Supply response in the context of structural adjustment in Sub-Saharan Africa

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I. Introduction

The performance of African economies has worsened over the last three decades, and the resulting problems have, more recently, reached crisis proportions. This crisis has several dimensions. Prominent among these is the sharp fall in living standards in most of the countries. In aggregate terms, the rate of growth of both gross domestic product (GDP) and per capita GDP of Sub-Sahara African (SSA) countries declined steeply from the 1960s to the mid-1980s. In the period 1960–1970, for instance, the overall annual rate of growth of GDP for these countries averaged 3.8 percent, then fell to 3.6 percent in 1970–1980; subsequently, the average fell further during 1980–1986 to only 1.1 percent. While a slight recovery was evident during 1985–1986, GDP declined in 1987 to reverse the earlier marginal improvements. In per capita terms, the rapid population growth rate, taken together with the anaemic GDP growth performance, meant that the slight improvement in the standard of living in the 1960–1980 period was subsequently reversed so that per capita income in 1988 was no more than 75 percent of the level reached at the end of the 1970s (World Bank, 1988). This falling trend in per capita GDP is particularly significant for low-income SSA countries in which it declined by an average of 0.9 percent in 1970–1980 and 2.5 percent in the subsequent 1980–1986 period.

A parallel development to the falling standard of living has been an equally sharp decline in trade indicators. Thus, between the mid-1970s and mid-1980s, the share of exports in GDP declined for most SSA countries. Similarly, the average ratio of external debt service to export of goods and services increased sharply from the 1970s, so that by the end of 1985, close to 20 countries had debt-service ratios of over 300 percent, including several whose ratios were well in excess of 1,000 percent (GATT, 1987); while in the aggregate, the ratio of external debt to GDP for SSA countries rose from 39 percent in 1980 to 69 percent in 1987 (IMF 1988). This massive debt burden further complicates Africa's economic crisis and, at the same time, is a symptom of the fundamental imbalances between aggregate domestic demand and aggregate supply which have characterized the economies of many SSA countries, particularly in the 1980s.

There is very little debate regarding Africa's poor economic performance and the long-term nature of the decline in living standards, particularly during the 1980s. But controversy continues to surround the issue of which factors are

responsible for the crisis. Two sharply contrasting views on the crisis and its causes emerged in the early 1980s. On the African side, the Organization of African Unit (OAU) articulated the Lagos Plan of Action (LPA) in 1980 which placed most of the blame of the plight of African economies on adverse external and climatic environments. This document specifically identified the world recession, falling real commodity prices, declining export volume and terms of trade, rising interest rates and debt burden, as well as drought, as the major factors responsible for Africa's economic crisis. In comparison, the World Bank's Berg Report (World Bank, 1981) attributed most of the problem to domestic factors such as poor economic management, including overly expansionary fiscal and monetary policy, policies which reduced micro-economic efficiency through the introduction of various distortions both in the product and factor markets, policies producing export disincentives such as overvalued exchange rates and high-cost inefficient import-substitution industrialization, as well as inefficient public-sector and parastatal activities.

It should be noted, of course, that African governments acknowledge that poor domestic policies in the early 1980s have played a role in the economic crisis. In the same way, external commentators certainly acknowledge the impact of external and climatic constraints on the economies of SSA countries. In fact, some analysts have concluded that external shocks have been more important in determining the poor economic performance and external payments imbalances, although poor domestic policies have also impeded appropriate adjustment responses (Yagci, Kamin and Rosenbaum, 1985). In any case, the concessions on both sides notwithstanding, the two contrasting views of the factors responsible for the crisis naturally led to marked differences in policy prescription. The African view enshrined in the Lagos Plan of Action recommended the promotion of regional co-operation and integration based on an essentially inward-looking strategy, which at the same time sought to put some distance between the alleged fragile, rigid and undiversified African economies and an "unreliable and hostile" external environment. The World Bank's policy recommendation, on the other hand, has pointed in the opposite direction by urging the adoption of an outward-oriented strategy that would become operational through adjustment and appropriate domestic policy reforms.

Policy-reform activities in the 1980–1989 period, show quite clearly that one of the contrasting views has won the day. Actual policy-reform efforts have focused primarily on the domestic front, thus giving the impression that SSA countries have either ignored or set aside the prescriptions of the Lagos Plan of Action in favour of the World Bank's policy recommendations. The reforms involve a clear shift toward greater reliance on market forces and the price system, and toward an export-oriented development strategy. What is less clear is the extent to which this radical shift in policy stance reflects a genuine conversion to an outward-looking strategy or an involuntary acceptance of an externally imposed "conditionality". Since virtually all of the ongoing domestic policy-reform packages have been designed (partially or completely) and supported, in one way or another, by arrangements with the World Bank and the International

Monetary Fund, it may be presumed that external "advice", if not pressure, has played an important role in bringing about many of the policy changes.

