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The Effects of Collective Devaluation on Commodity Prices and Exports

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Summary

In the pursuit of economic development and, in some cases, to service a sizable foreign debt, many developing countries seek to strengthen export performance in traditional primary commodities in the short run while they are diversifying into more income-elastic export products in the long run. In doing so, many poorer countries may be caught in a serious policy dilemma. Increasing the volume of traditional exports, particularly when other countries are attempting the same thing at the same time, may prove counterproductive if the main result of higher export volumes is lower commodity prices for all. Since measures to stimulate export production are often part of economic stabilization and adjustment programs supported by the Fund, the possible repercussions in particular commodity markets of collective actions by producers to encourage exports should be studied.

This paper explores how collective exchange rate action among exporters might reduce world commodity prices and might reduce, rather than increase, an individual country's receipts from its key commodity exports. For this purpose, a simplified model is developed and its properties explored. The analytical framework is used to simulate various supply-side policies in the world markets for cocoa, coffee, and copper in order to explore the effects on world market prices and volumes on the export receipts of African exporters during 1986-95.

Although the study concludes that the potential for deleterious effects on the African export position is real in the case of cocoa, and possibly that of copper, this conclusion is not an argument against devaluation in these or in similar countries. The analysis does imply,

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however, that for countries whose exports are dominated by a single traditional commodity, the assessment of the effects of devaluation must take into account the likely policies of major competitors and the implications of their collective actions for the world market. By implication, the paper also shows that the justification for devaluation in such "special cases" would have to rest more squarely on other effects, such as the stimulation of nontraditional exports and the deflection of domestic demand away from imports.

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I. Introduction

There has been much concern expressed recently in both popular and official circles that many poorer countries may be caught in a serious policy dilemma. In order to develop economically, and in some cases, to service their sizable foreign debts, these countries must increase export earnings, both in the short and long run. 1/ In order to achieve sustained export growth in the long run they must diversify their exports away from traditional primary commodities toward more income-elastic products. This diversification of the export base takes considerable time as well as increased flows of foreign capital and technology. Yet, these increased flows will not be forthcoming unless the countries concerned show a credible export performance in the short run. To do so requires that they rely in the first instance upon traditional primary commodity exports, which may account for as much as 80 percent of total exports. But is it always possible to increase a country's export proceeds merely by increasing the volume of exports, particularly when other countries are attempting to do the same thing at the same time, and demand is relatively inelastic? In this vein an Economist editorial argued that while ". . . export-led growth is rightly favored by the IMF and the World Bank, . . . [these institutions] will win few converts if poor countries know that the main result of higher exports is even lower commodity prices." 2/ Similarly, the Fund itself has recently undertaken a study of The Global Effects of Fund-Supported Adjustment Programs 3/ which, among other things, examines the potential impact of collective exchange rate action on world commodity prices.

The Fund study is concerned with this issue because the economic stabilization and adjustment programs it supports through use of its resources frequently include measures to stimulate increased production for export. Often these policy measures involve a depreciation of the currency with full pass-through to domestic producer prices. Where large wedges between producer prices and border prices at the official exchange rate may already exist, these measures normally will include at least significant increases in important producer prices. From the point of view of producers of export commodities, this latter measure essentially involves an effective devaluation, and it will induce the same supply response from them if their cost structure is not heavily weighted toward imports. Since the Fund may be simultaneously supporting adjustment programs in countries with similar production structures, it must be concerned with the possible repercussions of collective actions by such producers in particular commodity markets.

1/ Recent papers that emphasize the role of debt in inducing the kind of policy and price effects that we will analyze in this paper include Tanzi and Blejer (1986), see especially "The Effect on Key Prices," pp. 13-14; and Gilbert (1986).

2/ November 30, 1985.

3/ Goldstein (1986).

The Fund study identifies the important factors that determine the world price effects of multilateral exchange rate changes by primary producing countries as: (i) shares in world production, (ii) degrees of concentration of production among countries for given shares, and (iii) price elasticities of supply and demand. The study evaluates these factors within the context of a general discussion of developing countries as a group and of aggregated primary commodities. It concludes that the potential for deleterious collective effects may be somewhat less than is generally assumed. This muted impact results from the fact that even where the share of LDCs is large, production of many commodities is so widely dispersed that it would take simultaneous exchange rate action by many producing countries to achieve much of an impact on world supply. Moreover, elasticities of supply are frequently quite low, particularly in the short run, so that even where production is highly concentrated, supply shifts and consequent world price reductions are dampened.

However, the study also notes that world commodity markets do exist in which there is a considerable amount of producer concentration among LDCs, and for which supply elasticities seem to be sufficiently high that the ". . . potential for induced long-run price effects is larger. . . ." 1/ The only two commodities specifically mentioned are cocoa and coffee. The study also speculates that there probably are commodities for which production is highly concentrated, but for which supply elasticities are so low that, even in the long run, the collective effects are unlikely to be substantial. The only commodity specifically mentioned in this regard is copper. 2/

While these insights are valuable, they clearly need to be supplemented by an empirical study. The purpose of the current study is to develop an appropriate, though simplified, analytical framework within which the issues raised can be addressed, and then to apply this framework to the world markets for cocoa, coffee, and copper. The application takes the form of various simulations that explore the effects of the specified supply side policies on African exporters of the three commodities over the next decade, 1986-1995. The study examines the effects of various plausible scenarios of African and other exporters' policies with regard to exchange rates and producer prices, on world market prices and volumes of trade, as well as on African countries' individual and collective export earnings. The simulations utilize the best available estimates of the relevant demand and supply elasticities and project outcomes, given various assumptions regarding both consuming and producing countries' exchange rate policies. Although primarily an empirical study, the paper also derives some general results, such as the definition of the critical market share at which collective action to stimulate production becomes self-defeating in each commodity market from the point

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1/ Goldstein (1986), p. 35.

2/ For an elaboration of the discussion summarized here see, "Primary Commodity Trade," pp. 32-37 in Goldstein (1986).

of view of producing countries, in the sense that the effect is to decrease, instead of increase, their receipts from major commodity exports, such as the three under study here.

The rest of the paper is organized into three sections. Section II describes the model used, its relationship to similar efforts in the literature, and its limitations. Section III presents the results of the simulations, and Section IV offers some concluding remarks.

II. The Analytical Framework

1. Discussion of the model and its properties

a. The model

Most world markets for non-oil primary commodities are essentially competitive. Although particular distortions may affect particular markets, these qualifications are matters of degree in most cases, particularly beyond the short run. Therefore, as with most other studies, the model formulated in this paper is based on the assumption that the market is cleared reasonably quickly through adjustments in price. Specific qualifications to this and other aspects of the model in the context within which we will use it are discussed in the next section, following a discussion of the model's specific structure.

The purpose of the model is twofold: (1) to explain how stimulation of production through simultaneous devaluations in important exporting countries will affect the world market for a commodity and the export receipts of individual producers, and (2) to provide a simple way of generating quantitative estimates of these impacts. Given these objectives, the structure of the model has been kept as simple as possible, focusing only on the critical relative price relationships, while abstracting from other elements that are not directly relevant to the first round impacts of the changes explored. Various second round effects could be hypothesized, 1/ but they are beyond the scope of this paper. In addition,

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1/ For example, a reduction in current world prices could induce changes in the rates of planned capacity expansion in the medium term; for analysis along these lines, see Chu and Morrison (1986). Alternatively, the behavior of one country or a group of countries in the current period could induce various behavior patterns in other countries in a subsequent period through the specification of "reaction functions"; for analysis along these lines, see Lebrun, Sapir, and Ulph (1985).

Since the simulations for which the model is used in this paper are limited to three products for which the resources in use are not easily reallocated and for which investment gestation periods are relatively long, the first round impacts of the policy changes analyzed might well take up to a decade to play themselves out. Moreover, the use of different, empirically based estimates of supply elasticities in the short, medium, and long runs, also incorporates into the simulations some degree of interactive effects, based on past patterns of response.

because the simulations conducted with the model are centered on the supply side, the general properties of the model explored in this paper also are weighted toward the supply side.

Supply of a commodity is determined as a result of profit maximization on the part of producers, who are assumed to respond to incentives provided by changes in relative producer prices. Demand for a commodity is determined as a result of utility maximization on the part of consumers, who are assumed to respond to incentives provided by changes in relative consumer prices. Longer-run factors which may affect supply, e.g., technological change, are not explicitly part of the model, although implicitly they would appear as an integral part of the estimated supply elasticities used. If incorporated into the model, such factors would, no doubt, only serve to reinforce the weakness in primary producers' terms of trade. Longer-run factors on the demand side, e.g., population growth, have been incorporated into the model in a general way which will be detailed below and in Part C of the Annex.

Trade flows between producing and consuming countries meet in the world market, where the price adjusts to clear the market. Changes in international prices are assumed to be fully reflected in corresponding changes in domestic prices. This assumption of "full pass-through" of changes in international prices need not necessarily imply equal corresponding levels initially, but it does imply, in particular, that the producer pricing policy in supplying countries be one of introducing no further distortions.

With these introductory remarks in mind, consider the following set of structural equations for supply and demand in a world commodity market: 1/

$$(1) \quad Q^s = \alpha' \frac{(P \cdot ES)}{PS}$$

$$(2) \quad Q^d = \beta' \frac{(P \cdot ED)}{PD}$$

where: Q^s = quantity supplied

Q^d = quantity demanded

P = world price of the commodity, in dollars

ES (ED) = exchange rate of the supplying (demanding) country, in national currency units per dollar

PS (PD) = index of domestic prices in supplying (demanding) country

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1/ Both the supply and demand equations might be altered to incorporate additional "unspecified shift factors," but we do not need to do so for our purposes. Such an extension could be used, however, if one wished to simulate demand expansion.

We assume that the world market price is denominated (not determined) in dollars, reflecting the fact that most world commodity prices are quoted in dollars. Of course, any other currency could be used equally well. Supply is hypothesized to be a function of the real producer price, and demand is a function of the real consumer price. In this system when a producing country devalues its nominal exchange rate with the dollar (ES), the real producer price, and hence the profitability of production, is raised to the extent that this change is not also fully reflected in the output prices of the nontraded sector or in the cost structure (proxied by PS) of the producer. This increased incentive to produce is required in order to induce the reallocations of resources necessary to expand output. Similarly, when, for example, the world price (P) falls, the real consumer price in demanding countries also falls, assuming no change in the nominal exchange rate (ED), and to the extent that the same fall is not fully reflected in the prices of non-traded substitutes or in the budget constraint (proxied by PD) of the consumer. This increased incentive to consume the commodity in question is required in order to induce the necessary substitutions in order to absorb the increased output.

The reduced form equation for percentage changes in the world price which are associated with the structural equations above is: 1/

$$(3) \quad \Delta p = \frac{\alpha R - \beta K}{\alpha - \beta}$$

and, the reduced form equation for percentage changes in world quantity traded is:

$$(4) \quad \Delta q = \frac{-\alpha\beta(K-R)}{\alpha - \beta}$$

where: $R = \Delta ps - \Delta es$; or, the percentage change in the real exchange rate of the supplying country against the dollar

$K = \Delta pd - \Delta ed$; or, the percentage change in the real exchange rate of the demanding country against the dollar

α = elasticity of world supply in dollar terms

β = elasticity of world demand in dollar terms.

1/ The derivation of equation (3) is contained in Annex A.1. The lower case letter "p" indicates the natural log of P, as do "es," "ps," "ed," and "pd" for their respective variables. The derivation of equation (4) appears in Annex A.2.

The exchange rate changes specified are in real terms, i.e., changes in nominal rates, corrected for changes in relative inflation levels. 1/ Except for this alteration, the model is identical to the Ridler-Yandle (1972) model which relates world commodity prices, exchange rates, and exports. 2/ In utilizing real exchange rate changes as the shift factors for the world supply and demand schedules, the model developed here is similar to those of Gilbert (1973); Feltenstein, Goldstein, and Schadler (1979); Chambers and Just (1979); and, Bautista and Riedel (1982).

The way the system works is as follows. The first step (equation (3)), is to calculate an estimated average change in the world price of a commodity. This is done by specifying the demand and supply relationships in terms of a numeraire currency, in our case the U.S. dollar. If one were to draw the familiar Marshallian market cross, we would be in "dollar space." Real exchange rate changes (i.e., changes in the purchasing power parity value of the dollar viz-a-viz other currencies) are then interpreted as causing shifts in the demand and supply schedules in dollar space. This calculation assumes that each exporting country's supply schedule, expressed in terms of U.S. dollars, will shift to a degree directly proportional to its real exchange rate change. 3/ On the further assumption that the supply (demand) elasticities of the individual exporting (importing) countries are alike (or that the world elasticities are obtained as weighted averages, using trade weights, of individual country elasticities), an export-weighted (import-weighted) average of real exchange rate changes of the exporting (importing)

1/ It is important to note that these real exchange rate changes are calculated bilaterally with the dollar and are specific to the commodity in question. This is a more narrowly defined concept than is the conventionally defined real effective exchange rate (REER) of a country, which utilizes multilateral trade weights. The percentage change in an exporter's REER generally would not be equal to the percentage change in the real bilateral exchange rate specified here. With regard to the latter, the magnitudes of these real bilateral dollar exchange rate changes were checked for cocoa exporters in the 1970s, and the historical movements found were consistent with the magnitudes of changes specified in the various simulation scenarios to follow.

