THE WORLD BANK ECONOMIC REVIEW, VOL. 5, NO. 2: 259-289

Structural Adjustment and the Welfare of Rural Smallholders: A Comparative Analysis from Sub-Saharan Africa

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The direction and level of changes in real incomes brought about by structural adjustment are determined by a variety of factors, including sources of income, patterns of expenditures, and movements in relative prices in the wake of adjustment. An econometric model is used to derive an index of real income, which is employed for data from Côte d'Ivoire, Ghana, Malawi, Madagascar, and Tanzania. No systematic changes in relative prices, and especially in the ratio of tradable to nontradable prices, were noted after the beginning of adjustment, although the diversity of income sources implies that the implications of movements in relative prices on smallholder welfare are indeed complex. The results indicate that there is no unequivocal pattern of increase or decline in the real welfare of the rural poor but that there are marked differences among countries and regions.

Stabilization and structural adjustment programs are being implemented widely in Sub-Saharan Africa in response to the macroeconomic crisis that emerged during the 1970s. Although the timing and nature of adjustment has differed markedly from one country to the next, one of the common aspects is that the economic opportunities faced by various agents in the economy will be changed. In particular, of key importance are the expenditure switching policies of the adjustment programs, which alter relative prices for various products and factors, generally with the intent of expanding the tradable goods sector. Policies that bring about changes in the price signals in the economy will affect household welfare as mediated by changes in the structure and level of incomes and consumption. This article is concerned with how macroeconomic adjustment policies affect low-income rural smallholder households, since they comprise a

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large percentage of households in most Sub-Saharan African countries, many of which are appropriately classified as poor.

Since it has been shown that the rural poor are often net consumers of staple grains, especially traded goods whose prices are assumed to increase commensurate with devaluation or removal of price controls, adjustment programs are asserted to have deleterious consequences for the rural poor. The expectation that adjustment programs will induce a fall in real wages further exacerbates the negative impact of adjustment (see Pinstrup-Andersen 1988; Cornia, Jolly, and Stewart 1987). A contrary argument is that adjustment programs stand to help the rural poor directly or indirectly by raising producer incentives and rural incomes. Relative price movements commensurate with adjustment are seen to favor products produced by smallholders, whose real incomes will consequently rise . A more balanced and agnostic viewpoint is that the impact of adjustment on the poor is not knowable a priori and will be determined by the propensities of the poor to produce and consume tradables versus nontradables, as well as by actual movements in relative prices (see Addison and Demery 1985 and Sahn 1990).

In order to address this debate and gain some further insight into how smallholders are affected by adjustment in the short term, two especially important issues require careful analysis. The first is the structure of poor rural smallholders' income and consumption, namely, the sources from which they derive income, appropriately grouped for analysis, and the products that satisfy their consumer needs. The second aspect is how structural adjustment affects the values of these magnitudes by means of changes in relative prices.

In this article the emphasis will be on examining the relevant economic signals before and after policy reforms were instituted. This procedure cannot attribute any changes in the relevant signals to specific adjustment programs. To analyze how policy reforms affect economic signals in an economy is a major undertaking, which would necessitate the use of complex empirical models (see Scobie 1989, Pinstrup-Andersen 1990, and Sarris 1990). However, our aim is to infer directions of welfare changes after reforms were instituted and not to examine whether the change in the fortunes of the poor is due only to adjustment or to other concurrent developments. We are interested in the welfare changes of a typical household within a given group, rather than how the total magnitude of poverty will change (Kanbur 1987).

The next section outlines the methodological framework and analytical model that is to be used to examine how low-income smallholder households are affected by macroeconomic adjustment. This is followed by a discussion of the data employed from the five countries included in the comparative analysis: Côte d'Ivoire, Ghana, Malawi, Madagascar, and Tanzania. This presentation and discussion of descriptive statistics will focus on characterizing the structure of consumption and sources of income and on price movements that have occurred during adjustment. We then present the results of the analytical model as well as policy implications of the findings.

I. Methodology

The precise definition of poverty or vulnerability is a matter of considerable research, and we shall not delve into the issue here. We begin with a rural smallholder household that is representative of a class that has been identified as poor or vulnerable. The household will derive its income from agricultural and nonagricultural activities. The agricultural activities will be distinguished among those that produce exportable and other nonfood tradable cash crops (such as coffee, cocoa, cotton, and tea), those that produce tradable staple food crops (mainly maize, rice, and wheat), and those that produce nontradable food products (such as coarse grains, roots and tubers, fruits and vegetables, and livestock products).

The share of income derived from own-account agricultural activities and other agricultural or nonagricultural activities are denoted by S_a and S_r, respectively, in some base year, and include transfers and remittances, where

$$S_a + S_r = 1. \tag{1}$$

The shares of own-operated farm agricultural income derived from activities that produce exportable, tradable staple food, and other nontradable agricultural products are denoted by S_{ae}, S_{af}, and S_{ao}, respectively. The base year shares of total household consumption expenditures (including subsistence consumption) are denoted by θ_f, θ_o, and θ_n for expenditures on tradable staple food products, nontradable food products, and nonagricultural products, respectively. Changes in the welfare of this type of household can then be monitored by examining the following index of changes in real income:

$$\tilde{Y} = \{(S_{ae}\tilde{P}^p_e + S_{af}\tilde{P}^p_f + S_{ao}\tilde{P}^p_o) + S_r\tilde{r}\} - (\theta_f\tilde{P}^c_f + \theta_o\tilde{P}^c_o + \theta_n\tilde{P}^c_n) \tag{2}$$

where Y is real income; P_e, P_f, and P_o are the price indexes of the three agricultural product groups outlined above, with the superscript p for producer prices and c for consumer prices; r is the unit reward of any nonagricultural production activities of the given class of households; and P^c_n is the consumer price of the nonagricultural product. The symbol $\sim$ above a variable indicates a percentage change over a given period.

Equation 2 can be derived by taking the derivative of a standard household consumer utility function, which is a function only of quantities consumed, under the assumption that the household earns income by operating on a standard production possibility frontier of agricultural and other activities. As long as smallholder activities are labor intensive and total labor available for each household and technology do not change, the frontier will not shift outward over time. Thus only substitution among activities because of relative price changes will occur. This implies that quantity changes should not be part of equation 2. In Côte d'Ivoire, Ghana, Malawi, Madagascar, and Tanzania, per capita production of total agricultural output has not been increasing. If the technology is labor-using and there is full employment, not much aggregate supply response to price is expected (Binswanger 1989).

Although changes in the prices of the three agricultural products faced by producers and consumers and in the price of the nonagricultural product P_n^c, can be observed and monitored relatively easily, the price of nonagricultural production activity r cannot. Given, however, that in many countries a large share of the income of poor households is derived from such activities, it cannot be neglected. This has been acknowledged by several authors, who have emphasized the relation between the agricultural and nonagricultural wage and the price of other agricultural products (Ravallion 1989, Sah and Stiglitz 1987). In our approach, however, r symbolizes something wider than just wages. It stands for the reward to any other type of activity, apart from work on one's own farm. The appendix presents the outline of a model through which the change in r can be expressed as a function of the changes in the other four observable prices in equation 2, as well as several other parameters related to adjustment and smallholder income.