The nature, magnitude and timing of the effects of these policy changes on the key micro and macroeconomic variables, whose movements can be assumed to track the process of adjustment called forth by the policy reforms, are included in the concept of the supply response. Preliminary assessments of the adjustment efforts of many SSA countries provide mixed signals; in one case (World Bank, 1988), the firm conclusion is that supply response to policy changes has been generally slow (or low), while another report (World Bank and UNDP, 1989) paints a more optimistic picture.

This paper does not attempt to reconcile these contrasting views. Rather, it seeks to provide a general survey of supply response in the context of structural adjustment efforts and corresponding changes in the structure of incentives in SSA countries. The purpose is to offer some pointers to further research for the future programme of the African Economic Research Consortium. In the rest of the paper, the on-going structural adjustment programmes in SSA countries are briefly described as a prelude to an analysis of conceptual relationships between adjustment, incentives, supply response and growth. Next, the paper focuses on an analysis of supply response in the agricultural sector, paying particular attention to theoretical formulations and the available empirical evidence on the supply responsiveness of African agriculture. A final section presents a tentative research agenda in the area of supply response in the economies of Sub-Saharan Africa. Thus, this paper deals with a much narrower set of concerns than those addressed by Tony Killick (1990) in his paper in this AERC series. Hopefully, therefore, the two papers are complementary.

II. Adjustment efforts in Sub-Saharan Africa

The World Bank introduced structural adjustment loans (SALs) in 1980 as a means of assisting those developing countries facing severe macroeconomic problems such as falling export earnings, growing current-account deficits in their balance of payments, rising debt burden, and stagnant or declining per capita GDP. To the extent that these countries were experiencing considerable difficulties in adapting to external shocks emanating from the changing international environment and were prepared to adopt appropriate adjustment policies, the SALs could provide financing to these countries to assist them in implementing appropriate policy and institutional reforms aimed at making the economy more flexible and strengthening its capacity for adjusting relatively more efficiently and easily to future shocks (World Bank, 1985).

The objective of SALs is to support specific policy changes and institutional reforms directed toward achieving efficient resource use and contributing to a sustainable balance of payments while maintaining growth. The SALs focus on major macroeconomic and sectoral issues, particularly trade policy, resource mobilization, efficient use of resources and institutional reforms. The focus of SALs is economy-wide and an agreement on an effective stabilization programme and monitorable policy changes in specific areas is required as a prior condition.

Sector adjustment loans (SECALs) have broadly similar objectives and contents, except that they focus on policy changes and institutional reforms in specific sectors (e.g. agriculture and rural development, industry, energy, financial system, etc.). SECALs are used instead of SALs in countries which do not need comprehensive economy-wide reforms, which lack the capacity to formulate and implement SALs, which are big and powerful enough to resist the large external intrusions into the domestic policy making arena which accompany SALs (Helleiner, 1988).

SALs and SECALs have grown rapidly since their introduction, and during fiscal years 1979–1987, such adjustment lending accounted for 12.2 percent of total World Bank lending (see Table 1). By fiscal year 1988, the share of SALs and SECALs in Bank lending was almost 25 percent. Between 1979 and 1987,

some 25 SSA countries received World Bank adjustment loans: more than half of these countries had more than one such loan (see Table 2). In addition, the share of adjustment lending in total World Bank lending is higher in SSA than in any other region (see Table 3). Between 1980 and 1987, at least 51 countries received one or more SALs or SECALs from the World Bank; almost half of the total number of adjustment loans and credits went to Sub-Saharan Africa (McCleary, 1989), while at least 25 SSA countries also received IMF adjustment support over the same period.

Because of the dominant role of the agricultural sector in African economies, the World Bank's adjustment lending has been used largely to support agriculture. In this respect, "emphasis has been placed on raising producer prices, reducing the taxation of farmers associated with the high profits or low efficiency of marketing boards; and improving public services, especially in agricultural extension and research" (McCleary, 1989, p.32).

In addition, a major plank in the policy recommendations of World Bank adjustment loans is the adoption of an outward-oriented development strategy which places an explicit emphasis on export expansion as the primary channel for eliminating current-account deficits in the recipient countries. Thus, the Bank's adjustment programmes in Africa are aimed at expanding the production of agricultural tradeables, which is, in turn, expected to lead to increased exports.