2/ There is no doubt that Ridler and Yandle were thinking in terms of real exchange rate changes, but given the low inflationary era in which they wrote, there may have seemed less need to couch the model explicitly in these terms.

3/ Strictly speaking this statement requires that (1) the importer's demand schedule in terms of his own currency remains unchanged, and (2) the exporter's supply function is not affected by any cost change associated with the exchange rate change. However, even if neither of these assumptions were entirely true in practice, both probably give satisfactory approximations in the context of the present analysis (see IMF, 1972).

countries will represent an estimate of the composite shift in the aggregate export supply (import demand) schedule for all the exporting (importing) countries. 1/

From the estimates of the composite shifts in the global supply and demand schedules caused by the real exchange rate changes specified, an estimate of the average change in the equilibrium price in the world market for a given commodity can be made by introducing assumptions as to the respective supply and demand elasticities. In effect, the percentage change in the average equilibrium world price is computed as an elasticity-weighted average of the composite shifts in supply and demand schedules. 2/ This price change is shown in equation (3), while the related equation for percentage changes in world volume is shown in equation (4). The associated change in world value (not presented) is the simple sum of the price and volume components.

The shifts of the demand and supply schedules can easily be shown graphically. If there were a net real appreciation of importer currencies against the dollar, the demand schedule would shift to the right in dollar space, although the movement in national currency space would be along the demand curve (see Figure 1). 3/ Assuming a conventional upward sloping supply schedule, the result would be an increase in the dollar price and an increase in the volume traded. The economics of these movements is straightforward. With reference to Figure 1.A., imagine initially that the world price is constant, as are domestic prices, while an industrial country's nominal exchange rate with the dollar appreciates. The effect will be to lower the relative domestic price of this commodity, thus throwing the domestic market out of equilibrium, as indicated by the movement from E_1 to E_1'. Consumers will respond by increasing consumption of the now relatively cheaper commodity, thereby raising their overall level of satisfaction. Ultimately they will increase their consumption until the domestic market is back in equilibrium at point E_2. These same movements are depicted in dollar space as a shift in the demand schedule (Figure 1.B.). The demand schedule, by definition, is the locus of price and quantity pairs such that demand for the commodity is in equilibrium and there is no tendency to move, other things being held constant. One of the things being held constant, one which helps to define the position of the demand schedule in dollar space, is the exchange rate. When the exchange rate changes, the position of the demand curve in dollar space

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1/ In terms of equation (3), "R" is the export-weighted average real exchange rate change of exporting courtries and "K" is the import-weighted average real exchange rate change of importing countries. Also see footnote 1 in Annex A.1, page 3, and IMF (1972).

2/ This interpretation of the model is contained in IMF (1972).

3/ The variables on the axes in Figures 1, 2, and 3 are defined consistently with the corresponding definitions in equations (3) and (4) above. Since the logs of variables appear on the axes, the slopes of the supply and demand schedules are α and β, respectively, the constant elasticities of supply and demand. In order to make this correspondence most clearly, the conventional definition of axes has been reversed.

must be moved because of the underlying shift in real demand that has occurred in the national currency market. When the demand curve shifts in dollar space, this throws the world market out of equilibrium, raising the dollar price. At this increased price, incentives will be raised in the producing countries to expand output to satisfy the increased demand, thereby completing the circle.

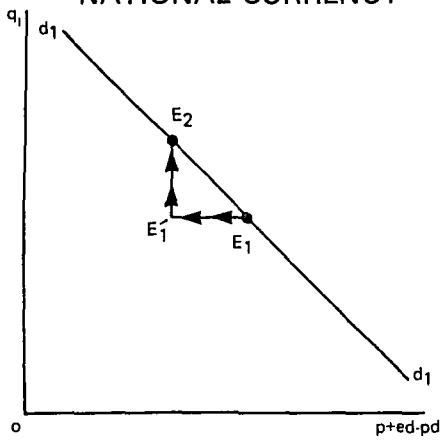
The increase in the volume traded will be further enlarged if the supply schedule is also shifted to the right by devaluation of exporter currencies against the dollar (see Figures 2 and 3). In this case there would be an offsetting negative tendency on the world dollar price, and whether it ultimately increases or decreases will depend upon whether the net appreciation of importers is greater or lesser than the net depreciation of exporters, as well as on the relative elasticities of supply and demand. The economics of the movements on the supply side are analogous to those on the demand side. With reference to Figure 2.A., imagine initially that the world price is constant, as are domestic prices, while a developing country's nominal exchange rate with the dollar depreciates. The effect will be to raise the relative producer price of this commodity, thus throwing the domestic market out of equilibrium, as indicated by the movement from E_1 to E_1'. Producers will respond by reallocating factors toward production of the now relatively more remunerative commodity, thereby raising the overall level of profits. Ultimately they will increase their production until the domestic market is back in equilibrium at point E_2. These same movements are depicted in dollar space as a shift in the supply schedule (Figure 2.B.) for reasons analogous to those already indicated in discussion of the demand schedule shift. When the supply schedule shifts in dollar space, this throws the dollar market out of equilibrium. The increased supplies that are forthcoming onto the world market depress the price. 1/

1/ The simple analytics of market adjustment described here illustrate one of the mechanisms that may have contributed to the current extremely weak state of commodity prices denominated in dollars, i.e., as the dollar appreciated strongly against virtually all other currencies during the first half of the 1980s, market forces were set in motion on both the supply and demand sides of the markets that tended, over time, to lower (in a reinforcing manner) dollar prices of commodities. On the demand side, the system was driven by the depreciation of nondollar currencies, which resulted in consecutive inward shifts of the demand schedule in dollar space. On the supply side, the system was driven by the existence of large amounts of dollar-denominated debt, and the corresponding need to generate ever increasing amounts of depreciated currencies to service the foreign debt, much of which was also based on floating interest rates that had risen to historically high levels. Because of the lags involved in expanding production, the effects of excess supplies of commodities may not have significantly affected world prices before 1984 or 1985. Now that the dollar's earlier appreciation has been partially reversed, at least against some currencies, the opposite process may be expected to be initiated, although the effects on world prices are also likely to be delayed.

FIGURE 1.

SHIFT IN THE DEMAND SCHEDULE

A. IMPORTER'S DEMAND IN NATIONAL CURRENCY



B. IMPORTER'S DEMAND IN DOLLARS

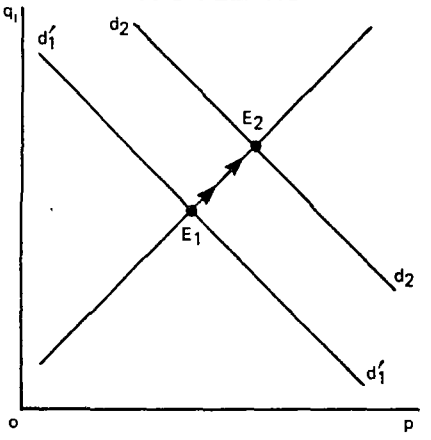
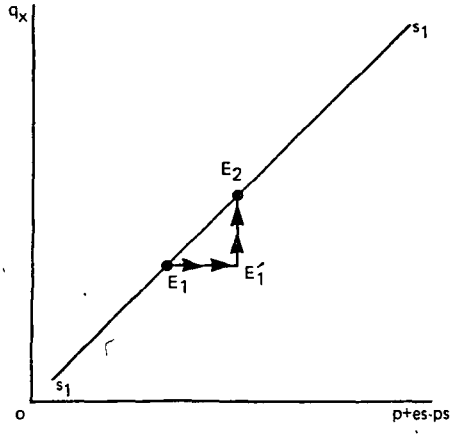


FIGURE 2.

SHIFT IN THE SUPPLY SCHEDULE

A. EXPORTER'S SUPPLY IN NATIONAL CURRENCY



B. EXPORTER'S SUPPLY IN DOLLARS

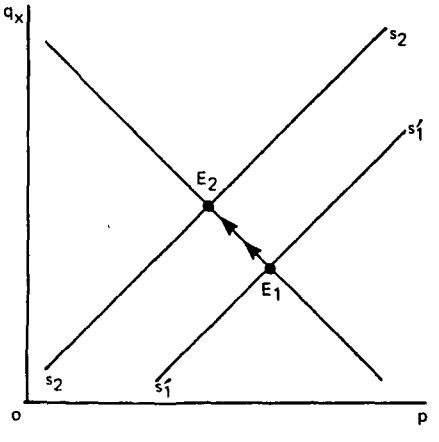
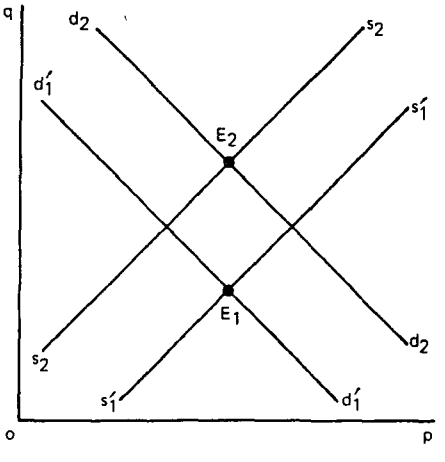


FIGURE 3.

WORLD MARKET EQUILIBRIUM



With the addition of some elasticity estimates considered appropriate to the trade of a particular country, the foregoing estimates of such a country's import and export price changes may be used to derive broad estimates of changes in the volume and value of its external trade: 1/

(5) $\Delta q_i = \alpha_i (\Delta p - R_i)$

(6) $\Delta v_i = \Delta_p (1+\alpha_i) - R_i \alpha_i$

where: Δq_i = percentage change in export volume in country i

Δv_i = percentage change in export value in country i

α_i = country i's elasticity of export supply

The individual country's export adjustment is with respect to the change in the world equilibrium price, which in turn has taken into account all of the global demand and supply responses, including that of the country in question. Equation (6) shows clearly that the change in a supplying country's value of exports in dollars includes the volume supply response both to the change in the world equilibrium price and to any shift factor improving local currency realizations at given numeraire currency prices (e.g., from devaluation with full pass-through to producer prices). 2/ In this application we derive only the effect on countries' export earnings, but the general approach is applicable to the import side as well. 3/

b. Properties of the model

Since one of our primary objectives is to determine whether a single country, or a group of countries, could benefit in terms of increased export earnings from its major primary commodity following devaluation, it is useful to explore the properties of equation (6), while varying the world market share of the country(s) that is (are) expanding. The most interesting cases to consider would seem to be the two polar cases, as well as the crossover point; these are: (1) when the devaluing country is a single monopoly supplier to the world market, but whose domestic production structure includes many producers, (2) when the devaluing country is a small, insignificant producer, and (3) the critical market share at which the returns to devaluation change sign, i.e., shift from positive to negative for the devaluing country(s).

1/ The derivation of equations (5) and (6) is contained in Annex A.3. This annex also shows that the value equation is simply the sum of price and volume equations.

2/ Ridler and Yandle (1972), p. 567.

3/ For example, see IMF (1972), Feltenstein et al. (1979), and Yandle (1974).

The derivations of each of these cases are contained in Annexes A.4.-A.5. Assuming that the country in question is the only exporter to devalue (i.e., $R_{other} = 0$) and that there are no shifts in the world demand schedule (i.e., $K = 0$), then the change in the equilibrium export value (Δv_i) of country i is:

$$(7) \quad \Delta v_i = R_i \left(\frac{\alpha+\alpha_i\beta}{\alpha-\beta}\right)$$

A devaluation and the consequent expansion of supply by such a country clearly does affect the world price. Whether the effect on the country's exports will be positive or negative depends on whether world demand is elastic or inelastic, since in equation (7) the value of Δv_i will be positive whenever demand is elastic ($|\beta|>1$) and negative whenever demand is inelastic ($|\beta|<1$). 1/

When country i is a small, insignificant exporter:

$$(8) \quad \Delta v_i = -R_i\alpha_i$$

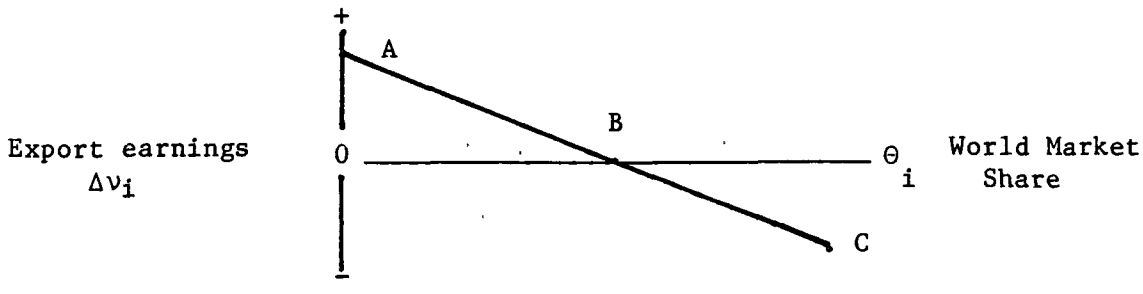
A devaluation and the consequent expansion of supply by such a country clearly does not affect the world price, and such a country will always benefit from devaluation, the usual "small country" assumption.