The derivation of the model described in the appendix yields the following expansion of equation 2 that captures changes in real income:

$$\tilde{Y} = \left\{ \left(S_{ae} + \frac{S_r \lambda_a b_e}{(1-\gamma)\Delta} \right) \tilde{P}_e^p + \left(S_{af} + \frac{S_r \lambda_a b_f}{(1-\gamma)\Delta} \right) \tilde{P}_f^p \right.$$

$$+ \left(S_{ao} + \frac{S_r \lambda_a b_o}{(1-\gamma)\Delta} \right) \tilde{P}_o^p + \frac{S_r \lambda_n}{(1-\alpha-\beta)\Delta} \tilde{P}_n^p \tag{3}$$

$$\left. - \frac{S_r \lambda_n \beta \tilde{P}_m}{(1-\alpha-\beta)\Delta} \right\} - \{\theta_f \tilde{P}_f^c + \theta_o \tilde{P}_o^c + \theta_n \tilde{P}_n^c\}$$

where:

$$\Delta = \frac{\lambda_n (1-\beta)}{1-\alpha-\beta} + \frac{\lambda_a}{1-\gamma}. \tag{4}$$

The symbols in equations 3 and 4 are explained in detail in the appendix. They involve the labor parameters of the Cobb-Douglas production function (α, β, γ), aggregated labor shares in agriculture and nonagriculture (λ_a, λ_n), and shares of exportables, traded food, and other agricultural activities in total agricultural output (b_e, b_f, b_o). The price P_m denotes an index of noncompetitive imported goods. Equation 3, therefore, depends on structural variables and changes in price indexes that are relatively easy to estimate, as well as on a set of assumptions that are explored explicitly in the appendix.

The weights multiplying producer prices inside the first bracket in the right-hand side of equation 3 sum to one. Similarly, the weights in the second bracket sum to one. In other words, real income changes can be looked at as changes in the ratio of a Laspeyres index of nominal income (in combination with wages) and a Laspeyres index of consumer prices, with weights specific to the poor smallholders being examined in this study.

The use of a fixed weight index underestimates real income gains and over-

estimates real income losses. This is so because the output, and consequently the income shares in the numerator, would tend to increase for products whose prices increase, and hence a fixed weight numerator would tend to be smaller than a true index. In the denominator, substitution among consumed goods would tend to lessen consumption shares for products whose prices increase. Hence, the fixed weight denominator would tend to be larger than the true one.

We could make the analysis more accurate by starting with a base year t_0 and using equation 3 to estimate the first order welfare changes for a subsequent period t_1, given observed price changes. Assumptions about production transformation parameters and own price and cross-price elasticities of demand could then be used to estimate new production and consumption shares in period t_1, which could be used to estimate welfare changes for period t_2 and so on. Although such an analysis of piecewise linearization and updating will give a better estimate of welfare changes, it must be based on assumptions about the values of several parameters, which are normally not available for countries in Sub-Saharan Africa. Hence, the second order gain in prediction accuracy might be lost by the parameter uncertainty. It is also the case that a variable weight divisia index in both the numerator and the denominator would clearly be superior, but there are no data with which to implement it. Therefore we have adopted a simpler and more straightforward analysis, but recognize the direction of bias being introduced into the analysis.

II. Data and Descriptive Statistics

To apply the framework described above, a data set on the sources from which households derive income and the products that satisfy their consumer needs has been organized for Côte d'Ivoire, Ghana, Malawi, Madagascar, and Tanzania. Household data on income and consumption from each country were analyzed. For Côte d'Ivoire, the Côte d'Ivoire Living Standards Survey data from 1985–86 were analyzed as the basis for understanding the income sources and the expenditure patterns. (See Grootaert 1986 and Ainsworth and Munoz 1986 for a description of the unpublished data set.) The Ghana Living Standards Survey from 1987–88 was analyzed to describe income and consumption patterns in Ghana. (The unpublished survey, conducted by the Ghana Statistical Service in cooperation with the World Bank, follows the structure of the Côte d'Ivoire survey.) For Côte d'Ivoire and Ghana, two prototype households are distinguished—one for the forest region and the other for the savannah—to reflect the main agroclimatic zones for smallholder agriculture. In both surveys, the profile of consumption and production characteristics was based on our analysis of the data tapes, which allowed us to select the bottom 20 percent of the per capita expenditure distribution.

The data for Madagascar were derived primarily from the social accounting matrix for 1984 (Dorosh and others 1990), which used various national accounts and regional surveys to define a group of smallholder farms cultivating

Table 1. *Sources of Total Income of Low-Income Rural Smallholders in Five Countries in Sub-Saharan Africa, Selected Years*
(percentage of total income)

	Per capita total income								
	Côte d'Ivoire		*Ghana*		*Madagascar*			*Malawi,*	*Tanzania,*
Type of income	*Forest*	*Savannah*	*Forest*	*Savannah*	*Coast*	*Plateau*	*South*	*south*	*all*
Agricultural income	76	81	57	68	42	39	48	51	73
From home consumption	31	40	37	54	25	31	37	37	50
From agricultural sales	45	41	20	14	17	8	11	14	23
Nonagricultural earned income[a]	21	17	40	31	55	58	49	13	25
Nonearned income[b]	3	2	3	1	3	3	3	36	2

a. Includes wages, salaries, and own-account earnings.

b. Includes income from transfers, remittances, and other nonearned sources.

Source: Based on data from: Côte d'Ivoire, 1985–86 Côte d'Ivoire Living Standards Survey (unpublished); Ghana, 1987–88 Ghana Living Standards Survey (unpublished); Madagascar, Dorosh and others (1990); Malawi, Harvard Institute for International Development (1989); and Tanzania, 1976–77 government household survey (unpublished).

between 0.25 and 1.5 hectares. The data allow us to distinguish between households in three agroclimatic regions (coast, plateau, and south) with markedly different production characteristics.

For Malawi, data tapes from a regional survey conducted in the Zomba district in the southern region were analyzed to arrive at the income and consumption patterns. (See Peters and Herrera 1989 for a complete discussion of the survey.) Because the communities surveyed were all in the densely populated region, the data have limited applicability to the more land-abundant regions in the north and center of the country. In keeping with the intent to profile the poor smallholder, the mean landholding of the smallholders represented in this sample was only 1.5 hectares. However, these households are not likely the poorest of the poor, given that the high population density in the region has contributed to a large number of households having less than 0.5 hectare to cultivate (Sahn and Arulpragasam, forthcoming).

The data for Tanzania were derived from the results of a nationwide household survey performed in 1976–77. The unpublished survey covered 2,744 households across a larger spectrum of landholding sizes and incomes than the surveys in the other four countries; nonetheless, it included predominantly poor smallholders who have an average holding size of 1.43 hectares.

Sources of Income

Initially we distinguish among three income categories: earnings from agricultural activities, earnings from nonagricultural activities, and nonearned income (table 1). Agricultural income includes the income derived from the sale of what is produced as well as the imputed value of the portion of the household's production that is consumed by the household. Nonagricultural income includes income from wages, salaries, and own-account other than farming. Nonearned income includes income in the form of remittances, the imputed value of rent (where it could be estimated), and other transfers. Despite the great diversity in income shares, a few interesting features of these data are worth highlighting. First, even for smallholder households, nonagricultural earned income is a significant share of the total. For example, nonagricultural income in Côte d'Ivoire was 21 and 17 percent of total income for the forest and savannah regions, respectively. Figures for the two regions in Ghana were 40 and 31 percent, respectively. In Malawi nonagricultural income represented 13 percent of total income, while the figure for Tanzania was 25 percent. Among the data examined, the highest income share from nonagricultural activities, including wages, salaries, and own-account, was observed in the plateau region of Madagascar, where it was 58 percent of total income.

