, was the country most negatively affected by the evaporation of international commodity markets at the start of the 1930s. In that case, export revenues dropped to less than one-sixth of previous peak levels, and total national product per capita fell to half of previous levels (see Behrman, 1976 for more details about the long-run Chilean experience).

2. For a review of events leading to the call for a new international economic order and for more details concerning the UNCTAD proposal and resolution see Lewis (1976); Hansen (1976); Barraclough (1976); Erb and Kallab (1975); Michalopoulos (1976); Behrman (1977, 1978a, 1978c); Taylor and Sarris (1977); Smith (1977); Grubel (1977); Adams and Klein (1978); and the references therein.

3. Several well-known studies look at this question, primarily on a cross-section basis. For example, see Coppock (1976); Glezakos (1973); Kenan and Voivodas (1972); Knudsen and Parnes (1975); MacBean (1966); and Maizels (1968). Lord reviews most of the relevant literature in Chapter 9. Such studies do not seem to come up with consistent conclusions. In part, this may reflect that cross-country estimates are satisfactory only under strong assumptions about the existence of equilibrium or identical lag structures and identical degrees of overvaluation across countries. A more satisfactory approach is one that integrates the producing country with a model of the international primary market. For early work in this area, see Acquah (1972). For some preliminary results concerning coffee and Brazil, see Chapter 7.

4. The measure of concentration that is utilized is the Herfindahl-Hirschman index defined as the sum of the squares of the shares of the individual commodities. The higher this index, the greater is the concentration. The maximum possible value is 1.

5. The data are from standard sources. For details, see Adams and Behrman (1976).

6. Behrman (1978b) discusses theoretical considerations for modeling commodity markets in some detail.

7. For most of the models used in this study, production is divided among developing, developed, and centrally planned nations because of heterogenous responses across these groups. For coffee, only the developing nations are significant producers.

8. In all of the regression estimates presented in this subsection, "*ln*" refers to the natural logarithm of the indicated variables, subscripts refer to the number of years of lags for the indicated variable (if any), *t*-statistics are given in parentheses beneath point estimates, $\overline{R}^2$ is the coefficient of determination (which indicates the extent of consistency of the relation with the variation in the dependent variable during the sample period), *SE* is the standard error of estimate, *DW* is the Durbin Watson statistic, and the years refer to the sample period.

9. For the centrally planned economies this variable is net material product per capita.

10. The relatively large size of the income elasticity for the centrally planned economies, however, may reflect a price response to a foreign ex-

change allocation for coffee imports in these economies; see Adams and Behrman (1976).

11. The coefficients on current and lagged demand are not significantly different from each other in absolute value, although they are opposite in sign. The response is equivalent, therefore, to a response to the first different of demand.

12. See Tinakorn (1978) for consideration of alternative specifications of inventory relations within these models.

13. The differential length of these cycles across commodities is interesting. To the extent that they originate in demand side fluctuations, fewer differences across commodities might be expected. To the extent that they originate in supply side fluctuations, longer cycles might be expected for the commodities with longer gestation periods (i.e., the tree crops and minerals). Although the estimates for the extreme points (i.e., sugar and coffee) seem consistent with such a pattern, many of the others are not. For example, except for sugar, the shortest mean cycles are for copper and cocoa (a mineral and a tree crop)—and except for coffee, the longest mean cycle is for cotton (an annual crop).

14. Actual quotas and restrictions are used to the same extent as in the sample period, since the estimates of the structure reflect the impact of any such policies.

15. Note that the use of price targets in real terms is not tantamount to indexing since the secular trend in the real price may be either up or down, depending upon changes in the long-run market forces. For a study of the implications of indexing, see Behrman and Tinakorn (1978a) and Tinakorn (1978).

16. The point of comparison for this table is a set of simulations that are identical to the simulations summarized in the table, except that no buffer stock activity is allowed.

17. This index is the ratio of the standard deviation of real revenues with the price stabilization program to the standard deviation in real revenues without the stabilization program. A value of less than 1 thus indicates that revenues are more stable with the program than without it.

18. Perhaps the failure of the cocoa agreement originally negotiated in 1970 to come into effect reflects not that the target price is so much below a long-run equilibrium value, but merely the existence of a long period in which the buffer stock would not be buying, even if the target price is related to the long-run equilibrium value.

19. This calculation of the gains from pooling depends upon the assumption that the capital markets are not perfect and that individual countries participating in the international commodity agreements could not do such pooling on their own. See Behrman and Tinakorn (1977) and Labys (1977) for further discussion of these issues.

20. But Smith and Schink (1976) suggest that the explanation more likely lies in U.S. government tin stockpile activities.

21. However, we have somewhat less confidence in our sugar model than in the others, see Behrman and Tinakorn (1978a, 1978b).

22. But see the previous note.

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