The critical market share at which the returns to devaluation change sign is:

$$(9) \quad \theta_i = \frac{\alpha_i(\alpha-\beta)}{\alpha(1+\alpha_i)}$$

When country i is a monopoly supplier to the world market, $\alpha_i = \alpha$, and the three cases just described may be related as shown in Figure 4 as:

Figure 4. Percentage Change in Export Receipts As a Function of the World Market Share of the Devaluing Country



1/ Recall that depreciation in our system is indicated by a negative number.

In Figure 4, point A represents equation (8), indicating the maximum gain possible, which is associated with a small or insignificant market share. Point B represents equation (9), the critical market share at which returns become negative. Point C represents equation (7), indicating the position of the monopoly exporter. As noted earlier, point C could be in the positive range of Δv_i, but Figure 4 depicts the kind of case we are studying, i.e., when demand is inelastic.

With appropriate estimates of the supply and demand elasticities, we can use the critical market share formula (equation 9) to evaluate the likelihood that particular countries could benefit from devaluation within particular export markets. For example, using the set of elasticity estimates for copper that incorporate more inelastic estimates of world demand (Annex B.2, SR.1, MR.1, and LR.1), the formula indicates that the critical market shares for Zaire are 10 percent in the short run, 17 percent in the medium run, and 25 percent in the long run. Since Zaire's average world market share is 9.2 percent (Annex Table C), it is likely that Zaire would benefit from devaluation in terms of increased copper export receipts. For Zambia, the corresponding estimates of critical market shares are 17 percent for the short run, 15 percent for the medium run, and 14 percent for the long run. Since Zambia's average world market share is 19.1 percent, it is unlikely that Zambia would benefit from devaluation, insofar as its copper export receipts are concerned. 1/

A final case of interest, and of direct relevance to the simulations undertaken with the model in a subsequent section of this paper, relates to the case in which multiple countries, with different export supply elasticities, devalue simultaneously. The derivation in Annex A.5 shows that, in the case of two such countries devaluing by the same amount, the country with a greater supply elasticity will exhibit a greater elasticity of export receipts with respect to devaluation:

$$(10) \quad \frac{\Delta v_1}{R_1} - \frac{\Delta v_2}{R_2} = (1-c)(\alpha_2-\alpha_1), \quad \text{where:} \quad c = \frac{\alpha}{\alpha-\beta}$$

If both countries pursue competitive policies and are gaining from devaluation, 2/ the country with the higher elasticity will gain more, and if both countries are losing, the country with the higher elasticity will lose less. Since it is intuitively clear that a country with a higher supply elasticity will lose more than a country with a lower supply elasticity if both countries remain passive while the world

1/ It should be emphasized that these estimates result from the more inelastic estimates of world demand contained in Annex B. The more elastic estimates of world demand would give rise to different critical market shares and to different conclusions for Zambia.

2/ As noted earlier, this depends on the elasticity of world demand.

market price is being reduced by devaluations of other market participants, we might summarize the expected pattern of relative gains or losses as in Table 1.

Table 1. Expected Relative Gains or Losses, by Policy Regime, and Elasticity of Export Supply

Elasticity of Export Supply	Policy Regime 1/	
	Competitive	Passive
High	gain more or lose less	lose more
Low	gain less or lose more	lose less

1/ A competitive policy means that the country participates in the group which is devaluing against the dollar, while a passive policy means that the country remains at par against the dollar while its competitors are devaluing.

2. Potential shortcomings of the model

The problems involved with using the type of model outlined above for an application of the kind anticipated here have largely been raised in previous studies. 1/ They will be discussed under two major categories, viz. characteristics of the commodity market model itself and the relative importance of nonprice factors in trade flows. In each case our comments will be directed particularly to our proposed use of the model for simulations of the world cocoa, copper, and coffee markets.

a. Characteristics of the commodity market model

First, the market model assumes that there is little product differentiation in the goods traded and, as noted earlier, that price alone moves to clear the market. In our application there are few problems with the first assumption, as it does not make much difference where the cocoa, coffee, or copper products originate; they are all much the same. 2/ The major difficulty with assuming that price alone

1/ See Ridler and Yandle (1972), pp. 568-71; Gilbert (1985a), pp. 1-3; Feltenstein et al. (1979), pp. 556-61.

2/ Of course, this is a matter of degree. Strictly defined, there are differences of taste and aroma between robusta coffee from Africa and arabica coffee from South America, or between cocoa from Ghana and cocoa from Brazil. But for the purposes of the analysis to be pursued in this study, these differences are unlikely to matter very much. They are a different order of magnitude than are differences among, for example, categories of manufactured products, such as automobiles.

clears the market is that it abstracts from changes in stocks, which might seem to be an important element for any of the three commodities with which we are dealing. Again, the degree to which each commodity is storable varies, so that the existence of stocks is likely to be more relevant for copper and coffee than for cocoa. As far as private stocks are concerned, the stock problem could be dealt with by assuming that private sector stockholding is a function only of the corresponding current and lagged commodity prices. The implication of this approach is that stock demand can be thought of as a component of consumption demand. 1/ In our application this would show up as lower net exports or higher net imports. Official stockholding can be conceived of in the same way, or one could assume that the level of such stocks did not change much over time, which might be a more tenable approach in the long run, when it is more reasonable to assume that production equals consumption.

A second aspect of the commodity market model is that it does not allow for the fact that a country might be both an importer and an exporter of the commodity. This dual trade in the three commodities with which we are concerned is a fact for many importing countries. The way this problem is handled in our application is to use net trade flows for the trade weights in calculating the weighted average exchange rate change for net exporters or net importers. This approach avoids the problem of double counting of gross trade flows, and it results in weights which are, in any case, closer to the conceptually correct notions of production and consumption. These calculations are described in Part C of the Annex to this paper.

A third aspect of the commodity market model has to do with the relative degree of market imperfections in the cases being analyzed. The most glaring imperfections of concern to us relate to the existence of international agreements for coffee and cocoa. These agreements alter the market process by setting country export quotas in order to defend an agreed range of prices for almost all coffee and cocoa exported from producing countries. Given these arrangements, the analysis outlined above is of limited usefulness in the case of coffee within the prescribed price range. 2/ However, it was thought useful to pursue the analysis in view of the fact that current world coffee prices have been high enough that quotas were recently suspended, so that the market operates freely. Moreover, provisions in the new cocoa agreement, which is expected to be fully in force by early 1987, link price targets and their adjustments under the scheme to underlying trends in market fundamentals, thus making the scheme more compatible with the thrust of our analysis. In any case, international market arrangements, such as those for coffee and cocoa, also are subject to review by both consuming and producing

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1/ Gilbert (1985a), p. 3.

2/ The analysis could still be applied, but elasticities of export supply would be zero for all countries. Since we are interested in the supply side ramifications in the world market in this paper, such an analysis would not be particularly fruitful.

members, while market pressures by nonmembers may sometimes also render the schemes ineffective. Should either agreement break up, or be revised in major ways, the analysis pursued in the next section could be relevant and useful, although one would have to bear in mind in interpreting the results that the disposition of any large stocks in producing member states would bias the outcome.

A fourth aspect of the market relationships specified above is that they ignore cross-price elasticities of demand or supply. On the supply side there are unlikely to be any serious biases introduced by this approach because we are dealing with production of two perennial crops and extraction of a mineral, all activities which involve relatively long gestation periods for investment. 1/ On the demand side this is probably not a problem within normal ranges of price variations, with the exception of copper, the demand for which is known to show a significant response to changes in the price of aluminum. The omission of this cross-price effect from the model is not considered serious within the limited scope of the current study. The baseline price projections for copper do include likely movements in aluminum prices over the simulation period. The simulations undertaken are only concerned with deviations from the baseline price series, and thus they do not exclude cross-price effects with aluminum altogether, but only those associated with the marginal changes simulated.

b. Relative importance of nonprice factors

The final set of problems with the commodity market model relate to the relative importance of nonprice factors in determining trade flows. Within this category are all the factors which underlie the construction of demand and supply schedules, and which together determine the position and shape of these schedules in "price space." Of the missing elements, it is undoubtedly income on the demand side that is most important. Essentially the model as specified assumes that income does not change, or that elasticities with respect to income are unimportant for the commodities we are considering in the context of the simulations undertaken. Again, this specification is likely to be reasonably accurate within the context of the supply side simulations that are undertaken in this study. These simulations compare deviations in implied market clearing prices associated with expansionary policies in specified exporting (developing) countries from a baseline path of prices which does incorporate the likely development of demand variables, including income (or industrial production) in industrial countries. 2/

1/ One possible exception is the case of coffee and cocoa in Cote d'Ivoire. Since many production units produce both crops, there is some degree of cross-price response, even in the short run. This characteristic is more important in accounting for the relatively high supply elasticities in Cote d'Ivoire than in biasing this study's results to any significant degree.

2/ See part E of the Annex for details.

Since the specified policy changes refer only to real depreciations on the part of major exporters of cocoa, copper, and coffee, it is unlikely that these policy changes would induce any corresponding changes in any major nonprice demand factor important in determing trade flows of these three commodities.

III. Simulation Results: Cocoa, Copper, and Coffee in Africa, 1986-95

This section discusses the results of simulations of the world cocoa, copper, and coffee markets using the model developed in the preceding section. The analysis focuses on the position of African exporters of these commodities over the next decade.

From the preceding section it follows that the problem of collective devaluation and the associated reduced export earnings is related both to specific characteristics of the market, e.g., elasticities of world supply and demand, and also to the concentration of production among countries. Concerning the specific characteristics of the market, we can use equation (9) from the preceding section to calculate the critical shares in each commodity market at which we would expect this problem to arise. In order to derive comparable figures across all three commodity markets and, to some extent, across most "average" countries, it is convenient to assume a monopoly supplier (so that $\alpha_i = \alpha$) in each case. These shares are presented in Table 2 below.

Table 2. Critical Market Shares 1/

	Cocoa	Copper: More inelastic demand	Copper: Less inelastic demand	Coffee
	(Percent of world exports) 2/			
Short run	27	14	55	26
Medium run	42	35	82	45
Long run	53	48	100	56

1/ Market shares at which the effect on export receipts from devaluation becomes negative. Shares are calculated from equation (9) in the text, using elasticity estimates in Annex B.

2/ Trade shares are derived as in Annex C.

Considering only the technical parameters of the markets, the copper market seems either most or least likely to illustrate the phenomena we are analyzing, depending upon which estimates of world copper demand one uses. The critical share levels of the cocoa and copper markets fall in the middle and look remarkably similar.

Considering the second criterion (the concentration of production among countries) and classifying the markets from most likely to least likely to reveal problems of collective devaluation from the point of view of African producers, the results are first cocoa, second copper, and finally coffee. In the world cocoa market about 62 percent of world exports of cocoa come from four African countries (Cote d'Ivoire, 30 percent, Ghana, 16 percent, Nigeria, 10 percent, and Cameroon, 6 percent). 1/ In the world copper market 28 percent of world exports are accounted for by two African countries (Zambia, 19 percent and Zaire, 9 percent). In the world coffee market about 26 percent of world exports is accounted for by ten African producers; the largest single country share is that of Cote d'Ivoire (about 6 percent), while the smallest five countries each account for less than 2 percent of world exports. 2/

The results of the simulations are discussed first for cocoa, then copper, and finally coffee. Within each commodity the discussion of simulation results follows the same format. First, a baseline scenario is selected as the reference set of price projections against which all simulation projections are compared. The baseline price projections for each commodity are those of the Fund's Spring 1986 World Economic Outlook. A full characterization of the extensive assumptions for the three baseline medium-term scenarios is contained in IMF (1986); the major assumptions are also summarized in part E of the Annex of this paper. After the baseline benchmark has been established, several supply expansion scenarios are run, and the results are presented as deviations from the baseline trend in prices. In each commodity market the smaller African producers first are hypothesized to depreciate their currencies moderately (by 3 percent per year) against the dollar during 1986-95 (compared with their baseline behavior), while all other exporters and importers follow their baseline behavior. Then, the set of devaluing countries is progressively widened, usually to all African exporters first, then to all exporters. Finally, a set of scenarios is undertaken in which one or two of the major exporters (not necessarily African countries) are hypothesized to depreciate by a relatively large amount (10 or 15 percent) in a given year, then differing sets of other exporters are hypothesized to match the devaluation in the following year, or to remain passive.