Second, even though nonearned income is the least important category, it makes a significant contribution in Malawi, where it comprises 36 percent of total per capita income. This is attributable to the fact that remittances from men working in South Africa or on estates within Malawi is an extremely

Table 2. *Sources of Agricultural Income of Low-Income Rural Smallholders in Five Countries in Sub-Saharan Africa, Selected Years*
(percentage of total agricultural income)

	Per capita agricultural income								
	Côte d'Ivoire		*Ghana*		*Madagascar*			*Malawi,*	*Tanzania,*
Source of agricultural income	*Forest*	*Savannah*	*Forest*	*Savannah*	*Coast*	*Plateau*	*South*	*south*	*all*
Traded food[a]	14	32	18	26	23	30	36	53	35
Consumed by the household	8	18	9	16	23	28	33	52	27
Sold	6	14	9	10	[d]	2	3	1	9
Nontraded food[b]	41	46	70	73	46	69	58	24	61
Consumed by the household	32	31	57	63	35	51	44	20	42
Sold	9	14	13	10	11	18	15	4	18
Export crops[c]	45	22	12	1	31	1	6	23	4

a. Rice, maize, groundnuts, and other traded food.
b. Millet, cassava, sweet potato, yams, and other nontraded food.
c. Cocoa, tobacco, cotton, coffee, cola nuts, rubber, sugar, and other exportables.
d. A positive share less than 0.50 percent.

Source: Based on data from: Côte d'Ivoire, 1985–86 Côte d'Ivoire Living Standards Survey (unpublished); Ghana, 1987–88 Ghana Living Standards Survey (unpublished); Madagascar, Dorosh and others (1990); Malawi, Harvard Institute for International Development (1989); and Tanzania, 1976–77 government household survey (unpublished).

important source of income for smallholder households in the highly land-constrained southern region of the country.

Third, we are able to distinguish between the relative value shares of goods that are consumed by the household and those that are marketed. In all cases, except in Côte d'Ivoire, the value of household consumption dominates sales. This indicates a relatively noncommercialized agricultural sector.

Of greatest relevance, however, is the difference between tradable (such as rice, maize, and groundnuts) and nontradable (such as roots and tubers, vegetables, meat, and milk) food products and export crops (such as coffee, tea, tobacco, cocoa, and cloves) in the production of the average smallholder household for each country or region (table 2). As indicated earlier, we focus on the implications of price changes among these three components of agricultural earnings and on nonagricultural earnings r. By definition, virtually none of the export crops are consumed by the household. Although designating a commodity as a nontradable implies that it is not a direct substitute for an import good and is likewise not traded internationally, there is still considerable scope for selling such commodities in the local market place. Therefore, like tradable goods, these appear in both consumption and marketing of the households.

The relative importance of these classes of goods in overall agricultural incomes (including the imputed value of household consumption) and in revenue from sales varies considerably from one country or region to the next (table 2). In Côte d'Ivoire, tradable food products comprise only 14 percent of total agricultural income (including the imputed value of household consumption) in the forest region, whereas the comparable figure is 33 percent for the savannah. Export crops represent 45 and 22 percent of agricultural incomes and 75 and 43 percent of agricultural sales revenue, in the two regions, respectively. These patterns reflect the dominance of coffee and cocoa in the forest region. In the savannah only cotton is an important export crop, and tradable and nontradable food crops (such as maize, rice, and yams) represent nearly equally important sources of income. In other countries export crops as a share of total agricultural incomes and as a share of sales revenue are also much lower than those observed in the Côte d'Ivoire forest region. In Tanzania, the savannah region of Ghana, and the plateau region of Madagascar, only 4, 1, and 1 percent, respectively, of agricultural incomes are from production of export crops. In Malawi 23 percent of agricultural incomes (and 83 percent of sales revenue) is from the primary export crop, tobacco, and 12 percent of agricultural income (35 percent of the sales revenue) in the forest region of Ghana is from export crops (cocoa and cola nut).

Perhaps the most interesting finding concerning the three groups of agricultural goods is that nontradable goods represent a very high share of total agricultural income as well as a high share of sales revenue. In Ghana, 70 percent of agricultural income is from nontradables in the forest region, with the comparable figure being 73 percent in the savannah. Nearly 40 and 50 percent of the sales revenue are from these sources in the two regions, respectively. In the

Table 3. *Expenditures by Low-Income Rural Smallholders in Five Countries in Sub-Saharan Africa, Selected Years*
(percentage of total expenditures)

	Per capita expenditure								
	Côte d'Ivoire		*Ghana*		*Madagascar*			*Malawi,*	*Tanzania,*
Type of expenditure	*Forest*	*Savannah*	*Forest*	*Savannah*	*Coast*	*Plateau*	*South*	*south*	*all*
Food	65	70	73	80	59	65	62	61	71
Traded	15	28	10	26	19	16	16	35	23
Rice	6	11	2	8	13	16	13	0	5
Maize	5	10	6	16	a	a	a	33	17
Groundnuts	1	5	1	1	a	a	a	2	1
Other	2	3	1	1	5	0	3	0	0
Nontraded	50	42	63	54	46[b]	49[b]	49[b]	26	48
Millet	0	3	0	16	a	a	a	1	4
Cassava	4	3	12	5	—	—	—	1	2
Other	46	37	51	33	—	—	—	25	41
Nonfood	35	30	27	20	41	35	38	39	29

— Not available.

a. A positive share less than 0.50 percent.

b. The data for Madagascar did not permit the role of cassava to be distinguished from that of other goods in the nontraded goods share.

Source: Based on data from: Côte d'Ivoire, 1985–86 Côte d'Ivoire Living Standards Survey (unpublished); Ghana, 1987–88 Ghana Living Standards Survey (unpublished); Madagascar, Dorosh and others (1990); Malawi, Harvard Institute for International Development (1989); and Tanzania, 1976–77 government household survey (unpublished).

Tanzania sample, nontradables were observed to comprise as high as 61 percent of total agricultural incomes and nearly 60 percent of the sales revenue. Even in the more commercialized Côte d'Ivoire, nontradables contribute 46 and 41 percent to total agricultural incomes in the savannah and forest regions, respectively. The relatively low level of nontradables in agricultural incomes in Malawi—24 percent—reflects the domination of maize in the diet.

The value of tradable food crops consumed by the households is generally greater than the value of sales of the same goods. This can be seen, for example, with maize and rice in both regions of Côte d'Ivoire and in Tanzania and Malawi. However, the degree to which household consumption dominates the sales of these specific commodities differs dramatically from one case to the next. In Malawi, where commercialized agriculture is by and large limited to the leasehold estate sector, the value of home-consumed maize per household is 100 times the value of sales. In the more commercialized forest region of Côte d'Ivoire 30 percent of the maize and nearly half of the rice is sold. Similarly, around half of the maize in Ghana's forest region is sold.

A sizable proportion of nontradable goods is sold, albeit locally. For example, 30 percent of the total value of nontradable crops in Tanzania is marketed. This is very close to the 32 percent observed for low-income smallholders in the savannah region of Côte d'Ivoire, which in turn is considerably higher than that in the forest region. However, in Malawi only 15 percent of nontradable goods are sold, which is in keeping with the overall lower level of commercialization of agriculture in the region. A larger share of nontradable goods than tradable commodities is sold locally in Malawi. Thus, local trade in nontradables represents an important source of agricultural and nonfarm income for traders, as well as for low-income smallholders.

Expenditure Shares

As expected of poor smallholder households, the share of expenditures allocated to food is high. The actual numbers range between 59 percent on the coast of Madagascar to 71 percent in Tanzania, 71 percent in the savannah in Côte d'Ivoire, and 80 percent in the savannah in Ghana (table 3).

A more disaggregated look at expenditures indicates that the shares represented by tradable versus nontradable commodities are quite variable. In the savannah region of Côte d'Ivoire, and especially in the southern region of Malawi, a relatively small portion of total expenditures (42 and 26 percent, respectively) is in the form of nontradable goods. However, for Ghana, 63 percent out of the 73 percent of the budget allocated to food in the forest region is in the form of nontradable goods. This reflects the importance of roots and tubers, legumes, vegetables, and meat (including fish and poultry) in the consumption bundle of the population. For example, yams alone in the Ghana forest region account for as high a budget share as rice and maize combined in the forest region of Côte d'Ivoire. In contrast, expenditures on tradables are higher in Malawi owing to the importance of maize in the consumption bundle.