Many African adjustment loan recipient countries have, as a result , been focusing their on-going policy reforms not only on sector-specific policies such as raising agricultural price levels, abolishing parastatal agricultural crop procurement and market authorities or removing their monopsony/monopoly powers, and reducing marketing margins; they are also addressing trade and general macroeconomic policies, including the establishment of market-determined exchange rates, tariff lowering and restructuring, and general liberalization of external trade. The five key elements of the policy package aimed at promoting increased output of agricultural tradeables and export expansions are shown in Table 4.

Key elements of the on-going policy reforms are aimed at correcting currency overvaluation and shifting the internal terms of trade in favour of agriculture and export production. Hence, the establishment of more flexible and largely market-determined exchange rate regimes and the deregulation of agricultural marketing systems have assumed clear prominence in the reform efforts across many African countries. Between 1983 and 1986, policy reform packages including these major elements were initiated or implemented in varying degrees in the Gambia, Ghana, Guinea, Madagascar, Mauritania, Nigeria, Sierra Leone, Uganda, Zaire, and Zambia. As a result, substantial devaluations of local currencies have taken place. Between September 1983 and March 1987, local currencies are reported to have fallen against the U.S. dollar as follows: Zaire 70 percent, Tanzania 77 percent, Nigeria 79 percent, the Gambia 81 percent, Zambia 84 percent, Sierra Leone 93 percent and Ghana 97 percent (World Bank, 1987). In addition, nominal crop prices have been raised substantially in several countries. Thus, Zambia increased the producer price of maize by over 35 per

Table 1 World Bank adjustment lending, fiscal year 1979–1987

	Fiscal Year									
	1979	1980	1981	1982	1983	1984	1985	1986	1987	1979–87
Structural adjustment										
Number	—	3	6	6	7	6	3	7	13	51
US$ million	—	305	717	1,071	1,285	1,082	163	610	665	5,897
% total lending	—	2.7	5.8	8.2	8.9	7.0	1.1	3.7	3.8	4.7
Sector adjustment										
Number	1	1	3	—	8	8	13	18	18	70
US$ million	31	65	137	—	641	1,318	1,475	2,283	3,452	9,403
% total lending	0.3	0.6	1.1	—	4.4	8.5	10.3	14.0	19.5	7.5
All adjustment										
Number	1	4	9	6	15	14	16	25	31	121
US$ million	31	370	854	101	1,926	2,400	1,638	2,893	4,118	15,300
% total lending	0.3	3.2	6.9	8.2	13.3	15.5	11.4	17.7	23.3	12.2

Source: "Lending for Adjustment: An Update." *World Bank News*, Special Report, April 1988.

Table 2 World Bank adjustment loan recipients in Sub-Saharan Africa

One loan		Two loans	Three loans	Four+ loans
Burundi	Somalia	Guinea Bissau	Côte d'Ivoire	Ghana (6)
Burkina Faso	Uganda	Niger	Kenya	Malawi (4)
C.A.R.	Zimbabwe	Nigeria	Madagascar	Zambia (4)
Gambia		Sudan	Mauritania	
Guinea		Tanzania	Mauritius	
Sao Tomé		Togo	Senegal	
Sierra Leone		Zaïre		

Source: As for Table 1.

Table 3 Structural and sector adjustment in Sub-Saharan Africa, 1979–1986

	Fiscal Year					
	1979–1981	1981/82	1983	1984	1985	1986
Total World Bank Loans (US$ million)	1,374.4	1,807.0	1,794.0	2,368.3	1,597.3	2,046.5
SALs and SECALs (US$ million)	230.0	429.8	406.5	818.2	192.3	574.5
%	16.7	23.8	22.7	34.6	12.1	28.1

Source: As for Table 1.

cent in 1984, and also boosted the price of coffee and cotton. In Zaire, the producer price of maize doubled and that of cassava increased about 300 percent between 1983 and 1984. Similarly, Ghana tripled the price of cocoa over the 1983–1985 period, while Guinea increased the wholesale price of imported rice by 400 percent. In Nigeria, post-reform producer prices for the major agricultural export crops increased by between 100 percent and 300 percent during the 1985–1987 period. In most of these countries, the steep increases in nominal producer prices have more than compensated for domestic inflation so that significant real producer price increases have been achieved.