1/ See Annex, part C, "Estimation of Trade Weights," for an explanation of the export shares of all three commodities. As noted earlier, trade shares are calculated on a net basis.

2/ In the robusta market alone, Africa accounts for over half of world exports, but robusta coffee accounts for only about a quarter of world coffee exports.

It is intuitively clear at the outset that virtually all the scenarios run would expand world output and lower the world price, when compared with the baseline projections. The depreciating country or countries could either benefit or lose, but the passive exporters would always lose. This is because of the way the policy scenarios are designed, i.e., because the hypothesized policy changes are unlikely to affect either important demand side variables or the deflator (the world price of manufactures) being used. However, there still is no necessary zero-sum character to any of the results. If demand were to increase (fall) because of factors omitted in the analysis, e.g., due to greater economic expansion (contraction) in the industrial countries than assumed in the baseline scenario, then the fluctuations originating on the supply side which are being explored in this study could be seen to vary around higher (lower) levels of world prices and export earnings.

Within each scenario the calculated percentage change in the world market price and volume traded are presented. The percentage change in world market values can be calculated by summing the percentage changes in the component price and volume figures. Within each scenario the calculated effects on the export earnings of all African producers are also presented. In this case the changes in export volumes of the individual countries are not provided, but these also can easily be calculated by subtracting the percentage change in world market price from the given percentage change in country export values.

The demand and supply elasticities used in the exercise, both at the world level and for individual countries, are described in the Annex, part B, of this paper. In most cases, the elasticities were obtained from the empirical literature on the advice of Fund staff who have worked on the relevant commodities for an extended period. In some instances, notably for supply elasticities of individual exporters of coffee, published estimates were unavailable. In such cases, experienced staff at the Fund and World Bank supplied estimates. In some cases a range of elasticities was used, e.g., in the cocoa analysis the results presented are the average of two separate sets of calculations using the two sets of elasticity estimates reported. Where there was considerable divergence of opinion in the literature regarding the appropriate value of a particular elasticity, such as was (only) the case for the elasticity of world demand for copper, results are presented for two sets of representative elasticities.

The supply elasticities from the literature generally indicate production response to changes in real output prices, measured at the producer level. In our model these elasticities are used to represent export, rather than production, changes. The main variables intervening between production and export flows are domestic consumption and stocks. Domestic consumption is negligible for the commodities we are considering in Africa, which is the focus of our analysis. Domestic consumption is quantitatively significant only for coffee in Brazil, which is unlikely

to bias the global supply estimates much. 1/ With respect to stocks one could think of the results as implying constant stocks, as we earlier assumed, and as seems especially reasonable in the long run.

The baseline price projections for all three commodities and the conventional deflator used to put them into real terms are presented in Annex Table D1. Summaries of each series also appear in the relevant commodity tables in each set of simulations, as necessary.

1. Cocoa

The results of the cocoa simulations are summarized in the Annex Table D2. The baseline scenario 2/ shows a cumulative fall from 1985 in the real world cocoa price of 25 percent by 1987, 29 percent by 1991, and 24 percent by 1995. This projection reflects both the weakness forecast in cocoa prices (in U.S. dollar terms) in the near term and also the strong increase forecast for the deflator, particularly in 1986 (14 percent, see Annex Table D2 and part E of the Annex). The world cocoa price itself is forecast to drop by 10 percent between 1985 and 1987, after which a slow recovery is forecast such that prices will reach the 1985 level by 1991; from 1991 through 1995, price increases will be significant, averaging 6.4 percent per year.

The initial set of supply side scenarios for cocoa contained three alternative runs of the model; in each case the specified country or countries depreciate in real terms by 3 percent per year during 1986-95, while all other exporters and importers assume their baseline behavior. As explained in the notes to Annex Table D2, the three sets of countries are: (i) Cote d'Ivoire, accounting for 29.8 percent of world exports, (ii) Cote d'Ivoire and Ghana, 46.1 percent, and (iii) all exporters, 100 percent.

When Cote d'Ivoire alone depreciates and correspondingly raises its domestic producer prices, the "small country" assumption works, i.e., the country benefits from the stimulation of production and the subsequent increase in its real export receipts. In the short run, and even in the medium run, the benefits are relatively modest, but in the long run the country's export receipts are estimated to be 7 percent higher than they otherwise would have been (i.e., compared to the baseline scenario). Other African producers, and indeed all other producers, suffer a decline in export earnings because they now face a lower world price. The decline in their export earnings is somewhat

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1/ To the extent a bias was introduced it would tend to understate export supply of Brazil. If domestic consumption were significant in size but relatively flat, a given percentage supply response of production would produce a quantity which, when taken relative to exports, would be a larger percentage change.

2/ As explained in the Annex, part E, official WEO assumptions run only through the medium term (1991), but for the purposes of this paper the 1991 assumptions were extended through 1995.

greater than the fall in the world price because they have positive supply elasticities--i.e., the decline in price also elicits lower output from them as resources are slowly shifted from cocoa production into other sectors whose return relative to cocoa has now risen. 1/

When the two largest African producers, viz., Cote d'Ivoire and Ghana, with a combined total of 46.1 percent of world exports, pursue the same policy together, a different picture emerges. In this case we are on the perimeter of applicability of the small country assumption, but each individual exporter is assumed to continue to behave as if its own actions were taken alone. There are significant reductions in the world price over time, although the net increase in world volume is still relatively small. Neither Cote d'Ivoire nor Ghana benefits in the short to medium run. In the long run Cote d'Ivoire does benefit, but Ghana does not. The difference is due to their very different supply elasticities (see Annex, part B). Cote d'Ivoire, with its much higher elasticity, eventually expands production enough to offset the fall in the world price. Ghana, with less responsive production, is unable to do so. 2/ The losses suffered by other African producers exhibit the opposite relative tendency. The country with the more responsive producers, i.e., Cameroon, loses more than the country with the less responsive producers, i.e., Nigeria, because the fall in output induced by the falling world price is greater in Cameroon.

As these offsetting movements suggest, there is no simple relationship in the model between the elasticity of export supply and the amount of losses or gains for an individual country. However, as is shown in the Annex, part A.6, the country with the greater supply elasticity will exhibit a greater elasticity of export receipts to devaluation. If both devaluing countries are gaining, the country with the higher elasticity will gain more, and if both are losing, the country with the higher elasticity will lose less. 3/ As indicated earlier, the simulations carried out here assume that the country or countries devaluing do so in the belief that the small country assumption is valid for them, i.e., that they would gain from devaluation. However, if the small country assumption did not hold, and the country knew how its own stimulation of output could affect the world price, then there would be a simple relationship between its change in export proceeds and its elasticity of

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1/ Note also that in terms of equation (6) in the text that for all exporters except Cote d'Ivoire, the second term is zero, as they have not devalued (R_1=0) in order to stimulate output and offset the decline in world price.

2/ It is possible that Cote d'Ivoire's relatively high supply elasticity partly reflects apparent movement of cocoa from Ghana into Cote d'Ivoire due to past differences in relative producer prices in the two countries.

3/ The results reported in Annex D are consistent with this general proposition as they are stated as deviations from the baseline scenario. In the baseline, Cameroon is assumed to remain at par with the dollar during 1986-95 while Nigeria is assumed to depreciate by 1 percent per year.

demand (rather than supply). The country then would be acting as a profit-maximizing monopolist or oligopolist, and would set its output level such that its marginal cost was equated with its declining marginal revenue schedule.

The final case (case C in Annex Table D2) in this type of scenario is when all exporters are hypothesized to devalue against the dollar simultaneously by 3 percent per year during 1986-95. In this case the world price falls significantly (by 15 percentage points more in the long run than under the baseline scenario) due to the increased volume being exported. This case illustrates how dramatically the world price can fall in the medium to long run, when world demand is inelastic, even with moderate increments in aggregate supply. The effect on African countries' export earnings is uniformly negative, although the more supply responsive countries, i.e., Cote d'Ivoire and Cameroon, suffer less in the long run.

The fourth supply scenario (case D in Annex Table D2) assumes that the developing country exporters of cocoa tie their currencies to a particular industrial country's currency, or to a basket of such currencies during 1986-95. Specifically, Cameroon and Cote d'Ivoire remain at par with the French franc, Nigeria with the pound sterling, and all other exporters with the U.S. dollar. When combined with the baseline scenario assumption that the nondollar major currencies appreciate against the U.S. and Canadian dollars during 1988-91, this scenario results in a slight net contraction of world output (as the net supply schedule shift is inward) and a slight increase in the world price. Both of the countries aligning with the franc lose because their domestic prices of cocoa fall and induce a reduction in exports. Ghana, the African producer which remains tied to the dollar, clearly gains the most.

The final set of supply scenarios for cocoa consists of three runs; in each run Brazil is assumed to depreciate by 15 percent in 1987. In the first run (case E in Annex Table D2), all other exporters are assumed to match Brazil's move by depreciating themselves by 15 percent in 1988. In the second run (case F), only the African exporters are assumed to match Brazil's devaluation. In the third run (case G) no other country matches Brazil's move. The comparative results show that the African exporters lose least by remaining passive--i.e., by not matching Brazil's devaluation. If they and all other exporters do match the devaluation, their losses are roughly twice as large as when they do nothing, as the additional supplies on world markets simply drive the world price lower. If the non-African exporters do not go along, then an intermediate position is reached. Again, in each case the active countries with the most elastic production structures lose least.

2. Copper

The results of the copper simulations are summarized in Annex Tables D3 and D4. In general the simulations parallel those of cocoa. However, for each individual scenario two separate runs are reported that

are based on two separate estimates of the elasticity of world demand. The alternate estimates contained in the literature are far more widely divergent for copper (Annex, B.2) than was the case for cocoa (Annex, B.1). Consequently, it was inappropriate to use an averaging technique in presenting the results, as was done for cocoa. While it is difficult to argue that either set of estimates is absolutely correct, it would appear that more recent estimates of world demand are the more inelastic estimates. Again, we will review the results of each scenario briefly, including the implications of using alternative assumptions for the degree of inelasticity of world demand.

The baseline scenario shows the cumulative change from 1985 in the real world copper price of -6 by 1987, 3 by 1991, and 4 by 1995. The initial weakness in the real price is again due primarily to the large increase forecast for the deflator in 1986 (Annex, part E). Copper prices themselves are expected to increase at a moderate rate of 5.8 percent per year during 1986-95, while the corresponding rate for the deflator is 5.4 percent per year.

The initial set of scenarios for copper contained four runs of the model; in each case the countries accounting for an increasing share of world exports were again assumed to depreciate by 3 percent per year against the U.S. dollar. The four sets of countries are: (i) Zaire, with 9.2 percent of world exports, (ii) Zambia, 19.1 percent, (iii) Zaire and Zambia, 28.3 percent, and (iv) all exporters, 100 percent. The comparative results suggest that Zaire could benefit from the assumed policy, but Zambia could benefit only if the less inelastic estimates of world demand were correct. Similarly, neither would benefit if they devalued together and if demand were more inelastic, while only Zaire, whose supply elasticity is estimated to be twice Zambia's in the long run, would gain if demand were less inelastic. Clearly, both lose much more when all exporters expand output if demand is more inelastic than if demand is less inelastic. In addition, in the former case the fall in the world price (19 percent) is very large, considering the relatively modest increase in world supply (3 percent in the long run).

The final set of supply scenarios consisted of three runs; in each run the large South American exporters (Chile and Peru, together accounting for 46 percent of world exports) are assumed to depreciate by 15 percent in 1988. In the first run, all other exporters are assumed to match the depreciation in 1989; in the second run, only the African exporters are assumed to match the devaluation; and, in the third run, no other exporters are assumed to match the devaluation. Again, the comparative results are very similar to those for cocoa, i.e., the Africans lose least when they remain passive and do not drive the world price even lower by expanding their own exports. Clearly, when all exporters match the devaluation, the losses are very sizable and greater than when only the Africans match the depreciation. For all the corresponding cases, losses are lower with less inelastic world demand. As was the case for cocoa, countries with more elastic supplies lose less in the long run than those with less elastic supply.

3. Coffee

The results of the coffee simulations are summarized in the Annex Table D5. In general, the simulations parallel those of the previous two commodities, although the results differ. However, it should be noted that the results for coffee are less reliable because estimates of individual country supply elasticities were not available in the literature. Consequently, on the basis of advice from experienced staff at the Fund and World Bank, individual country estimates were assumed (see Annex, B.3).