Prices

For each country and region six price indexes were constructed. Three producer price indexes approximate developments in the prices of exportables, tradable food crops and other nontradable food products, respectively. Three consumer price indexes similarly summarize developments in the consumer prices of tradable food products, nontradable food products, and nonfood products.

The indexes were constructed from time series data for the producer and consumer prices of a number of products, which were considered major or representative. The shares in income and consumption of the pertinent group were considered in aggregating the different price series into group specific indexes. For example, for Côte d'Ivoire, the export price index was constructed by considering the producer prices of cocoa and coffee, with different weights for the forest and savannah rural poor, which reflect their respective income shares from table 2, scaled up so as to sum to one. Similarly, maize and rice producer prices were considered representative for the tradable food price index, while producer prices for plantain, cassava, and yams were considered representative of the other agricultural products category. For the consumer price indexes in Côte d'Ivoire, consumer prices for maize and milled rice were considered representative of the tradable food price index; plantain, cassava, and yams were considered representative for the products consumed under the other nontradable foods category, and the nonfood consumer price index was taken to represent the consumer prices of nonfood products. Similar procedures were followed for the other countries and groups.

In equation 3 there is one other price that must be specified: the price of importable intermediate products P_m. As a proxy for this we used the nominal exchange rate, multiplied by the import unit value index for African countries (which is from IMF 1990b).

Table 4 exhibits the evolution of the ratios of producer price indexes of exportable agricultural products (P_e^p) to the price indexes of tradable foods (P_f^p) and nontradable agricultural products (P_o^p) for each country and region. Given that exchange rate depreciation is a pillar of policy reform efforts in Sub-Saharan Africa, one would generally expect the price of exportables to rise compared with the price of nontradable agricultural products. At the same time one would not expect the expenditure-switching policy to cause a significant trend in the price of exportables with respect to tradable food crops. Despite these expectations, some caveats apply that may result in outcomes differing in practice. First, parallel free markets may be operating so that prices observed before adjustment already reflected what could be viewed as an approximation of the equilibrium exchange rate toward which adjustment will move the official market. Second, exchange rate devaluation is often undertaken in combination with other domestic and international trade and marketing reforms, such as adjustment of quotas and tariffs that may offset some of the gains to farmers or

losses to consumers that would be a consequence of higher relative prices for tradables and export goods. Third, there is often a considerable lag between the beginning of adjustment programs and the implementation of real policy changes.

With these points in mind, it comes as no surprise that the results of the price ratios analysis are mixed. For Ghana it appears that the ratio of exportables to tradable foods is higher after 1984 in both regions, and likewise the ratio of exportables to nontradable agricultural products also appears to have reversed a decline before 1984. In Côte d'Ivoire the trends appear to be quite different. Although the ratio of P_e^p/P_f^p appears to have risen after adjustment, the ratio P_e^p/P_o^p exhibits a clear downward trend. This likely reflects in part the appreciation of the CFA franc during this period.

In Malawi and Tanzania no significant trend is apparent in either ratio. In Malawi this is explained by pricing policy for export crops, specifically the tobacco varieties that smallholders are permitted to produce. The government administers the price of tobacco, and parastatals assume all the responsibility for procuring and marketing the crop. Therefore, there is no opportunity for the potential benefits of expenditure switching policies to be transmitted to the farmer. In Madagascar the trend in P_e^p/P_o^p takes a big jump in 1987 and 1988, back to levels observed in the 1970s. After falling dramatically in 1982 and 1983, during the formative stages of Madagascar's adjustment program, P_e^p/P_f^p showed signs of increasing during 1984 to 1988. However, in 1986 rice prices soared owing to insufficient imports and the emergence of shortages.

A similar set of consumer prices and ratios, including tradables to nontradables, tradables to nonfood, and nontradables to nonfood, were constructed. As with producer prices, in consumer price ratios there is little indication of generalizable trends that correspond to what might be expected to occur during adjustment: expenditure-switching policies that favor exportables, or at least tradable goods, relative to nontradables. This is explained by the fact that movements in prices in each country must be related not only to the specific exchange rate regime, but also to the commercial policies being pursued, institutional reforms that allow prices to clear the market, and stochastic events such as rainfall.

But perhaps of equal note is the instability in the price ratios in some of the countries. In Madagascar, for example, the large decline in P_e^p/P_f^p in 1986 reflected the shortfall in imports when a lack of coordination between ministries caused the government distribution system to run out of stocks (Shuttleworth 1989). In Malawi, P_e^p/P_f^p decreased from 100.0 in 1981 to 64.5 in 1982 because of a dramatic increase in the price of tradable food crops. Maize prices increased from Mk6.6 to Mk11.0, and the price of groundnuts increased from Mk33.8 to Mk51.9, while tobacco, the predominant export crop, witnessed a very small price change. In 1983, however, the tobacco price increased from Mk45.1 to Mk75.9, while maize prices did not change; the P_e^p/P_f^p ratio increased to 107.5. Thus price policy in Malawi was affected by a variety of signals, such as the

Table 4. *Producer Price Ratios for Exportable, Tradable Food and Nontradable Agricultural Products in Five Countries in Sub-Saharan Africa, 1975–89*
(percent)

Year	Côte d'Ivoire		Ghana		Madagascar			Malawi, south	Tanzania, all
	Forest	Savannah	Forest	Savannah	Coast	Plateau	South		
	Ratio of exportable agricultural product prices to tradable food prices (P_e^p/P_f^p)								
1975	79.8	143.7	175.3	180.9	178.8	196.4	196.4	95.8	123.6
1976	76.3	135.6	98.0	105.2	195.5	212.4	212.4	87.6	146.3
1977	74.0	122.7	67.8	77.8	192.0	211.2	211.2	98.5	117.1
1978	86.3	103.5	140.2	157.9	199.0	214.5	214.5	128.8	107.8
1979	85.1	97.7	152.4	168.9	194.7	189.9	189.9	123.3	108.9
1980	112.6	110.7	74.6	84.4	167.4	164.4	164.4	100.0	120.0
1981	100.0	100.0	124.6	141.0	161.4	159.5	159.5	100.0	94.9
1982	98.0	91.4	115.3	118.3	100.0	100.0	100.0	64.5	93.9
1983	93.1	84.5	39.9	44.1	107.8	101.0	101.0	107.5	101.6
1984	126.5	78.5	100.0	100.0	126.9	125.9	125.9	95.0	78.6
1985	111.3	90.4	205.7	214.7	106.8	112.2	112.2	113.2	88.9
1986	127.5	125.4	196.5	205.9	71.6	82.8	82.8	107.1	100.0
1987	124.9	126.1	200.1	212.8	117.4	139.3	139.3	114.8	105.2
1988	106.0	106.9	179.0	191.5	172.7	199.5	199.5	97.9	116.8
1989	—	—	—	—	—	—	—	97.7	137.3

Table 4. *(continued)*

Year	Côte d'Ivoire		Ghana		Madagascar			Malawi, south	Tanzania, all
	Forest	Savannah	Forest	Savannah	Coast	Plateau	South		
	Ratio of exportables to nontradable agricultural products (P_e^p / P_o^p)								
1975	191.9	275.1	—	355.3	145.3	178.0	163.9	65.1	112.9
1976	159.3	229.7	—	207.8	176.5	213.5	194.2	69.6	113.4
1977	86.3	136.5	122.1	107.3	136.5	176.3	153.0	78.3	65.2
1978	101.0	119.1	224.8	188.8	131.1	168.5	143.2	96.8	58.8
1979	85.6	101.9	227.2	225.6	118.3	143.4	117.4	95.6	70.7
1980	99.9	101.2	131.8	119.1	106.8	118.3	105.7	100.0	87.0
1981	100.0	100.0	153.9	153.7	93.0	99.6	92.9	100.2	98.0
1982	96.0	96.3	115.8	116.5	100.0	100.0	100.0	107.4	97.8
1983	80.6	80.4	45.1	50.4	103.7	95.7	96.4	85.8	100.7
1984	85.7	77.9	100.0	100.0	106.4	105.8	105.5	66.2	85.8
1985	97.0	97.5	279.2	277.7	102.5	108.7	107.1	75.0	88.9
1986	90.1	98.1	242.6	298.7	88.9	116.9	103.2	66.9	100.0
1987	87.8	94.5	182.6	265.8	129.7	173.9	152.6	71.7	107.0
1988	85.1	90.7	242.0	229.9	171.6	209.3	197.6	74.1	120.7
1989	—	—	—	—	—	—	—	82.2	128.2

— Not available.