Table 4 Major types of policy reform measures undertaken in Sub-Sahara African countries during the 1980s

Country	Reform period	Exchange rate adjustments	Increased producer prices	Liberalized marketing and pricing	Liberalized external trade	Liberalized payments arrangements
Burundi	1986–1989	x		x	x	
Congo	1985–1988	x	x	x	x	
Gabon	1986–1989		x	x	x	x
Gambia	1985, 1986–1988	x	x	x	x	x
Ghana	1983–1985, 1986–1989	x	x	x	x	x
Guinea	1985–1986, 1987–1990	x	x	x	x	x
Guinea Bissau	1983–1984, 1987–1990	x	x	x	x	x
Kenya	1980–1985, 1988–1990	x	x	x	x	
Madagascar	1986–1987	x	x	x		
Mauritania	1985–1986, 1986–1989	x	x			
Mauritius	1982–1986	x	x	x	x	x
Mozambique	1987–1989	x	x	x	x	
Niger	1983–1985, 1987–1990		x	x	x	x
Nigeria	1986–1988	x	x	x		
Senegal	1980–1983, 1983–1986, 1986–1989		x	x	x	x
Sierra Leone	1986–1989	x	x	x	x	x
Somalia	1985–1986, 1987–1989	x	x	x	x	x
Tanzania	1982–1985, 1986–1989	x	x	x	x	
Uganda	1987–1989	x	x	x	x	x
Zaire	1983–1986, 1987–1990	x	x	x	x	x

Source: IMF Survey, various issues, 1984–1989.

Various studies have examined the effects of the nominal devaluations that have taken place in the process of implementing policy reforms in SSA countries. Jaeger and Humphreys (1989, p. 1034) find that "nominal devaluation appears to be compensating for the high rate of inflation in Africa, with the result that the real exchange rate index (REER) has declined by about a fifth, so that by 1987, Africa's REER was about 10 percent lower than in the early 1970s". Thomas and Chhibber (1989, p.30) find that "by 1987 the real exchange rate had on average depreciated by about 40 percent compared to the 1965–1981 level" in the 15 SSA countries reviewed. The nominal devaluation of local currencies permitted larger increases in nominal producer prices, especially from 1984, so that more of the benefits of devaluation could be passed on to farmers.

The poor performance of African agriculture, particularly through the 1970s and early 1980s, is well documented. For the SSA countries, the total volume of agricultural output grew at an average annual rate of 2.5 percent during 1960–

1970 but this rate of growth fell by almost 50 percent to only 1.4 percent per annum in the 1970–1982 period. Performance seems to have picked up somewhat around the mid-1980s, as the annual growth rate of agricultural production was 1.72 percent during 1976–1985. However, agricultural output continued to decline in per capita terms and reached an average of 1.04 percent per annum in 1976–1985. Similarly, the index of per capita food production fell by 12 percent in 1970–1982, and declined by another 5 percentage points between 1976/77 and 1985.

Given the dominance of the agricultural sector in African economies, the sector's poor performance is obviously closely related to the poor overall economic performance described earlier. Hence, improvements in agricultural incentives which lead to improved agricultural production may be expected to boost overall economic growth. There is, thus, considerable interest in relating the agricultural sector's performance to the ongoing policy-reform efforts.

The evidence on this issue is still fragmentary and should be treated with some caution. But it does appear that as a result of better weather, and perhaps also to improved agricultural incentives, African agriculture has performed better during the 1984–1988 period than over the previous 15 years. More specifically, total agricultural production grew at an average rate of 4 percent per annum during 1984–1988 (FAO, 1989), while Sub-Saharan Africa's decline in per capita agricultural output appears to have been arrested, if not reversed, as the average per capita agricultural production was rising or stable between 1985 and 1988. Although the performance of food production did not quite match that of aggregate agriculture, the food production index is reported to have risen sufficiently between 1984 and 1988 to maintain a stable per capita output over the period (World Bank and UNDP, 1989).

III. Adjustment, incentives, supply response and growth

As indicated above, structural adjustment policy changes in SSA countries have focused primarily on the agricultural sector. The performance of this sector is considered critical to the entire adjustment process "because it is usually more labour-intensive and less import-intensive than the rest of the economy" (World Bank, 1988, p. 49), and as a reflection of the fact that the sector plays a dominant role in the typical SSA economy. Prominent price policy measures, aimed at enhancing incentives for increased agricultural production and export, include attempts to bring product prices closer to international levels and initiatives to reduce agricultural disincentives emanating from overvalued exchange rates and/or industrial protection. Longer-term policies to enhance agricultural growth aim at reducing farm costs through research and extension, provision of infrastructural facilities (transport and communication, irrigation, market information, etc.) and adoption of improved farm technologies as well as new higher-yielding seeds and crop varieties. Policy reforms at the institutional level focus on dismantling the monopoly on commodity and distribution of parastatals or, where this is not immediately feasible, enhancing their efficiency and reducing their overhead costs.