The baseline scenario shows the cumulative change from 1985 in the real world coffee price of 10 percent by 1987, -13 percent by 1991, and -3 percent by 1995. The behavior of the deflator over this period has already been discussed. Coffee prices themselves are expected to increase by 45 percent (on average) in 1986, due primarily to drought in Brazil in 1985. In 1987 and 1988 prices are expected to fall by 10 percent per year from the abnormally high levels of 1986, and as world producers respond to the generally high prices of recent months. In 1989 no change in prices is expected, and beginning in 1990-91 and continuing through 1995, price increases are projected to accelerate from around 3 percent per year to 10 percent per year.

The initial set of scenarios for coffee contained three runs of the model; in each case the countries accounting for an increased share of world exports are again assumed to depreciate by 3 percent per year against the U.S. dollar. The three sets of countries are: (i) Cote d'Ivoire and Uganda, accounting for 10.5 percent of world coffee exports, (ii) all African exporters, 26.5 percent, and (iii) all exporters, 100 percent. The comparative results suggest that any set of the African exporters could benefit from the assumed policy. Given the quite inelastic estimates of world demand, particularly in the long run, the magnitude of the implied decline in the world price (20 percent) in the long run when all exporters moderately expand output is remarkable.

The final set of supply scenarios consists of four runs; in the first two runs (D and E in Annex Table D5), the world's major coffee producers, Brazil and Colombia, are assumed to depreciate against the U.S. dollar by 5 percent in 1988 and 1989. In one scenario all other exporters are assumed to match the depreciation in 1990 and 1991; in the other they remain passive. Comparison of the two outcomes shows that it makes little difference which strategy the other exporters follow, particularly since the simulations end so soon after their alternative reactions. Had the effects had longer to work through the system, the others would have been hurt less by remaining passive. In the final two runs (F and G), Brazil and Colombia are assumed to depreciate by 10 percent in 1987. In one of the runs all the African exporters are assumed to match the depreciation in 1988, while in the final run no other exporters match the South American producers. In this case, because the aggregate African share is still relatively small, the Africans lose less by matching the devaluation (if others do not), rather than by remaining passive.

IV. Concluding Remarks

Since production of some traditional primary commodities is concentrated in a relatively few countries, and because world demand for these commodities is highly inelastic, the possibility exists that simultaneous expansion of output by even a couple of exporters could reduce, rather than increase, receipts from what are frequently the dominant exports of these countries. This study has explored this possibility by examining the impact of individual and collective stimulation of production by exporters on both the expanding and nonexpanding countries. The discussion focused initially on the general results which can be derived from the market model utilized and subsequently on simulations of the impact of various supply side scenarios on African producers of three commodities (cocoa, copper, and coffee) during the next decade, 1986-95.

The general results consist mostly of a set of simple equations which may be employed to estimate the likelihood that a particular country (or set of countries) would encounter reduced receipts from its (or their) major traditional commodity export, given specified assumptions regarding exporters' exchange rate-cum-producer price policies, and estimates of the relevant elasticities. A second general result is the (intuitively appealing) implication that countries with a more flexible production structure, characterized by higher elasticities of export supply, are more likely to fare better if they pursue an active policy course, than those with less flexible production structures.

The simulation results are presented as percentage point deviations from a set of baseline price projections for each commodity. The assumptions underlying the baseline projections are described in detail, including a characterization of developments in the industrial countries, which largely form the markets for the three commodities we are analyzing.

The results for cocoa suggest that the potential for reduced export earnings from cocoa resulting from simultaneously increased production by African producers is a real possibility. The central reason for this result is the high concentration of production among only a few African countries: four African countries account for about 62 percent of world exports of cocoa. If both Cote d'Ivoire and Ghana (with a combined total of 46 percent of the world market) only moderately stimulate output by real exchange rate depreciations of 3 percent per year for the next decade, 1/ Ghana would be likely to lose real export earnings from cocoa, while Cote d'Ivoire, with a much higher supply elasticity, would be likely to gain only very modestly. If either of the other two African producers were to pursue similar policies at the same time, then the three countries would be likely to lose real export earnings from cocoa.

1/ As noted earlier, this rate is bilateral; the real effective depreciation would be less if the dollar fell against other major currencies. Also, recall that full pass-through of exchange rate changes to domestic producer prices is assumed.

The cocoa simulations also suggest that a policy of pegging a country's exchange rate to a nondollar major currency, or basket of such currencies, would be likely to result in losses of export receipts from cocoa, if the dollar were to depreciate significantly against other major currencies, but the magnitude of such losses probably would not be very large. Finally, the simulations show that, at least as far as the first round effects are concerned, African exporters would lose least by remaining passive after a large devaluation by a major third country (non-African) cocoa exporter, compared with their position when either they alone, or they and other exporters, match the initial depreciation.

The results for copper are broadly similar to those for cocoa. Although the African market share, at 28 percent of world exports, is much smaller than for cocoa, it is concentrated in only two countries, Zambia, with 19 percent, and Zaire, with 9 percent. The simulation results imply that it is unlikely that either country would gain much in terms of real copper exports if both stimulated production simultaneously, the uncertainty regarding the precise degree of inelasticity of world demand for copper products notwithstanding. The likelihood of loss is particularly great for Zambia, whose elasticity of supply, even in the long run, is estimated to be very low. Moreover, if a major third country exporter were to depreciate significantly, the Africans would be likely to lose more in terms of real copper export receipts if they matched the depreciation than if they remained passive.

The more tentative results for coffee suggest that the collective impact on real export earnings from coffee of the policies examined is not likely to be a problem for African producers. Coffee production is much less concentrated among countries in Africa than either cocoa or copper production; ten African countries account for 26 percent of world exports, and five of them have shares below 2 percent. Even if all ten countries should move together, the simulations suggest they all could benefit significantly in terms of increased real earnings from coffee exports. Moreover, if a major third country exporter should devalue significantly, the Africans' best strategy to minimize losses of real coffee export receipts would be to match the devaluation.

These basic results for the three commodities abstract from unexpected short-term supply shocks that might disturb the market, as has recently occurred in the coffee market. Another major qualification, which applies to the cocoa and copper analyses, as well as to coffee, relates to the elasticity estimates used. As the analysis of copper demonstrates, the results are sensitive to changes in the elasticity estimates of world demand. The same is true of the supply elasticity estimates. While every effort has been made to use the most reliable and consistent estimates available, such elasticity estimates are well known to be sensitive to changes in the time period over which they are measured and to the specific econometric techniques utilized. Consequently, it is preferable not to view the results as exact quantitative estimates, but rather as general indications of range, or of orders of magnitude.

It also should be emphasized that while the general framework of analysis outlined in this paper could usefully be applied to other commodity markets, the results of the simulations undertaken for the cocoa, copper, and coffee markets should not be generalized. As was stated in the introduction, these three markets were chosen because they illustrated, from the Africans' point of view, the important characteristics that are likely to result in deleterious effects of multilateral exchange rate changes, viz., large shares in world exports, high degrees of concentration of production among exporters, and highly inelastic supply and demand. It is quite possible, indeed likely, that a similar analysis of other commodity markets and groups of exporters would lead to different conclusions.

Finally, a major note of caution is in order with regard to what may or may not be concluded from this paper regarding the appropriateness of devaluation in the type of economies and world environment we have been discussing. Because there is a need for such countries to diversify and restructure their economies, we could not conclude that devaluation is inappropriate, even if we were to conclude that such a policy would, either by itself or through its inducement of similar policies by competitors, unequivocally reduce export receipts from a major traditional primary commodity in a given country. Since devaluation is a general instrument, the economy's resources would be reallocated not only into the traditional export sector, but also into nontraditional exports and into import-competing production. Because the purpose of this paper has been focused elsewhere, and recognizing the need to constrain the study to manageable proportions, we have intentionally not expanded the scope of analysis to include estimates of these effects, nor of those on imports, the stock of debt or flow of debt service, or on foreign exchange reserves. Surely all these factors would have to be taken into account in assessing the net impact of devaluation on an economy and its external position. However, the analysis does imply that for some of the countries on which we have focused, countries where a single traditional commodity dominates in exports, the evaluation of the effects of devaluation must take into account the likely policies of major competitors and the implications of these collective actions for the world market. In this connection, it is hoped that the demonstration of the relatively simple methodology used in this study will provide a useful framework for analysis.

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A. Mathematical formulation of the model

1. Consider the following structural equations for supply and demand in a world commodity market:

$$(1) \quad Q^s = \alpha' \left(\frac{P \cdot ES}{PS}\right)$$

$$(2) \quad Q^d = \beta' \left(\frac{P \cdot ED}{PD}\right)$$

where: Q^s = quantity supplied

Q^d = quantity demanded

P = world price of the commodity, in dollars

ES (ED) = exchange rate of the supplying (demanding) country, in national currency units per dollar

PS (PD) = index of domestic prices in supplying (demanding) country

Solution for the percentage change in the market-clearing equilibrium price (Δp) is as follows, where lower case letters indicate natural logs of variables:

$$\alpha'(p+es-ps) = \beta'(p+ed-pd)$$

$$\alpha(\Delta p+\Delta es-\Delta ps) = \beta(\Delta p+\Delta ed-\Delta pd)$$

$$\alpha\Delta p+\alpha\Delta es-\alpha\Delta ps = \beta\Delta p+\beta\Delta ed-\beta\Delta pd$$

$$\alpha\Delta p-\beta\Delta s = -\alpha\Delta es+\alpha\Delta ps+\beta\Delta ed-\beta\Delta pd$$

$$\Delta p(\alpha-\beta) = -\alpha(\Delta es-\Delta ps)+\beta(\Delta ed-\Delta pd)$$

$$\Delta p = \frac{-\alpha(\Delta es-\Delta ps)+\beta(\Delta ed-\Delta pd)}{\alpha-\beta}$$

or,

$$(3) \quad \Delta p = \frac{\alpha R-\beta K}{\alpha-\beta}$$

where: $R = \Delta ps-\Delta es$; or, the percentage change in the real exchange rate of the supplying country against the dollar

$K = \Delta pd-\Delta ed$; or, the percentage change in the real exchange rate of the demanding country against the dollar

α = elasticity of world supply in dollar terms

β = elasticity of world demand in dollar terms

Equation 3 is exactly analogous to the corresponding equation in the Ridler-Yandle system (1972), except the "shift factors" for the world supply and demand schedules, R and K, respectively, in equation 3 are explicitly expressed as real, rather than nominal, exchange rate changes. The world supply (demand) shift factor is equivalent to the weighted average percentage change in real exchange rates against the dollar of exporters (importers), where the weights are net world export (import) shares. 1/

2. Solution for the percentage change in the market-clearing equilibrium quantity is (using the supply expression):

$$\Delta q = \alpha(\Delta p + \Delta es - \Delta ps)$$

substituting for Δp from equation (3):

$$\Delta q = \alpha \left(\frac{\alpha R - \beta K}{\alpha - \beta} - R \right)$$

1/ As shown in the mathematical appendix of Ridler and Yandle (1972) the weighting pattern in the general case could include additional terms for the ratios of the individual country's export supply (import demand) price elasticities to the world elasticity. For "m" exporters, the percentage shift in the world export supply curve (measured in the price direction) is:

$$R = \sum_{i=1}^{m} R_i . \alpha_i . \frac{\eta_{si}}{\eta_s}$$

where:

R_i = percentage change in the exchange rate of the ith exporter

α_i = the proportion of world exports of the commodity exported by the ith producer in the base period

η_{si} = price elasticity of supply for exports of the commodity in the ith country

It can be assumed (as is done in the text, and by Ridler and Yandle) that the ratios $\frac{\eta_{si}}{\eta_s}$ will not significantly affect the results, so the formula used becomes:

(continued)

$$= \frac{\alpha 2R-\alpha\beta K}{\alpha-\beta} - \alpha R$$

$$= \frac{\alpha 2R-\alpha\beta K-\alpha(\alpha-\beta)R}{\alpha-\beta}$$

$$= \frac{-\alpha\beta K+\alpha\beta R}{\alpha-\beta}$$

$$(4) \quad \Delta q = \frac{-\alpha\beta(K-R)}{\alpha-\beta}$$

3. Derivation of the percentage changes in equilibrium export volume and value for an individual exporter, country "i", begins with the definition of export supply elasticity for country "i":

$$\alpha_i = \frac{\Delta q_i}{\Delta p_i}$$

or,

$$\Delta q_i = \alpha_i \Delta p_i$$

and,

$$\Delta q_i = \alpha_i(\Delta p + \Delta es_i - \Delta ps_i)$$

where: α_i = country i's elasticity of export supply

Δq_i = percentage change in country i's quantity exported

Δp_i = percentage change in real producer price

or,

$$(5) \quad \Delta q_i = \alpha_i(\Delta p - R_i)$$

Equation (5) gives the percentage change in equilibrium export volume of country "i".

1/ (concluded)

$$R = \sum_{i=1}^{m} R_i . \alpha_i$$

The formulas for "K" and the importers on the demand side are defined analogously.