Note: The indexes for each country and region equal 100.0 in the year in which the first World Bank structural adjustment loan was approved for that country.

Source: Computed from data from: Côte d'Ivoire, International Monetary Fund (1990a), Government of Côte d'Ivoire (various years), and World Bank data; Ghana, Alderman (forthcoming), Republic of Ghana (1989), and World Bank data; Madagascar, Republic of Madagascar (1988), Dorosh, Bernier, and Sarris (1990), and Dorosh and others (1990); Malawi, Government of Malawi (various years), Sahn and Arulpragasam (forthcoming), and World Bank data; Tanzania, Government of the United Republic of Tanzania (1988, 1989), Economic Research Bureau (various years), and World Bank data.

Table 5. *Values of Other Structural Parameters in Five Countries in Sub-Saharan Africa*

Parameter	*Côte d'Ivoire*	*Ghana*	*Madagascar*	*Malawi*	*Tanzania*
Share of labor in nonagricultural production (α)	0.58	0.48	0.56	0.49	0.65
Share of capital in nonagricultural production (β)	0.12	0.13	0.20	0.22	0.18
Share of labor in agricultural production (γ)	0.66	0.66	0.58	0.66	0.90
Share of labor employed in agriculture (λ_a)	0.64	0.53	0.74	0.81	0.61
Share of labor employed in nonagriculture (λ_n)	0.36	0.47	0.26	0.19	0.39
Share of export crops in total agricultural output (b_e)	0.44	0.15	0.07	0.28	0.16
Share of traded food crops in total agricultural output (b_f)	0.07	0.16	0.26	0.43	0.17
Share of other food products in total agricultural output (b_o)	0.49	0.69	0.67	0.29	0.67

Source: Computed from data from: Côte d'Ivoire, World Bank data; Ghana, World Bank (1983, 1990) and national accounts and production data from the government of Ghana; Madagascar, Dorosh and others (1990); Malawi, Government of Malawi (1985), Government of Malawi (various years b), Government of Malawi (various years c), World Bank data, and trade data from the National Statistics Office of Malawi; and Tanzania, World Bank (1990) and 1976 input-output table, and national accounts data from the government of Tanzania.

maize shortage in 1981 and pressure to increase foreign exchange commensurate with the signing of the second adjustment loan in 1983 (Sahn and Arulpragasam forthcoming).

Another example of a marked incongruity in the price ratio is found in Ghana in 1983, when both P_e^p/P_f^p and P_e^p/P_o^p plummeted. The explanation is to be found in the food shortages caused by the drought and bush fires that decimated food crops, driving the prices of rice, maize, and subsequently roots and tubers to dramatic highs (Alderman forthcoming).

Many interesting stories could be told about observed price fluctuations. The data indicate the lack of clear adjustment-induced trends in prices. Smallholders have been, and continue to be, buffeted by price shocks. The combination of the stochastic nature of the weather and the vagaries of government decisionmaking results in large and unpredictable year-to-year fluctuations.

Other Parameters

The remaining necessary parameters for the simulation of the model were estimated from a variety of sources for each country, and they are summarized in table 5. These parameters refer to the national level, and so they are not specific to any regional or income group. They were compiled generally by examining national accounts, input-output, and labor force statistics in the various countries, using some adjustments and approximations where the exact figures were not available.

III. Results of the Model

From the analysis in section I and the appendix, we derived equation 3, which enables us to simulate changes in the income of a typical member of a rural poor smallholder household. This equation was derived by constructing two Laspeyres indexes of nominal income and nominal consumer prices for each class, corresponding to the two brackets in equation 3. The index of nominal income was computed by multiplying the weights by the various producer price indexes mentioned in the previous section, where the parameters in the weights and the price series were those described in tables 2 and 4. Similarly, as shown in the second bracket of equation 3, we multiplied the index of nominal consumer prices discussed in the previous section by the weights derived from table 3. The ratio of the weighted nominal income index to the nominal consumer price index gives an index of real income for a given class of rural smallholders.

Table 6 exhibits the evolution of this index of real income for poor rural households in each country and region from 1975 to 1989. For each country and region the index is set at 100 in the first year that a structural adjustment program was implemented in each country (the first year in which a structural adjustment loan from the World Bank was approved). The index describes changes in real income arising only from relative price changes and does not incorporate changes that would arise from random fluctuations in production.

Table 6. *Index of Real Income of Low-Income Rural Smallholders in Five Countries in Sub-Saharan Africa, 1975–89*

	Côte d'Ivoire		*Ghana*		*Madagascar*			*Malawi,*	*Tanzania,*
Year	*Forest*	*Savannah*	*Forest*	*Savannah*	*Coast*	*Plateau*	*South*	*south*	*all*
1975	102.0	105.2	n.a.	n.a.	108.2	100.2	101.8	95.3	148.6
1976	103.2	110.5	n.a.	n.a.	106.8	97.6	100.0	102.6	145.3
1977	91.1	102.3	146.9	123.0	107.3	98.3	100.1	101.9	154.4
1978	116.1	119.6	88.9	88.5	107.0	97.5	99.2	106.0	164.4
1979	100.0	105.7	83.5	78.4	106.9	96.8	98.4	106.4	166.7
1980	106.9	103.9	97.5	93.1	106.8	99.2	99.6	100.0	154.1
1981	100.0	100.0	109.5	100.2	104.9	99.5	98.3	88.8	125.0
1982	98.7	99.5	101.8	100.9	100.0	100.0	100.0	101.6	134.1
1983	84.8	91.5	108.5	123.4	98.2	98.2	97.4	125.6	147.4
1984	90.3	89.8	100.0	100.0	97.8	96.8	95.7	116.2	133.9
1985	90.3	91.6	97.6	90.0	99.7	99.1	99.3	124.2	118.5
1986	97.8	96.3	89.5	85.6	104.9	104.3	108.8	118.4	100.0
1987	87.0	86.6	99.9	88.5	102.8	97.9	102.4	105.0	111.1
1988	89.3	91.7	89.1	88.0	98.5	93.0	95.2	104.2	91.6
1989	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	118.1	n.a.

n.a. Not available.

Note: The indexes for each country and region equal 100.0 in the year in which the first World Bank structural adjustment loan was approved for that country.

Source: Authors' computations.

So, for instance, in a year of drought and high food prices, the index might indicate high real incomes for typical rural smallholders, under the assumption that their production was not affected by the drought. Although this is clearly not correct, it isolates the effects of prices from the effects of random shocks on the quantities produced. Even this, however, is a simplification, because random shocks in production will affect observable prices and might bias the results. In any case, the objective of the exercise is to see if there are noticeable trends.