Clearly, structural adjustment policies aimed at inducing increased production of agricultural tradeables and exports in Sub-Saharan Africa have two main parts. Some of them concentrate on boosting price incentives; in such cases, a careful analysis of tradeable output responses to changing prices is a key element in any attempt to determine the effects of structural adjustment policies. Other aspects of these policies focus on enhancing incentives for increased production of tradeables through non-price factors. Hence, one must be concerned not only with the supply response to price incentives, but also with the supply response to changes in non-price incentives.

The link between structural adjustment policies, changes in the structure of incentives and improved economic performance is, in theory, quite simple. By providing better price and non-price incentives to producers of tradeables, structural adjustment policies are expected to improve the balance of payments

by inducing an increased supply of exportables. In the context of SSA countries, the agricultural sector is expected to be the primary source of an increased supply of exportables. In order to make a realistic assessment of the effects of structural adjustment policies on the growth performance of the agricultural sector in specific cases, it is necessary to determine the elasticity of aggregate agricultural supply to price and non-price incentives.

There exists already a degree of pessimism about the supply response of domestic production to structural adjustment policies, particularly in Africa. A recent study (World Bank, 1988, p. 3) concludes that: "The supply response to adjustment lending in low-income countries, especially in Sub-Saharan Africa, has been slow because of the legacy of deep-seated structural problems. Inadequate infrastructure, poorly developed markets, rudimentary industrial sectors, and severe institutional and managerial weaknesses in the public and private sectors have proved unexpectedly serious as constraints to better performance".

This conclusion reflects the belief that supply response to price changes is constrained by institutional and other non-price factors against which African adjustment efforts have apparently not made headway. It can be argued, however, that many non-price factors are also influenced indirectly by changes in relative prices. More specifically, the price incentives that farmers receive influence their decisions regarding adoption of new technology and crop varieties, higher application of yield-enhancing inputs, better resource management and application of greater effort (Chhibber, 1988). There are other non-price factors whose constraining influence may not be relaxed through improved price incentives. Falling in this category are "public goods", such as agricultural research and extension advice, improved transport and communication, as well as large-scale irrigation and water-management schemes.

The foregoing analysis implies (a) that the magnitude and speed of the supply response of tradeable goods' output are critical for the effectiveness of structural adjustment policies, and (b) that total supply response has at least two component parts—a part which is influenced directly or indirectly by changes in the structure of incentives generated by changes in relative prices, and another part which is influenced by non-price factors. Not much appears to be known, in quantitative terms, about the magnitude and speed of supply response to changes in incentives by different sectors and sub-sectors of a typical Sub-Sahara African economy; neither are there any estimates of the decomposition of the aggregate magnitude of supply response into its price and non-price components. The absence, or near absence, of reliable quantitative estimates of these parameters obviously makes a definitive assessment of effectiveness of structural adjustment policies in the SSA context quite difficult.

IV. Estimating supply response in agriculture

In general, agricultural supply response is measured by numerical estimates of the elasticities of aggregate, sub-sectoral and individual crop supply to price and non-price variables. A distinction needs to be made between estimates of responsiveness of aggregate output relative to price changes and that of individual crops. An empirical testing of aggregate supply responsiveness involves special problems. Some of these difficulties emanate from the fact that, in many cases, the aggregate supply function is derived by summing over the supply functions for individual crops. Since individual crops tend to respond to price and non-price changes in different ways, it is often not quite clear what the aggregate estimates represent. In addition, the lag structure exhibited by the grouped estimates does not usually capture the richness of the individual crop supply functions. Largely because of these problems, grouped data estimators of the supply elasticities are less efficient than those based on single-crop ungrouped data. The problems associated with summing over individual crop outputs to derive aggregate supply also carry over to those associated with deriving a composite real agricultural producer price index to be used in estimating aggregate elasticities of supply.

The elasticity of response of an individual crop to a change in its relative producer price is an easier concept to handle, although it is not entirely free of complications. The individual crop supply elasticity is likely to be larger than that of aggregate supply, since farmers can often switch resources and inputs between crops in response to relative price changes much more easily than they can change the amount of inputs and resources committed to agriculture in the aggregate.

Because there are diffferent measures of output and of price, an analysis of the elasticity of response for an individual crop must recognize the distinctions between elasticity of response to a change in the relative price of the crop and the elasticity of response for an individual crop must recognize the distinctions between elasticity of response to change in the relative prices of the inputs. Similarly, it makes a lot of difference in some cases whether the focus is on marketed surplus or on total output; the former tends to be more sensitive to

price changes than the latter, while the two measures of output may diverge quite widely for crops which are produced for both own consumption and sale.