The percentage change in the value of country i's exports (Δv_i), measured in terms of dollars, would be:

$$\Delta v_i = \Delta p + \Delta q_i$$

where: Δp = percentage change in world (dollar) price substituting,

$$\Delta v_i = \Delta p + \alpha_i(\Delta p + \Delta es_i - \Delta ps_i)$$
$$= \Delta p + \alpha_i \Delta p + \alpha_i(\Delta es_i - \Delta ps_i)$$

$$(6) \quad \Delta v_i = \Delta p(1+\alpha_i) - R_i\alpha_i$$

where: $R_i = \Delta ps_i - \Delta es_i$

4. Derivation of the percentage change in equilibrium export value for an individual exporter, (a) when that country is the only exporter, and (b) when it is a small, insignificant producer.

Substituting equation (3) into (6):

$$\Delta v_i = \left(\frac{R\alpha - K\beta}{\alpha - \beta}\right)(1+\alpha_i) - R_i\alpha_i$$

let "R" be decomposed into its elements as a weighted average between country "i" and "other," where θ_i and $(1-\theta_i)$ represent world trade shares, then

$$= \left(\frac{R_i\theta_i\alpha + R\ \text{other}\ (1-\theta_i)\alpha - K\beta}{\alpha-\beta}\right)(1+\alpha_i) - R_i\alpha_i$$

$$= \left(\frac{R_i\theta_i\alpha}{\alpha-\beta} + \frac{R\ \text{other}\ (1-\theta_i)\alpha - K\beta}{\alpha-\beta}\right)(1+\alpha_i) - R_i\alpha_i$$

$$= \frac{R_i\theta_i\alpha}{\alpha-\beta}(1+\alpha_i) - R_i\alpha_i + \frac{R\ \text{other}\ (1-\theta_i)\ \alpha - K\beta}{\alpha-\beta})(1+\alpha_i)$$

$$= R_i\left(\frac{\theta_i\alpha}{\alpha-\beta}(1+\alpha_i) - \alpha_i\right) + \frac{R\ \text{other}\ (1-\theta_i)\alpha - K\beta}{\alpha-\beta}(1+\alpha_i)$$

now, suppose $K = 0$ (i.e., no shifts in world demand schedule due to importers' depreciation against the dollar)

and, $R_{other} = 0$ (i.e., no shifts in world supply schedule due to exporters other than exporter "i" depreciating against the dollar)

then,

$$(7)\ \Delta\nu_i = R_i \left(\frac{\theta_i \alpha}{\alpha-\beta}(1+\alpha_i)-\alpha_i\right)$$

(a) if $\theta = 1$, then country "i" is a monopoly supplier and

$$\Delta\nu_i = R_i \left(\frac{\alpha}{\alpha-\beta}(1+\alpha_i)-\alpha_i\right)$$

$$= R_i \left(\frac{\alpha+\alpha\alpha_i-\alpha_i\alpha+\alpha_i\beta}{\alpha-\beta}\right), \text{ and}$$

$$(8)\ \Delta\nu_i = R_i \left(\frac{\alpha+\alpha_i\beta}{\alpha-\beta}\right)$$

and a devaluation by country "i" will have an impact on the world price.

(b) if $\theta = 0$, then country "i" is a small, insignificant producer, and

$$(9)\ \Delta\nu_i = -R_i\alpha_i.$$

Hence, a devaluation by country "i" will not have an impact on the world price, and the country will always benefit, since devaluation is our notation is a negative number.

5. Derivation of the relationship between the world market share of country "i", θ_i, and the effect on its export earnings, $\Delta\nu_i$, when country "i" devalues.

Differentiate equation 7 above with respect to θ_i:

$$\frac{\partial\Delta\nu_i}{\partial\theta_i} = R_i\left(\frac{\alpha}{\alpha-\beta}\right)(1+\alpha_i)$$

This is the general statement for any country "i". If we assume country "i" is the sole exporter, then $\theta_i = 1$, and the result in equation 8 above holds. In equation 8, when $\alpha_i = \alpha$, then

$$(10) \quad \Delta\nu_i = R_i \left(\frac{\alpha(1+\beta)}{\alpha-\beta}\right)$$

The percentage change in country "i's" export receipts will be positive whenever $|\beta|>1$, and it will be negative whenever $|\beta|<1$, since devaluation in our notation (R_i) is a negative number.

To determine the critical market share at which the effect on country "i's" exports changes from positive to negative, set equation (7) equal to zero and solve for θ_i:

$$0 = R_i\left(\frac{\theta_i\alpha}{\alpha-\beta}\,(1+\alpha_i)-\alpha_i\right)$$

$$0 = \theta_i\alpha(1+\alpha_i)-\alpha_i(\alpha-\beta)$$

$$\theta_i\alpha(1+\alpha_i) = \alpha_i(\alpha-\beta)$$

$$(11) \quad \theta_i = \frac{\alpha_i(\alpha-\beta)}{\alpha(1+\alpha_i)}$$

This is the general expression, and it will be recalled that we are assuming $K = 0$ and $R_{other} = 0$. Within the framework where country "i" is the sole exporter, $\alpha_i = \alpha$, equation 11 reduces to

$$(12) \quad \theta_i = \frac{\alpha-\beta}{1+\alpha}$$

6. Derivation of the differential effects on export earnings between two countries who devalue by the same amount and who are the only two exporters to devalue, but whose supply elasticities differ.

For each of the two countries, 1 and 2, respectively, rewrite equation (6) from above, substituting equation (3) into it, and assuming that no importers devalue, so $K = 0$.

$$\Delta\nu_1 = \frac{\alpha}{\alpha-\beta}\,(1+\alpha_1)R-R_1\alpha_1$$

$$\Delta\nu_2 = \frac{\alpha}{\alpha-\beta}\,(1+\alpha_2)R-R_2\alpha_2$$

Note that, as established earlier, "R", the total shift in the world supply schedule, may be expressed as a weighted average of the shifts in individual supplier's export schedules:

$$(13) \quad \Delta\nu_1 = \frac{\alpha}{\alpha-\beta}(1+\alpha_1)\left(\frac{\theta_1 R_1+\theta_2 R_2}{\theta_1+\theta_2}\right)-R_1\alpha_1$$

$$(14) \quad \Delta\nu_2 = \frac{\alpha}{\alpha-\beta}(1+\alpha_2)\left(\frac{\theta_1 R_1+\theta_2 R_2}{\theta_1+\theta_2}\right)-R_2\alpha_2$$

Noting that $R_1 = R_2$, subtracting equation (14) from (13), and rearranging terms:

$$\frac{\Delta\nu_1-\Delta\nu_2}{R_1} = (\alpha_2-\alpha_1) + (\alpha_1-\alpha_2)\frac{\alpha}{\alpha-\beta}$$

$$\frac{\Delta\nu_1}{R_1} - \frac{\Delta\nu_2}{R_2} = (\alpha_2-\alpha_1) + (\alpha_1-\alpha_2)\frac{\alpha}{\alpha-\beta}$$

Since β, the world demand elasticity is negative,

$0 < \frac{\alpha}{\alpha-\beta} < 1$, so let $c = \frac{\alpha}{\alpha-\beta}$, and

$(\alpha_2-\alpha_1)+(\alpha_1-\alpha_2)\,c$, and

$$(15) \quad \frac{\Delta\nu_1}{R_1} - \frac{\Delta\nu_2}{R_2} = (1-c)(\alpha_2-\alpha_1)$$

Equation (15) states that the country with the greater supply elasticity will exhibit a greater elasticity of export receipts to devaluation. If both countries are gaining from devaluation, the country with the higher elasticity will gain more, and if both countries are losing, the country with the higher elasticity will lose less.

B. Elasticity estimates

1. Cocoa

Table 1. Cocoa: Elasticity Estimates

	Short Run		Medium Run		Long Run	
	SR.1	SR.2	MR.1	MR.2	LR.1	LR.2
World market						
Demand	-0.17	-0.20	-0.26	-0.27	-0.30	-0.34
Supply	0.14	0.10	0.24	0.30	0.42	0.50
Country/region supply						
Cameroon	0.10	0.10	0.32	0.30	0.59	0.50
Cote d'Ivoire	0.26	0.10	0.32	0.30	0.59	0.50
Nigeria	0.10	0.10	0.11	0.30	0.11	0.50
Ghana	0.18	0.10	0.11	0.30	0.13	0.50
Africa	0.20	0.10	0.23	0.30	0.39	0.50

Notes: Short run = current and one-year lag
Medium run = five-six years
Long run = nine years or more

Sources: SR.1: World demand--ICCO (1984), Table 6, p. 17; world supply--Akiyama and Duncan (1982a), Table 9, p. 18; African countries' supply--IBRD (1982a), Table III-B1, p. III-4; Africa--weighted average of individual countries using the standard trade weights of this exercise (see section B below).

MR.1: World demand--regional estimates were obtained from Akiyama and Duncan (1982a) Table 7, p. 14, then weighted average was calculated using the standard trade weights from this exercise; world supply--Akiyama and Duncan (1982a), Table 9, p. 18; African and African countries' supply--same as SR.1.

LR.1: World demand--IBRD (1982a), P. IV-3; world supply--Akiyama and Duncan (1982a), Table 9, p. 18; African and African countries' supply--same as SR.1.

SR.2, MR.2, LR.2: Staff estimates. Figures for world demand in medium and long run also are equivalent to, or near, those reported in Behrman (1968) and Goreaux (1975), according to IBRD (1982a).

2. Copper

Table 2. Copper: Elasticity Estimates

	Short Run		Medium Run		Long Run	
	SR.1	SR.2	MR.1	MR.2	MR.1	MR.2
World market						
Demand	-0.05	-0.50	-0.10	-0.75	-0.15	-1.00
Supply	0.11	0.11	0.38	0.38	0.65	0.65
Region/country supply						
Zambia	0.13	0.13	0.13	0.13	0.13	0.13
Zaire	0.07	0.07	0.16	0.16	0.25	0.25
Africa	0.11	0.11	0.14	0.14	0.17	0.17

Notes: Short run = current or one-year lag.
Medium run = five years.
Long run = ten years or more.

Sources: SR.1, MR.1, LR.1: World demand short and long run are calculated as weighted averages using the net trade weights (see section B below) from data for individual countries and regions reported in Adams and Behrman (1982), p. 173, the medium run estimate is midway between the short and long run figures; world supply--same as world demand; region/country supply--same source as world market parameters.

SR.2., MR.2, L.R.2: World demand--short and long run are among the largest absolute values of estimates in IBRD (1981), Table IV.1, p. IV-2, the medium-run estimate is midway between the short and long run figures; all other estimates are the same as SR.1., MR.1, LR.1.

3. Coffee

Table 3. Coffee: Elasticity Estimates

	Short Run	Medium Run	Long Run
World market			
Demand	-0.19	-0.21	-0.23
Supply	0.10	0.43	0.75
Country/region supply			
Ethiopia	0.10	0.43	0.75
Cote d'Ivoire	0.10	0.43	0.75
Kenya	0.10	0.43	0.75
Uganda	0.10	0.43	0.75
Burundi	0.10	0.43	0.75
Cameroon	0.10	0.43	0.75
Madagascar	0.10	0.43	0.75
Rwanda	0.10	0.43	0.75
Tanzania	0.10	0.43	0.75
Zaire	0.10	0.43	0.75
Africa	0.10	0.43	0.75

Notes: Short run = current or one-year lag.
Medium run = five years.
Long run = ten years or more.

Sources: World demand--short and long run estimates from IBRD, (1982b), medium-run estimate is midway between short and long run estimates; world supply--staff estimates for SR, MR, and LR, estimates here are almost equivalent to those reported by Akiyama and Duncan (1982b) of 0.12 for SR and 0.74 for LR; individual country and region supply estimates--staff estimates; reliable published figures could only be found for Cote d'Ivoire of 0.0 in SR, 0.55 after 3 years, and 0.73 for long run, in IBRD (1982b), p. III-7; however, this SR estimate seemed too low; staff judgment was that the LR response should be between 0.5 and 1.0.

C. Estimation of trade weights

1. Cocoa

The trade weights used for all cocoa scenarios appear in text Table 1. They were derived in the following manner. First, the latest available three years' data (1981-83) on export and import values for each country engaged in trade of primary cocoa products (beans, powder and cake, paste, and butter) were collected from the relevant FAO Trade Yearbook. Countries accounting for less than 2 percent of gross world trade values were deleted. For the remaining countries, the total average value of net exports during 1981-83 of all primary cocoa products was calculated. Exports were computed on a net basis to avoid double counting of imports and exports. Once again, countries accounting for less than 2 percent of world net exports or net imports were deleted.