In Tanzania the results indicate that after the 1976–77 coffee boom, there was a decline in rural smallholder incomes, which became more acute beginning in the major crisis years of 1984 and 1985 before structural adjustment. In 1987 real rural incomes began to rise, but this was not sustained into 1988. The decline in rural smallholder incomes during the last half of the 1980s was largely attributable to the liberalization of maize meal in 1984, which led to a threefold increase in its price. This had adverse consequences on the smallholders who are net consumers and making purchases at official prices. Nonetheless, the actual decline in incomes shown in table 6 is overstated, given that many consumers were already paying the open-market price before liberalization. Without a comprehensive data series on the price of open-market maize and on the share purchased on the open versus official market, it is not possible, however, to determine the extent of the decline.

In Côte d'Ivoire, since 1981, when adjustment programs were first implemented, there appears to be a small but significant trend toward declines in real rural smallholder incomes in the forest and the savannah regions. This is especially obvious in 1987 and 1988, when the CFA franc appreciated considerably concurrent with falling world prices for cocoa and coffee. But it also reflects the contraction of the economy as a whole, which has occurred since the beginning of adjustment.

In Malawi the results also correspond to expectations. In particular, the negative GDP growth rates reported in 1980 and 1981 correspond to the low values in the index. Similarly, the index fell temporarily in 1987 and 1988 because the real prices for the major traded agricultural good, maize, and the major export crop, tobacco, were lower during those two years than at any time during the period between 1975 and 1989 (Sahn, Arulpragasam, and Merid 1990). But in addition to the movement of the income index corresponding to our expectations, it is equally important that total output and yield for all major export, traded, and nontraded goods were at best stagnant during the period covered by the model (Sahn and Arulpragasam forthcoming). This implies that neglecting to incorporate the supply response is not a serious compromise in the Malawi case.

Madagascar also witnessed no significant trend in rural incomes in any of the three regions after 1982, when the adjustment operations were initiated. This is not surprising given that the initial years of Madagascar's reform program were dedicated primarily to stabilizing the account balances through reducing absorption. In addition, an examination of government policies regarding the taxation of agriculture reveals that at least through 1987, the last year for which data are

available, the extremely high level of taxation of coffee, vanilla, and cloves had not abated during adjustment (Dorosh, Bernier, and Sarris 1990). Similarly, other indicators on the performance of the food crop sector, such as total rural rice consumption and rice production per capita, actually declined between 1982–83 and 1986–87 (Dorosh, Bernier, and Sarris 1990). This adds further credence to the results of the model, which indicate that smallholders have not been early beneficiaries from adjustment.

The most questionable results of the model regard the case of Ghana. In particular, the index of real income for poor rural smallholders suggests that incomes were highest during 1981–83. This seems counterintuitive, given that after 1984 the macroeconomic performance of Ghana was quite impressive, partially because of incentives to produce exportable crops, particularly cocoa. The explanation for the surprising results of the model is to be found by referring back to earlier tables on the structure of incomes and expenditures and price trends, recognizing the limitations of the model itself in incorporating aggregate supply response, and reconsidering the importance of rewards to non-agricultural activities that are captured in the model.

The fact that export crops, particularly cocoa, make up such a small share of overall income in the savannah (0.7 percent of total income and 1.0 percent of agricultural income) and in the forest region (6.8 percent of total income and 12 percent of agricultural income) partially explains why increased incentives to export crop producers have not resulted in higher real income for the rural poor. A related factor is the prominence of nontraded crops in income shares. In keeping with expectations about the consequence of large-scale currency devaluation, the relative prices of nontraded commodities have not been increased during adjustment. Thus there has been little increased income to households that are heavily engaged in producing roots and tubers.

The limitation of this model, which was discussed earlier, is that it does not capture aggregate increases in output that result from adjustment programs or unrelated stochastic events. This represents a noteworthy shortcoming for Ghana, given the evidence that, unlike the other countries included in the study, there have been sustained increases in aggregate output since the beginning of adjustment. In 1984 agricultural labor was significantly increased by the massive repatriation of Ghanaians from Nigeria. Most of these settled in rural areas and joined their former households, thus increasing the labor available in each household as well as the ratio of workers per dependents. This would tend to shift the typical smallholder production possibility frontier outward and would tend to improve average smallholder per capita income. The model's limitations in considering a fixed production possibility frontier are most seriously manifested in the Ghana case.

Perhaps the most interesting point in explaining the counterintuitive results for Ghana lies in reconsidering one of the innovations of the methodology used here: the incorporation of nonfarm smallholder income in the index of total real income. It would be useful to investigate whether the trends indicated in table 6 are common for different components of income. To illustrate this, we separated

the total real income index into two components, the first representing real income from agriculture and the second representing real income or rewards from nonagricultural activities (table 7). In terms of equation 3, in the first index the numerator is nominal agricultural income, which is composed of the three agricultural producer price indexes, P_e^p, P_f^p, and P_o^p, weighted by the agricultural income shares S_{ae}/S_a, S_{af}/S_a, and S_{ao}/S_a (which sum to one). The denominator is the consumer price index. In the index of real income from nonagricultural sources the numerator incorporates all five producer price indexes (P_e^p, P_f^p, P_o^p, P_n^p, and P_m^p) and their remaining (without the agricultural income shares) weights (which are divided by S_r so that they sum to one) as indicated in equation 3. The denominator is the consumer price index.

Table 7 indicates that for Ghana the major factor leading to the mild decline in real income is not a fall in agricultural income, but the decline in nonagricultural income. To the extent that adjustment programs in fact bring about shifts in relative prices that lower returns to labor, this finding is not altogether surprising. Furthermore, there was a large devaluation of the cedi in 1984, which led to a sharp rise in the cost of capital, intermediate inputs, and consumables. It is plausible that there was a sharp rise in the cost of nonagricultural activities and a subsequent decline in nonfarm income-earning opportunities for the rural poor. However, possible increases in marketing services and other forward and backward links with agriculture are not fully captured, given that aggregate output is fixed. This latter point once again admonishes caution in interpreting the results.

Examining the trends of the index of real income from agriculture and the index of real income from nonagricultural sources for other countries indicates that for Tanzania, both components of real income exhibit similar trends. In Côte d'Ivoire, although in the forest region the indexes exhibit similar trends, in the savannah region real agricultural income shows a declining trend, while nonagricultural income does not exhibit any clear direction of change. In Malawi both components of real income generally show similar trends. However, the increase in income in 1989 shown in table 6 is largely attributable to the increase in the index of real income from agriculture, which reflects the large jump in producer prices for maize and tobacco, while consumer price increases for staple tradable foods (maize and groundnuts) were moderate. In Madagascar the overall indexes do not exhibit significant trends, and this appears to be the case for agricultural and nonagricultural incomes. Therefore, it appears that, except for Ghana, the trends in agricultural real income are similar to those in nonagricultural real income.

IV. Summary and Conclusions

This article presents a model that enables us to examine trends in the real incomes of rural smallholders in several countries and regions in Sub-Saharan Africa. The results indicate that there is no unequivocal pattern of increase or decline in the real welfare of the rural poor but that there are marked differences

Table 7. *Agricultural and Nonagricultural Components of the Index of Real Income of Low-Income Rural Smallholders in Five Countries in Sub-Saharan Africa, 1975–89*

	Côte d'Ivoire				*Ghana*			
	Forest		*Savannah*		*Forest*		*Savannah*	
Year	*Agricultural component*	*Non-agricultural component*	*Agricultural component*	*Non-agricultural component*	*Agricultural component*	*Non-agricultural component*	*Agricultural component*	*Non-agricultural component*
1975	103.5	93.7	104.8	103.6	n.a.	n.a.	n.a.	n.a.
1976	104.1	96.5	110.2	108.5	n.a.	n.a.	n.a.	n.a.
1977	92.4	84.7	103.5	95.0	157.1	123.3	130.4	99.3
1978	117.2	110.7	120.6	113.4	88.8	83.6	87.3	86.1
1979	100.8	96.6	106.9	99.8	83.7	82.0	76.0	82.3
1980	107.8	103.8	104.3	102.1	98.7	100.0	94.6	93.4
1981	100.0	100.0	100.0	100.0	107.1	116.7	96.7	111.6
1982	98.1	100.6	99.5	99.6	100.4	106.9	99.2	108.0
1983	84.3	86.0	91.9	89.3	121.5	93.6	135.3	99.9
1984	90.0	90.6	90.6	85.8	100.0	100.0	100.0	100.0
1985	89.8	90.9	91.8	89.6	92.1	99.3	82.0	102.1
1986	97.1	99.4	95.5	99.4	98.9	73.3	87.6	76.7
1987	86.4	88.8	85.8	89.8	117.0	76.7	95.4	72.8
1988	88.9	90.5	91.5	92.2	102.0	69.4	94.3	71.8
1989	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.