Analysis of individual crop supply response generally deals with two aspects of crop-production separately. On some studies, the focus is on yield response, while some others examine area (or acreage) response. Studies focusing on the latter measure of output, tend to underestimate total response to the extent that the contributions of factors such as labour and capital to total response are omitted (Garcia and Llamas, 1988). The choice between area yield changes as indicators of output response is also affected by the nature of the crop being investigated. In general, there is likely to be a high correlation between area and output responses relative to price changes for annual crops since, in the short run, output can be altered by varying either the area under cultivation, or the intensity of farming, or both. For perennial crops, in comparison, short-run output can be changed only by varying the intensity of farming. Hence, the relationship between acreage and output response is likely to be weaker.

Estimates of aggregate and individual crop supply elasticities have been derived on the basis of at least four types of models (Chhibber, 1988). These include cross-country, cross-section (farm households), inter-sectoral general equilibrium, and time-series models. In general, estimates based on cross-country and inter-sectoral general equilibrium models have produced relatively high estimates of elasticities of aggregate agricultural supply. Thus, Peterson(1988) using a cross-country data set, produces estimated long-run aggregate supply elasticities varying from 1.27 to 1.66. Cavallo and Mundlak (1982), in their Argentina study which used an inter-sectoral general equilibrium model, produced a long-run aggregate agricultural supply elasticity of approximately 0.9.

Cross-farm and time-series estimates of the elasticity of aggregate supply tend to be more modest. In fact, cross-farm estimates often show negative elasticities, perhaps because of the relative unreliability of farm-level price data. Time-series estimates are normally positive but generally low, indicating, perhaps, the inability of such models to capture the contributions to total supply elasticity of changes in labour, capital, other inputs and technology use in response to changes in the aggregate agricultural price index.

Table 5 provides data on available estimates for long-run aggregate supply elasticities grouped according to the four basic models identified above. Both the inter-sectoral general equilibrium and cross-country models capture some elements of indirect price effects generated through non-price factors; this probably accounts for the relatively high estimates they produce. Estimates of long-run aggregate agricultural supply elasticities for developed countries derived from the time-series models are generally higher than those for developing countries—this is, again, an indication of the impact of the much more developed "non-price" factors (e.g. infrastructure, research and extension, communication, etc.) in developed countries which help to amplify aggregate supply response to price changes.

Table 5 Long-run estimates of aggregate agricultural supply elasticity

Model	Range of estimates
Cross-farm	-0.02 – 0.15
Time series:	
Developed countries	0.34 – 2.96
Developing countries	0.13 – 0.78
Inter-sectoral general equilibrium	0.9
Cross-country	1.27 – 1.66

Source: Chhibber, 1988, p.10.

Naturally, estimates for short-run aggregate agricultural supply elasticities are, on average, lower than those summarized in Table 5; and estimates for individual crop supply elasticities are, in general, higher than the corresponding aggregate supply elasticities. But the primary message of the cross-country and general equilibrium estimate is that aggregate agricultural supply is not necessarily price-inelastic and therefore that appropriate price policy has a significant role to play in promoting growth of the agricultural sector.

Analyses of supply response for individual agricultural commodities and for aggregate agriculture, which rely on time-series data to estimate supply elasticities, largely rest directly or indirectly on the Nerlovian (1958) dynamics-of-supply model. This basic supply response model has been widely applied and has produced much of the empirical evidence currently available on agricultural supply response for both developed and developing countries (see, for example, Askari and Cummings, 1976). But in a major review of his work after 20 years, Nerlove (1979) was no longer so sure that the model was sufficiently powerful as a tool for understanding the essential dynamics of agricultural supply in developing countries. The overall economies and the agricultural sectors of these countries are undergoing dramatic, large and often discontinuous changes that are usually accompanied by major resource shifts intra-sectorally, within agriculture, and inter-sectorally. The rapid changes, in terms of infrastructural development, technology and demography, should, in Nerlove's view, have significant implications for supply response and the methodology for measuring it. Hence, he concluded: "The inadequacy of the basic supply response model to disentangle the forces shaping agricultural supply in the context of a developing country is . . . serious. We are lacking both the necessary theoretical and econometric tools and basic data" (p. 886).