The resulting list of trade weights included eight developing countries as net exporters. Since the projections were to cover the period 1986-1995, the 1981-83 relative weights were adjusted to take into account staff estimates of likely long-term shifts in supply among the exporting countries over the coming decade. The adjusted weights intend to capture relative export positions in 1990-91, the midpoint of the projection period. The adjustments included a shift of 0.4 percent of world net exports from the Dominican Republic to Brazil, leaving the overall figure for Latin America unchanged at 30.2 percent of total. Similarly, a shift of 3.7 percent of total from African producers to Southeast Asian producers was foreseen. Within Africa the loss was distributed as follows: Cameroon, -1.0; Cote d'Ivoire, -1.2; and Nigeria, -1.5. The corresponding increase appears in this model in Malaysia, the only remaining Southeast Asian producer. However, in fact the expected expansion is in Indonesia.

On the net importer side, ten countries remained before the final adjustments were made to the 1981-83 relative weights. Of these countries, one was the U.S.S.R., which accounted for a share of 12.5 percent of world net imports. Because the exchange rate in this centrally-planned economy does not perform the same function with regard to the domestic pricing system as does the exchange rate in the other industrialized countries in the list, and because the current exercise presupposes the latter role for the exchange rate, the U.S.S.R. was deleted. Since the remaining countries were rebased to sum to 100, the U.S.S.R.'s share was implicitly distributed among the rest according to their relative weights. If those shares are not too dissimilar from the relative proportions in which the U.S.S.R. earns and spends its fully convertible currencies, this procedure would not bias the results. Secondly, since the staff did not foresee any major shifts in relative shares among the remaining consuming countries in the coming decade, the 1981-83 weights were used as indicative of 1990-91 shares.

2. Copper

The procedure followed for copper was similar to that employed for cocoa. Net trade weights, which appear in text Table 9, were based on average trade in ore, blistered copper, and refined copper during 1980-82, the latest three-year period for which trade value data are available. Countries accounting for less than 2 percent of the relevant world totals were deleted, which left ten countries on the producing side and nine countries on the consuming side. Among the consumers, China accounted for 3.8 percent of total, while on the producing side, the U.S.S.R. (2.6 percent), and Poland (3.2 percent) accounted for 5.9 percent. As was the case in the cocoa analysis, these centrally-planned economies were deleted from the copper analysis, and for the same reasons as in the cocoa case. Finally, for copper, staff did not expect the relative shares to shift significantly among either the exporting or importing countries in the next decade. Consequently, the calculated 1980-82 weights were retained to proxy for the 1990-91 weights.

3. Coffee

The procedure followed for coffee was similar to that employed for cocoa and copper. Net trade weights, which appear in text Table 15, were based on green and roasted coffee during 1981-83. The figure for Brazil also included soluble coffee exports obtained from the ICO (1985). Since coffee production is much more diversified among a number of small African producers than is cocoa production, and because the focus of this study was the African countries, those accounting for less than 2 percent of world net exports were retained in this case. This procedure increased the coverage by five countries, which together accounted for 6.5 percent of total.

Final adjustments made to the 1981-83 net trade weights to make them more representative of expected relative shares in 1990-91 included the following. On the exporting side 3 percent of world total net exports was shifted from Brazil to Indonesia (2 percent), Kenya (0.6 percent), and Uganda (0.4 percent). On the consumption side the U.S. share was reduced substantially (by 5.2 percent of total). A large portion of this reduction was allocated to Japan (2.5 percent), while the remainder was spread across the remaining countries in varying amounts, the largest of which went to Spain (0.7 percent), Germany (0.5 percent), and the United Kingdom (0.5 percent).

Table C. Individual Country Trade Weights by Commodity 1/

	Cocoa	Copper	Coffee
Net exporters	100.0	100.0	100.0
Developing countries	100.0	89.5	100.0
Africa	61.8	28.3	26.5
Burundi			0.9
Cameroon	6.1		2.3
Cote d'Ivoire	29.8		5.9
Ethiopia			3.2
Ghana	16.3		
Kenya			4.0
Madagascar			1.4
Nigeria	9.6		
Rwanda			0.9
Tanzania			1.8
Uganda			4.6
Zaire		9.2	1.5
Zambia		19.1	
Asia	8.0	6.8	9.7
India		4.0	2.7
Indonesia		2.8	7.0
Malaysia	8.0		
Latin America	30.2	54.4	63.8
Brazil	24.2		24.8
Chile		26.9	
Columbia			20.1
Costa Rica			3.3
Dominican Republic	1.8		
Ecuador	4.2		
El Salvador			5.6
Guatemala			4.5
Mexico		8.2	5.5
Peru		19.3	
Industrial countries		10.5	
Canada		10.5	
Net importers	100.0	100.0	100.0
Industrial countries	100.0	95.0	100.0
Belgium-Luxembourg	5.8	6.6	3.0
Canada			4.0
France	10.6	10.7	10.7
Germany	17.2	13.5	17.8
Italy	4.6	9.7	8.6
Japan	7.2	23.3	9.5
Netherlands			5.5
Spain	2.6		5.0
Sweden			3.8
Switzerland	2.6		
United Kingdom	13.2	9.6	3.8
United States	36.2	21.6	28.3
Developing countries		5.0	
Brazil		5.0	

1/ The derivation of these weights is explained in Annex C.

D. Simulations results

Table D1. WEO Baseline Commodity Price Projections, 1985-95 1/

	Coffee 2/	Cocoa	Copper	U.V.M. 3/	Real Commodity Prices 4/ Coffee	Cocoa	Copper
1985	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1986	145.0	90.4	105.8	114.0	127.2	79.3	92.8
1987	130.8	89.9	112.0	119.1	109.8	75.5	94.0
1988	116.3	92.9	121.3	124.5	93.4	74.6	97.4
1989	116.3	94.8	130.6	130.1	89.4	72.9	100.4
1990	120.1	96.8	138.4	135.9	88.3	71.2	101.8
1991	123.8	100.7	146.2	142.1	87.1	70.9	102.9
1992	129.9	104.6	152.4	148.5	87.5	70.4	102.6
1993	137.7	109.5	160.2	155.1	88.8	70.6	103.3
1994	148.8	117.3	168.0	162.1	91.8	72.4	103.6
1995	163.6	129.0	175.7	169.4	96.6	76.2	103.7

Source: IMF staff estimates.

1/ These projections were prepared in the spring of 1986 and are consistent with the baseline medium-term assumptions reported in IMF (1986). Since these projections are subject to revision as underlying assumptions and information change, current price projections of the Commodities Division may differ from those presented here. All prices are in terms of U.S. dollars.

2/ Weighted average, 54 percent milds and 46 percent robusta.

3/ Index of export unit value of manufactures (U.V.M.) of industrial countries.

4/ Deflator is the U.V.M.

Table D2. Cocoa Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Cocoa, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
(Percentage change in real terms) 1/			
I. WEO Baseline Scenario 2/			
World price	-25	-29	-24
(Percentage point deviation from WEO baseline scenario) 3/			
II. Selected Exporters' Expansion			
A. Cote d'Ivoire (29.8) 4/			
World price	-1	-3	-5
World volume	--	1	2
African countries' exports 5/	--	-1	-1
Cameroon	-1	-3	-7
Cote d'Ivoire	--	2	7
Nigeria	-1	-3	-6
Ghana	-1	-3	-6
B. Cote d'Ivoire and Ghana (46.1)			
World price	-1	-4	-7
World volume	--	1	2
African countries' exports	-1	-2	-2
Cameroon	-1	-5	-11
Cote d'Ivoire	--	--	3
Nigeria	-1	-5	-9
Ghana	--	-1	-1

Table D2 (continued). Cocoa Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Cocoa, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
C. All exporters (100.0)			
World price	-2	-8	-15
World volume	--	2	5
African countries' exports	-2	-6	-11
Cameroon	-2	-6	-9
Cote d'Ivoire	-2	-6	-9
Nigeria	-2	-7	-13
Ghana	-2	-7	-12
D. Selective pegs 6/			
World price	--	2	3
World volume	--	-1	-1
African countries' exports	--	1	1
Cameroon	--	--	-1
Cote d'Ivoire	--	--	-1
Nigeria	--	1	1
Ghana	--	3	3
E. Matching reaction (all exporters) 7/			
World price	-1	-8	-9
World volume	--	2	3
African countries' exports	-2	-6	-6
Cameroon	-2	-5	-5
Cote d'Ivoire	-2	-5	-5
Nigeria	-2	-6	-7
Ghana	-2	-6	-7

Table D2 (continued). Cocoa Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Cocoa, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
F. Matching reaction (Africans only) 8/			
World price	-1	-6	-8
World volume	--	2	2
African countries' exports	-2	-4	-4
Cameroon	-2	-4	-3
Cote d'Ivoire	-2	-4	-3
Nigeria	-2	-5	-6
Ghana	-2	-5	-5
G. Matching reaction (non-Africans only) 9/			
World price	-1	-3	-3
World volume	--	1	1
African countries' exports	-2	-4	-5
Cameroon	-2	-4	-5
Cote d'Ivoire	-2	-4	-5
Nigeria	-2	-4	-5
Ghana	-2	-4	-5
H. Passive reaction 10/			
World price	-1	-2	-2
World volume	--	1	1
African countries' exports	-2	-2	-3
Cameroon	-2	-2	-3
Cote d'Ivoire	-2	-2	-3
Nigeria	-2	-2	-3
Ghana	-2	-2	-3

Table D2 (continued). Cocoa Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Cocoa, 1987-95

1/ The deflator is the export unit value of manufactures (UVM) of industrial countries, in terms of U.S. dollars, that is used in the Fund's World Economic Outlook (WEO), IMF (1986).

2/ The WEO medium-term (through 1991) baseline scenario is described in IMF (1986). For 1992-95 the UVM is assumed to increase by 4.5 percent per year, as is the case for 1987-91. On the demand side the WEO baseline scenario assumes that the U.S. and Canadian dollars depreciate against other major currencies by 2.3 percent per year in real terms during 198891; during other years all major currencies remain unchanged. In terms of equation (3) Annex A, for example, this implies that all Ki=9.5 percent in 1991 for all importers except the United States; correspondingly, the weighted average outward shift in the world demand schedule (K) is equal to 6.4 percent by 1991. The weights are contained in Annex Table C. For suppliers, the cocoa baseline scenario assumes that Nigeria depreciates by 1 percent per year against the U.S. dollar during 1986-95, while all other exporters remain at par. In terms of equation (3) Annex A, the Ks for any year are slightly smaller in the case of coffee than in the case for cocoa (since the relative share of the United States in the world coffee market is somewhat larger), while the Rs are larger over any comparable period from 1985 because Nigeria's share in the world cocoa market is somewhat greater (in an absolute sense) than the combined share of Ethiopia, Madagascar, and Tanzania in the world coffee market.

3/ The simulation results reported in this table utilize the average of the two sets of elasticities for each period that are presented in Annex B, Table 1. Also, see Table D, footnote 4, concerning the interpretation of deviations from the baseline results.

4/ The simulation results reported in this table utilize the elasticity estimates presented in Annex B, Table 3. The percentages indicated in Section II are to be added to or subtracted from the corresponding figure for the WEO baseline scenario reported in Section I. Thus, in scenario A the world price would be 2 percentage points lower by 1995 when compared with the WEO baseline figure in the same year; or alternatively, in scenario A the world price in 1995 would be 5 percent lower than the price in 1985. Also, since the policy changes described in Section II would not affect the deflator, the deviations are also in real terms.

5/ In scenarios II A-C, the countries indicated are assumed to depreciate by 3 percent per year during 1986-95, while the assumptions relating to all other countries are the same as those in the WEO baseline. Exchange rates are defined as units of national currency per dollar and percentage changes are calculated as: $100((r_1 - r_2)/r_2)$, where r_1 = beginning exchange rate, and r_2 = final exchange rate. This method is equivalent to calculating percentage changes based on the initial period value and defining the exchange rate in terms of foreign currency units

Table D2 (concluded). Cocoa Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Cocoa, 1987-95

5/ (continued) per unit of the non-dollar national currency. This formulation was chosen so that appreciation of a currency is shown as a positive number, while depreciation is a negative number. The year-on-year changes were computed as follows: for a 3 percent annual appreciation: $r_2 = (r_1/1.03)$, and for a 3 percent annual depreciation: $r_2 = (r_1/0.97)$.

The figure in parenthesis is the market share of the specified set of countries in world exports. These shares, and an explanation of their derivation, are contained in Annex Table C.

6/ This scenario assumes that developing country exporters' currencies move with the major currencies with which they have been most closely aligned in the past, i.e., Cote d'Ivoire and Cameroon remain at par with the French franc (and therefore appreciate against the dollar during 1988-91), Nigeria moves with the British pound (adjusted for the naira's position against the dollar in the baseline scenario) and the rest with the U.S. dollar.

7/ This scenario assumes Brazil depreciates 15 percent against the U.S. dollar in 1987, while remaining at par at other times. All other exporters match the depreciation in 1988. The WEO baseline assumptions apply in all other cases.