Table 7. *(continued)*

	Madagascar									
	Coast		Plateau		South		Malawi, south		Tanzania, all	
Year	Agricultural component	Non-agricultural component	Agricultural component	Non-agricultural component	Agricultural component	Non-agricultural component	Agricultural component	Non-agricultural component	Agricultural component	Non-agricultural component
1975	115.8	97.0	96.0	96.8	101.2	96.6	93.6	93.6	150.7	138.4
1976	113.6	94.9	88.6	96.1	96.3	96.4	102.0	99.9	147.8	134.4
1977	114.2	97.0	93.5	95.6	99.2	95.6	101.0	99.8	156.8	145.1
1978	113.0	98.8	92.4	96.7	97.9	96.7	105.0	104.9	170.4	147.3
1979	112.8	101.2	93.5	97.3	98.0	97.4	105.0	106.6	172.6	151.5
1980	112.7	103.0	100.1	99.2	101.0	98.7	100.0	100.0	156.5	149.5
1981	108.5	102.5	101.5	98.7	99.4	97.6	87.7	89.9	126.5	122.2
1982	100.0	100.0	100.0	100.0	100.0	100.0	103.1	99.9	135.6	131.3
1983	96.4	99.6	95.8	99.7	95.1	99.7	126.9	124.0	148.9	144.5
1984	96.4	97.6	93.5	97.7	92.7	97.3	116.1	115.4	137.8	124.1
1985	99.7	97.5	98.2	97.6	98.8	97.6	123.4	123.7	118.7	117.9
1986	110.5	100.0	111.5	98.9	117.1	100.5	116.5	119.3	100.0	100.0
1987	109.9	97.2	98.0	97.4	105.9	98.7	101.4	107.9	113.0	106.8
1988	102.1	94.8	83.8	97.8	90.8	98.2	99.4	108.2	91.9	90.5
1989	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	115.5	120.0	n.a.	n.a.

n.a. Not available.

Note: The indexes for each country and region equal 100.0 in the year in which the first World Bank structural adjustment loan was approved for that country.

Source: Authors' computations.

among countries and regions. This highlights the importance of the structure of rural smallholders' incomes and expenditures and the evolution of relative prices. However, changes in relative prices, and especially in the ratio of tradable to nontradable prices, are not sufficient indicators or predictors of developments in real welfare. Ghana seems to be a good case in point: although the agricultural exportable good prices seem to have been favored after adjustment, this has not led to major rises in the real incomes of rural smallholders in either the forest or the savannah regions.

This analysis suffers from several limitations. For example, as discussed above, the simulation model is unable to capture adjustments to price signals made by producers and consumers. Hence, indications that rural smallholder welfare does not change in fact might imply small improvements. Similarly, our price indexes do not include prices for all products that make up the tradable and nontradable groups. However, we do not believe that more detailed analysis of prices would reverse the general conclusions, since we captured a large proportion of income and expenditure shares for each country. We have stopped short of the type of modeling that is required to explain how policy has influenced the observed price trends and hence cannot attribute the evolution of smallholder real incomes to adjustment programs or any other specific factor. However, we believe that we have shown that the issue of structural adjustment and rural poverty is complex and that earlier efforts that arrived at simplified statements on the harmful or beneficial effects of adjustment based on stylized facts were not useful. They failed to account for sources of income, patterns of expenditures, and movements in relative prices in the wake of adjustment.

We have shown that the direction and level of changes in real income brought about by structural adjustment are determined by a variety of factors. Outcomes will be different and unpredictable without, at a minimum, a careful analysis of an extensive range of data, including the information on income, expenditures, and prices found in this article. This is because there is considerable variation in the shares of tradables, nontradables, and exportables in the consumption bundle as well as in the outputs of smallholders; because changes in nonagricultural incomes can offset or reinforce changes in agricultural earnings, and these shifts are in turn conditioned by a variety of parameters that characterize the economy as a whole; and because relative prices do not move in a predictable fashion in the wake of adjustment because of the range of domestic and international commercial and trade policies that impact upon these patterns. Further research to construct dynamic and general equilibrium models is needed to define, using counterfactual analysis, the changes brought about by adjustment. The loss in precision in some of the simplifying assumptions in the model presented here does not, however, detract from the fact that it indicates the direction and order of magnitude of changes in smallholder welfare in the years since adjustment programs began. Thus, although the search for generalizations will continue, at this juncture, it is safe to conclude that there is little evidence of large welfare

gains or losses accruing to smallholders in the wake of policy reforms that have been initiated in the countries studied.

Appendix. A Model for Analyzing Real Income Changes of Rural Smallholders

Consider an economy composed of two sectors: agriculture and nonagriculture. The agricultural sector produces three products (exportables, traded foods, and other agricultural products, denoted by e, f, and o, respectively) and, apart from land, uses only labor. The nonagricultural sector produces one product using labor and an imported intermediate product. Technology is Cobb-Douglas. The nonagricultural sector can be thought of as composed of a formal and an informal sector, producing largely consumer products that are imperfect substitutes in consumer preferences. The formal sector, which includes all the public enterprises, is in many analyses modeled as a fix-price nonagricultural sector; it has excess capacity and fixed nominal wages. The informal sector, composed of many individual and small-scale unincorporated enterprises, is a flex-price sector characterized by ease of entry and exit and a lot of self-employment. The two sectors are lumped together here as one sector that operates so as to maximize short-run profit.

It might appear strange to lump together two sectors that apparently behave very differently. However, from our perspective, what is of interest is that the reward to nonagricultural activities varies and that labor can shift between the agricultural and nonagricultural sectors. The labor rewards to the flex-price nonagricultural sector vary in response to labor supply and demand. However, although it might appear that nominal wages are fixed in the so-called fix-price sector (that is, the public sector), it is well known that when real wages decline there, people reduce their labor input and engage in other agricultural and nonagricultural activities. Hence a decline in the output of the fix-price sector might mean an increase in the activity of the informal sector. In the aggregate, it is reasonable to expect that the output of both sectors together will respond to total expected rewards in both formal and informal activities, and this is what justifies our assumption that the total nonagricultural sector behaves as if it maximizes profits. The profit maximization assumption is a convenient way to describe our belief that output varies with prices and that labor and other input demands will also respond to prices.

Denote by X_n the output of the nonagricultural sector, by L_n the demand for labor in the same sector, by M the amount of the imported intermediate product that is demanded in the nonagricultural sector n, by w the effective unit labor reward, and by P_m the domestic price of M. The sector will maximize profit, π, where

$$\pi = P_n X_n - wL_n - P_m M. \tag{A-1}$$

The technology producing X_n is

$$X_n = K_n L_n^{\alpha} M^{\beta} \tag{A-2}$$

with α, β positive parameters ($\alpha + \beta < 1$) denoting the share of labor and imported intermediates, respectively, in the production of the nonagricultural products. Substituting equation A-2 into equation A-1 and maximizing, yields a function for the demand for labor L_n and the demand for M. Log-differentiating the demand for labor, we obtain

$$\tilde{L}_n = \frac{1}{1 - \alpha - \beta} \{\tilde{P}_n - (1 - \beta)\tilde{w} - \beta\tilde{P}_m\}. \tag{A-3}$$

Equation A-3 expresses how the demand for nonagricultural labor changes, with changes in the price of the nonagricultural product, and its two main inputs.