V. Supply response of African agriculture

There are three broad questions which together constitute perhaps the most important concerns of all structural adjustment programmes in SSA countries, particularly in relation to the agricultural sector. Firstly, is the issue of how, and the extent to which, various structural adjustment policies have affected (and are affecting) agricultural incentives in the 1980s. The second question relates to the extent to which changes in the structure of incentives (due to structural adjustment policy reforms) have impacted upon agricultural performance in those SSA countries which have implemented such policies. Finally, there is some concern regarding how, and the degree to which, the agricultural sector's performance has itself affected the adjustment process.

Since agriculture is a highly tradeable sector, it may be expected to be favourably influenced by certain structural adjustment policies through policy-induced changes in relative prices. And given the relative significance of the agricultural sector in SSA economies, it is virtually obligatory that the sector should play a central role in a successful process of structural adjustment. If agriculture responds strongly to structural adjustment policy changes through increased supply of exports, it could help in restoring external balance. Similarly, agricultural response in the form of increased food production could assist in moderating domestic inflation and thus contribute to the process of internal adjustment. Whether or not the agricultural sector makes a significant contribution to the adjustment process, and to what extent it does so, hinge on the sector's supply response to the induced changes in incentives brought about by structural adjustment policies. A knowledge of the sector's responsiveness provides the means for gauging the effects of specific policies on agricultural and overall economic performance.

Studies of the supply response of African agriculture have been carried out against the background of three broad *a priori* hypotheses regarding the behaviour of African smallholder farmers. First is the standard optimizing hypothesis that these farmers respond normally, quickly and efficiently to changes in the incentive structure generated by relative price changes. The two alternative hypotheses are (a) that the marketed output of subsistence farmers is inversely

related to the crop price, and (b) that although farmers would normally respond positively to relative price changes, they face institutional constraints which limit this response.

Various arguments have been marshalled in support of the perverse-behaviour hypothesis. A sample of these arguments is the following. Subsistence farmers have fixed monetary obligations or target incomes, hence they sell only as much of their production as is necessary to obtain their set target incomes. Thus, marketed output tends to vary inversely with the crop price and thus produce a backward-sloping supply curve for output. Alternatively, subsistence farmers are thought to be very risk-averse and to value leisure and related activities very highly. The same perverse behaviour would result on the assumption that the income effect arising from a crop price increase dominates the substitution effect. Thus, an increase in the subsistence-crop price may increase farmers' real income sufficiently for them to use more of the crop for own consumption, and hence the marketed surplus falls as the crop price rises. Another variation of the same basic theme is that scarcity of consumer goods, perhaps due to import restrictions, price control, and rationing, limits the farmers' desired real money income and hence leads to a reduction in marketed surplus as crop price increases.

The hypothesis developed around institutional and cultural constraints is supported by arguments regarding various alleged market imperfections and infrastructural problems which significantly inhibit the supply response of African agriculture to changes in relative prices. These arguments also imply that the interdependence among the price and non-price determinants of supply response are so pervasive that they must be changed together before any substantial output response can be generated. Recent expressions of this broad view range from the claim that policies which work largely through induced relative price changes are probably irrelevant as a means of enhancing agricultural performance in Sub-Saharan Africa (Smith, 1989), to that which suggests that improved price incentives "will lead to a higher supply response only if other fundamental bottlenecks in agriculture are eliminated" (Thomas and Chhibber, 1989, p. 31).

What appears to be the emerging consensus view is that apparent deviations from "normal" optimizing behaviour are to be explained not by some imagined motivational peculiarities exhibited by African smallholder farmers, but rather in terms of the constraints they face. In any case, Helleiner (1975) and Bond (1983) have assembled a large body of empirical evidence demonstrating that African farmers respond "correctly" to price incentives. This evidence conclusively negates all variants of the perverse-behaviour hypothesis. More specifically, studies covering a wide variety of smallholder export crops in SSA countries—including cocoa, coffee, cotton, groundnuts, palm kernels, palm oil, rubber, sisal, and tobacco—produce clear empirical evidence of positive supply responses to price increases. The evidence put together by Helleiner (1975) and Bond (1983) is reproduced as Appendix 1 and Appendix 2, respectively. This evidence indicates that crop-price elasticities of supply are positive and

significant, even in the short-run. They are, however, not particularly large, ranging from 0.23 to 0.87. But corresponding long-run price elasticities tend to be larger than the short-run ones, and are in the range of 0.25 to 1.55. It should be noted that most of these estimates were derived on the basis of some varieties of the Nerlovian dynamics-of-supply model using time-series data. This methodology may explain the relative magnitudes of the elasticities.