8/ This scenario assumes Brazil depreciates 15 percent against the U.S. dollar in 1987, and only the African exporters match the depreciation in 1988. The WEO baseline assumptions hold otherwise.

9/ This scenario assumes Brazil depreciates 15 percent against the U.S. dollar in 1987, and only the non-African exporters match the depreciation in 1988. The WEO baseline assumptions hold in all other cases.

10/ This scenario assumes Brazil depreciates 15 percent against the U.S. dollar in 1987, and no other exporters respond, so that the WEO baseline assumptions hold in all other cases.

Table D3. Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using More Inelastic Estimates of World Demand, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
(Percentage change in real terms) 1/			
I. WEO Baseline Scenarios 2/			
World price	-6	3	4
(Percentage point deviation from WEO baseline scenario) 3/			
II. Selected Exporters' Expansion			
A. Zaire (9.2) 4/			
World price	--	-1	-2
World volume	--	--	--
African countries' exports 5/	--	-1	-1
Zaire	--	1	4
Zambia	--	-1	-2
B. Zambia (19.1)			
World price	-1	-3	-4
World volume	--	--	1
African countries' exports	--	-1	-2
Zaire	-1	-3	-5
Zambia	--	-1	-1
C. Zaire and Zambia (28.3)			
World price	-1	-4	-6
World volume	--	--	1
African countries' exports	-1	-2	-3
Zaire	-1	-2	-1
Zambia	-1	-2	-3

Table D3 (continued). Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using More Inelastic Estimates of World Demand, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
D. All exporters (100.0)			
World price	-4	-12	-19
World volume	--	1	3
African countries' exports	-4	-11	-18
Zaire	-4	-11	-18
Zambia	-3	-11	-18
E. Matching reaction (all exporters) 6/			
World price	--	-10	-11
World volume	--	1	2
African countries' exports	--	-10	-10
Zaire	--	-10	-10
Zambia	--	-10	-11
F. Matching reaction (Africans only) 7/			
World price	--	-9	-9
World volume	--	1	1
African countries' exports	--	-8	-8
Zaire	--	-8	-8
Zambia	--	-8	-8
G. Matching reaction (non-Africans only) 8/			
World price	--	-7	-8
World volume	--	1	1
African countries' exports	--	-9	-9
Zaire	--	-8	-9
Zambia	--	-8	-9

Table D3 (concluded). Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using More Inelastic Estimates of World Demand, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
H. Passive reaction 9/			
World price	--	-6	-6
World volume	--	1	1
African countries' exports	--	-6	-7
Zaire	--	-6	-7
Zambia	--	-6	-6

1/ See Annex Table D2, footnote 1.

2/ See Annex Table D2, footnote 2, for assumptions regarding the deflator (the UVM) and policies pursued by importers on the demand side. For suppliers, the copper baseline scenario assumes that all exporters remain at par with the U.S. dollar during 1986-95. In terms of equation (3) Annex A, the Ks for any years are somewhat greater than was the case for cocoa (since the relative share of the United States in the world copper market is somewhat smaller), while the Rs are all equal to zero, since all R_i's equal zero.

3/ The simulation results reported in this table utilize the first set of elasticity estimates (SR.1, MR.1, and LR.1) presented in Annex B, Table 2, i.e., the more inelastic estimates of world demand. Also, see Table D, footnote 4, concerning the interpretation of deviations from the baseline results.

4/ See Annex Table D2, footnote 5.

5/ See Annex Table D2, footnote 6.

6/ This scenario assumes that Chile and Peru depreciate against the U.S. dollar by 15 percent in 1988, and that all other exporters match this depreciation in 1989; in all other instances the WEO baseline assumptions hold.

7/ This scenario is identical to case E (footnote 6), except in this case only the African producers match the initial depreciation.

8/ This scenario is identical to case E (footnote 6), except this case only the non-African producers match the initial depreciation.

9/ This scenario is identical to case E (footnote 6), except in this case none of the other exporters follows the initial depreciation by Chile and Peru.

Table D4. Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using Less Inelastic Estimates of World Demand, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
(Percentage change in real terms) 1/			
I. WEO Baseline Scenarios 2/			
World price	-6	3	4
(Percentage point deviation from WEO baseline scenario) 3/			
II. Selected Exporters' Expansion			
A. Zaire (9.2) 4/			
World price	--	-1	-1
World volume	--	--	1
African countries' exports 5/	--	--	--
Zaire	--	2	--
Zambia	--	-1	-1
B. Zambia (19.1)			
World price	--	-1	-2
World volume	--	1	2
African countries' exports	--	--	1
Zaire	--	-1	-3
Zambia	1	1	1
C. Zaire and Zambia (28.3)			
World price	--	-2	-3
World volume	--	1	3
African countries' exports	--	1	1
Zaire	--	1	3
Zambia	--	--	--

Table D4 (continued). Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using Less Inelastic Estimates of World Demand, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
D. All exporters (100.0)			
World price	-1	-6	-10
World volume	1	4	9
African countries' exports	-1	-4	-7
Zaire	-1	-4	-6
Zambia	-1	-4	-8
E. Matching reaction (all exporters) 6/			
World price	--	-5	-6
World volume	--	3	5
African countries' exports	--	-4	-4
Zaire	--	-3	-3
Zambia	--	-4	-5
F. Matching reaction (Africans only) 7/			
World price	--	-4	-4
World volume	--	3	4
African countries' exports	--	-2	-3
Zaire	--	-2	-2
Zambia	--	-2	-3
G. Matching reaction (non-Africans only) 8/			
World price	--	-4	-4
World volume	--	2	3
African countries' exports	--	-4	-5
Zaire	--	-4	-5
Zambia	--	-4	-5

Table D4 (concluded). Copper Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Copper, Using Less Inelastic Estimates of World Demand, 1987-95

	From 1985 To:		
	1987	1991	1995
Policy Scenario	Short Run	Medium Run	Long Run
H. Passive reaction 9/			
World price	--	-2	-3
World volume	--	2	3
African countries' exports	--	-3	-3
Zaire	--	-3	-3
Zambia	--	-3	-3

1/ See Annex Table D2, footnote 1.

2/ See Annex Table D2, footnote 2, for assumptions regarding the deflator (the UVM) and policies pursued by importers on the demand side. For suppliers, the copper baseline scenario assumes that all exporters remain at par with the U.S. dollar during 1986-95. In terms of equation (3) Annex A, the Ks for any years are somewhat greater than was the case for cocoa (since the relative share of the United States in the world copper market is somewhat smaller), while the Rs are all equal to zero, since all R_i's equal zero.

3/ The simulation results reported in this table utilize the second set of elasticity estimates (SR.2, MR.2, and LR.2) presented in Annex B, Table 2, i.e., the less inelastic estimates of world demand elasticities. Also, see Table D, footnote 4, concerning the interpretation of deviations from the baseline results.

4/ See Annex Table D2, footnote 5.

5/ See Annex Table D2, footnote 6.

6/ This scenario assumes that Chile and Peru depreciate against the U.S. dollar by 15 percent in 1988, and that all other exporters match this depreciation in 1989; in all other instances the WEO baseline assumptions hold.

7/ This scenario is identical to case E (footnote 6), except in this case only the African producers match the initial depreciation.

8/ This scenario is identical to case E (footnote 6), except in this case only the non-African producers matched the initial depreciation.

9/ This scenario is identical to case E (footnote 6), except in this case none of the other exporters follows the initial depreciation by Chile and Peru.

Table D5. Coffee Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Coffee, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
(Percentage change in real terms) 1/			
I. WEO Baseline Scenarios 2/			
World price 3/	10	-13	-3
(Percentage point deviation from WEO baseline scenario) 4/			
II. Selected Exporters' Expansion			
A. Cote d'Ivoire and Uganda (10.5) 5/			
World price	--	-1	-2
World volume	--	--	1
African countries' exports 6/	--	1	4
Cote d'Ivoire and Uganda	--	6	16
Other African exporters	--	-2	-4
B. All African exporters (26.5)			
World price	-1	--	-5
World volume	--	1	1
African countries' exports	--	3	10
Ethiopia, Madagascar, and Tanzania	--	3	9
Other African producers	--	3	10
C. All exporters (100.0)			
World price	-2	-11	-20
World volume	--	2	5
African countries' exports	-2	-9	-16
Ethiopia, Madagascar, and Tanzania	-2	-9	-17
Other African exporters	-2	-9	-15

Table D5 (continued). Coffee Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Coffee, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
D. Matching reaction (all exporters) 7/			
World price	--	-7	-7
World volume	--	1	2
African countries' exports	--	-5	-6
Ethiopia, Madagascar, and Tanzania	--	-5	-6
Other African producers	--	-5	-6
E. Passive reaction 8/			
World price	--	-3	-3
World volume	--	1	1
African countries' exports	--	-4	-6
Ethiopia, Madagascar, and Tanzania	--	-4	-6
Other African producers	--	-4	-6
F. Matching reaction (Africans only) 9/			
World price	-2	-5	-5
World volume	--	1	1
African countries' exports	-2	-3	-2
Ethiopia, Madagascar, and Tanzania	-2	-3	-3
Other African producers	-2	-3	-2
G. Matching reaction (non-Africans only) 10/			
World price	-2	-5	-6
World volume	--	1	1
African countries' exports	-2	-7	-10

Table D5 (continued). Coffee Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Coffee, 1987-95

Policy Scenario	From 1985 To: 1987 Short Run	1991 Medium Run	1995 Long Run
H. Matching reaction (all exporters) 11/			
World price	-2	-7	-8
World volume	--	1	2
African countries' exports	-2	-5	-6
I. Passive reaction 12/			
World price	-2	-3	-3
World volume	--	1	1
African countries' exports	-2	-4	-6

1/ See Table D2, footnote 1.

2/ See Table D2, footnote 2. On the supply side the WEO baseline assumes that the currencies of Ethiopia, Madagascar, and Tanzania each depreciate against the U.S. dollar in real terms by 1 percent per year during 1986-95. The currencies of all other coffee exporters are assumed to remain at par with the dollar during the entire period. Thus, in terms of equation (3) Annex A, the "R_i" of the three depreciating currencies are -5.9 percent in 1991, and correspondingly, the weighted average shift (R) in the world supply schedule is -0.4 by 1991, where the weights are contained in Annex Table C.

3/ The coffee price forecast is a weighted average of robusta (46 percent) and milds (54 percent) and is in terms of U.S. dollars.

4/ See Table D2, footnote 4.

5/ See Table D2, footnote 5.

6/ Weighted average using weights in Annex Table C.

7/ This scenario assumes that Brazil and Colombia depreciate 5 percent against the dollar in 1988 and 1989, while remaining at par in all other years. All other exporters match these depreciations in 1990 and 1991 (5 percent each year), while in all other years they follow the assumptions in the WEO baseline.

8/ See footnote 7 for Brazil and Colombia; for all other exporters, the WEO baseline assumptions hold.

Table D5 (concluded). Coffee Supply Simulations: Effects on World Market Parameters and African Countries' Export Earnings from Coffee, 1987-95

9/ Brazil and Colombia are assumed to depreciate against the U.S. dollar by 10 percent in 1987 and to remain at par in all other years. All the African exporters match the depreciation (10 percent) in 1988, while the WEO baseline assumptions also hold in other years and for other countries.

10/ Same as scenario in footnote 9 above, except only the non-African exporters match the depreciation in 1988.

11/ Same as scenario in footnote 9 above, except all exporters except Brazil and Colombia match the depreciation in 1988.

12/ For Brazil and Colombia, see footnote 9 above, for all other exporters the WEO baseline assumptions hold.

E. Assumptions for the baseline scenario price projections

The following are the general assumptions common to the baseline price projections for all three commodities (cocoa, copper, and coffee) that we are analyzing; if desired, more detailed assumptions are reported in IMF (1986). Any additional specific assumptions are reported in the notes to the tables reporting on the results of the simulations in part D of this Annex.

	Short Run (Mar. 1986-87)	Medium Run (1988-91)	Long Run 1/ (1992-95)
1. Average exchange rates in real terms among the major currencies	Fixed at level of March 3-7, 1986	U.S. and Canadian dollars depreciate by 2.3 percent per year vis-a-vis other majors	Fixed at level of end-1991
2. World oil price (US$) change in percent, p.a.	-40.0, 1986 -6.3, 1987	4.5	4.5
3. Average rate of growth in real GNP in industrial countries	3.0, 1986 3.2, 1987	3.0	3.0
4. Average rate of change in GNP deflator of industrial countries percent p.a.	3.4, 1986 3.0, 1987	3.7	3.7
5. Real six-month LIBOR	3.4, 1986 3.0, 1987	3.7	3.7
6. Change in world price of manufactures (US$)	14.0, 1986 4.5, 1987	4.5	4.5

1/ The official WEO medium-term assumptions cover the period through 1991; for the purposes of this study they have been extended through 1995.