The other major labor-using sector is agriculture. Agriculture supplies labor to the nonagricultural sector depending on the relative rewards of agricultural versus nonagricultural activities. At this point, we introduce two structural assumptions that seem to be quite relevant for countries in Sub-Saharan Africa. First, most agricultural production is organized along individually operated farm units. This implies that the reward of a unit of agricultural labor is on aggregate close to the *average* product of labor in agriculture. The second assumption has to do with the types of nonagricultural activities in which the rural poor engage. They usually involve either wage employment in rural or urban areas or some type of small-scale, owner-operated enterprise. Given capital requirements, risks, and so forth, we assume that the effective reward offered by the nonfarm enterprise to a unit of nonagricultural labor is close to the effective reward of farm operator labor. This type of assumption has been supported by some empirical evidence (Collier, Radwan, and Wangwe 1986), and we consider it to hold true for the countries in our sample.

Given the above reasoning, the behavioral relation that will govern the supply of labor from agriculture to nonagriculture is

$$r = w = \frac{P_a X_a}{L_a} \tag{A-4}$$

where X_a is the aggregate output of the agricultural sector, L_a is the labor employed in agriculture, and P_a is the aggregate price of agricultural output. If the production of X_a is governed by the following Cobb-Douglas relation:

$$X_a = K_a L_a^{\gamma} \tag{A-5}$$

then equation A-4 gives a relation between L_a and r. Log-differentiating that equation, we obtain a relation between the aggregate use of agricultural labor and the nonagricultural wage:

$$\tilde{L}_a = \frac{1}{1 - \gamma}(\tilde{P}_a - \tilde{r}). \tag{A-6}$$

Under the assumed Cobb-Douglas technology, equation A-6 is also valid if the unit reward is equal to the marginal product of labor in agriculture.

The final consideration has to do with the structure of the aggregate labor market. In Sub-Saharan Africa unemployment rates are very low; they are virtually zero in rural areas, based on data from household surveys (see, for example, Glewwe 1988). The reason is that people move in and out of various low-skilled activities quite easily. Although it is more difficult to find permanent wage work in the rural sector (for example, as a public employee), even that submarket is not separated from the rest of the labor market. In fact, it is quite prevalent that underpaid civil employees are involved in other activities by effectively diminishing their labor input into their official activity. The upshot of these arguments is that it is reasonable to suggest that the labor market in Sub-Saharan Africa is characterized by full employment, which determines returns to labor.

The implication of this consideration for our simple model is that we can use equations A-3 and A-6 in an aggregate labor market clearing equation to determine $\tilde{r}$. The aggregate labor market equilibrium condition is

$$L_a + L_n = L \tag{A-7}$$

where L is exogenously given. Log-differentiating equation A-7 and using equations A-3 and A-6, we obtain

$$\tilde{r}\left(\frac{\lambda_n(1-\beta)}{1-\alpha-\beta} + \frac{\lambda_a}{1-\gamma}\right) = \frac{\lambda_n\tilde{P}_n}{1-\alpha-\beta} + \frac{\lambda_a\tilde{P}_a}{1-\gamma} - \frac{\lambda_n\beta\tilde{P}_m}{1-\alpha-\beta}. \tag{A-8}$$

In equation A-8 λ_a, λ_n are the base year shares of total labor employed in agriculture and nonagriculture, respectively.

We have abstracted from secular trends in wages caused by changes in the capacity of the two sectors (summarized by the all-inclusive indexes K_a and K_n in the model) as well as exogenous growth in the labor force. These influences could easily be included by adding to the right-hand side of equation A-6 another term $\tilde{r}^*$, where

$$\tilde{r}^* = \frac{\lambda_n\tilde{K}_n}{1-\alpha-\beta} + \frac{\lambda_a\tilde{K}_a}{1-\gamma} - \tilde{L} \tag{A-9}$$

and $\tilde{L}$ is the exogenous natural growth rate of the labor force. Lacking much information on which to empirically estimate $\tilde{K}_a$ and $\tilde{K}_n$, we simply neglect the term $\tilde{r}^*$ altogether.

Before substituting equation A-8 into our original equation 2 in the main text, we note that the log-change in the index of agricultural prices $\tilde{P}_a$ can be written as a function of the three agricultural product groups, as follows:

$$\tilde{P}_a = \sum_i b_i\tilde{P}_i^p \tag{A-10}$$

where b_i $(i = e, f, o)$ are the base year shares of each group's output in the total

agricultural output of the country. With these conventions, equation A-8 can be substituted in equation 2 in the main text to yield the following equation that will be used to trace the real welfare of a typical poor household:

$$\text{(A-11)} \qquad \tilde{Y} = \left\{ \left(S_{ae} + \frac{S_r \lambda_a b_e}{(1-\gamma)\Delta} \right) \tilde{P}_e^p + \left(S_{af} + \frac{S_r \lambda_a b_f}{(1-\gamma)\Delta} \right) \tilde{P}_f^p + \left(S_{ao} + \frac{S_r \lambda_a b_o}{(1-\gamma)\Delta} \right) \tilde{P}_o^p + \frac{S_r \lambda_n}{(1-\alpha-\beta)\Delta} \tilde{P}_n^p - \frac{S_r \lambda_n \beta \tilde{P}_m}{(1-\alpha-\beta)\Delta} \right\} - \{\theta_f \tilde{P}_f^c + \theta_o \tilde{P}_o^c + \theta_n \tilde{P}_n^c\}$$

where

$$\text{(A-12)} \qquad \Delta = \frac{\lambda_n (1-\beta)}{1-\alpha-\beta} + \frac{\lambda_a}{1-\gamma}.$$

Equation A-11 depends on structural variables that are relatively easy to estimate and on changes in price indexes that can be readily estimated. There are, nevertheless, several points of clarification and caveats about an expression such as equation A-11 that deserve mentioning. The behavioral relation equation A-4 is meant to imply that agricultural owner operators essentially equate the marginal reward to other activities with their average reward to their own agricultural activities. In other words, they regard agricultural activities as basic. In practice considerations such as risk and food security might make any specific test of equation A-4 difficult to implement. For instance, agricultural daily wages might appear higher than returns per day from own production, but we still do not observe small farmers abandoning their plots to work for large-scale operators or plantations. This implies that the effective wage, or the nominal wage adjusted for other factors, is lower than the apparent nominal wage. This is well known from the Harris-Todaro model.

Another salient feature of our assumption about sources of income of the poor rural household is that their reward to nonagricultural activities is basically assumed to be reward to the labor input. In other words, they do not share much in the aggregated profits of the nonagricultural sector. This basically means that because of ease of entry in the informal sector, whatever businesses the rural poor engage in will be mostly own labor intensive and owner operated, earning effective rewards, which, when adjusted for risk and other factors will be roughly equivalent to other labor activities.

Another assumption underlying our framework is that remittances and transfers, which in our model are included with non-own-account agricultural income, change proportionately with the unit rewards to nonagricultural activities. Private transfers and remittances are important parts of rural income in many African countries. They are usually generated by former household mem-

bers that have moved temporarily or permanently to work off-farm for wages or in their own business. If the income accruing to a rural smallholder household from remittances is regarded as reward to a portion of the household labor that is occupied with off-farm work, then it is reasonable to regard these transfers as part of non-own-account agricultural income and to include it with other non-agricultural income. If remittances come from abroad, then it is reasonable to consider them exogenous. However, the available statistics usually do not allow the breakdown of nonearned income into that originating within the country and that from abroad; in the empirical part of the article they are lumped with nonagricultural income.

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