The list of crops covered by most of the available empirical studies of supply response in SSA countries does not include Africa's major subsistence food crops. Hence very little is known empirically about the supply responsiveness of the food crops. At the analytical level, Helleiner (1975, p. 42) suggests that price responses may be larger for export crops than for food crops since the former have a better marketing system, frequently occupy relatively smaller proportions of total land and labour time, and since farmers are probably less risk averse with respect to export crops than food crops. The sharp distinction which analysts have traditionally drawn between these two categories of crops is probably becoming less relevant in many SSA countries, and hence implied differences in supply response may not necessarily continue to be significant.

From the point of view of the agricultural sector's role in the process of structural adjustment, the more important issue is the extent to which aggregate agricultural output responds to price incentives. The evidence on individual crop-supply response, however strong, does not offer an unambiguous indication about aggregate agricultural supply response. Yet, there is hardly any reliable or robust estimate of aggregate agricultural supply response for SSA countries. A recent attempt by Bond (1983) was not very successful but, since it is the only one readily available, its results are reproduced in Appendix 3. Based on the Nerlovian method, the results indicate that overall agricultural output (in the nine SSA countries covered by the study) responds positively to price incentives. However, the estimated price elasticities are small (0.18 in the short run and 0.21 in the long run), and are generally lower than the estimated price elasticities obtained for individual crops. Data limitations (poor quality and non availability) presumably precluded more rigorous tests. In addition, as Peterson (1988) and Cavallo and Mundlak (1982) demonstrate, the highly price-inelastic supply response of aggregate African agricultural supply response implied by the Bond estimate emanates more from the methodology used than from the underlying relationship. In spite of this reservation, it is not difficult to agree with Bond's conclusions that both individual crops and aggregate agricultural output in SSA countries respond positively to improved price incentives, and hence that policies which provide better agricultural incentives can be expected to generate increased agricultural production. However, as Helleiner (1975, p. 44) has warned: "Measuring the response to a change in only one of the myriad of influences upon small holder decision making, even if it is as important a one as output price is likely ultimately to be unrewarding or even misleading. What one seeks to understand is the effect of alterations in various packages of influences".

Structural adjustment policies being implemented in many SSA countries contain policy packages with interacting elements whose effects cannot, apparently, be captured in a Nerlovian framework. Hence, robust estimates of the supply response of African agriculture must be sought in the context of more appropriate methodologies.

VI. A research agenda

The current spate of policy-reform activities in SSA countries is based on an implicit assumption about the capability of African producers to respond positively, effectively and efficiently to the challenges, risks and opportunities offered in the framework of an altered economic environment. The concern that this has not happened to the extent hoped for, or as quickly as expected, has brought to the forefront the issue of supply response. The wide variety of questions which can be investigated in this connection could form an agenda for research. In listing items to be included in such an agenda, the intention is not necessarily to be exhaustive, nor to suggest that all questions worthy of analysis should be dealt with under the mandate of the African Economic Research Consortium.

Issues relating to the changing structure of African economies, and how current adjustment policies could alter the structure of incentives and generate producer and consumer responses, might be tackled through the following:

1. Studies of structural changes in SSA economies and their determinants
   - Extent of sectoral shifts and resource flows in relation to changes in the incentive system
   - How much of these changes are induced by government policies and reactions to them by producers and consumers;

2. Studies of changing structure of African agriculture (e.g. food versus export crops, etc.)
   - Intra-sectoral shifts and resource flows in reaction to incentive changes and other factors
   - Implications for agricultural performance, trade flows and balance of payments;

3. Studies of adjustment policies in SSA countries
   - Rationale, focus, major components, internal consistency and impact on major economic indicators and sectors;

4. Studies of the incentive system and the role of government

   - How much do government policies matter in shaping the system of incentives confronting economic agents in SSA countries?
   - How does policy instabilty affect perceived incentives?

5. Studies of the relationships between adjustment policies and the structure of incentives

   - How specific adjustment policies influence incentives
   - How the interaction of policies affects the structure of incentives;

6. Studies of the relationships between the system of incentives and supply response

   - How changes in the structure of incentives elicit corresponding changes in productive investment and output
   - Differences in supply response between food crops and export crops; individual crops and aggregate agriculture
   - Differences in supply response between smallholder subsistence farmers and larger commercial farms
   - Differences in supply response between the short run and long run
   - Implications of these differences for policy.

The problems associated with the conceptualization, measurement and estimation of supply response could be addressed by the following:

1. Studies to refine the concept of supply response and develop alternative measurements in the context of the characteristics of SSA producers and the process of rapid change

   - The extent to which supply elasticities measure supply response when changes in incentives and general economic environment are not "marginal"

2. Studies of the methodology of supply response of agriculture and other sectors

   - Development of approaches which permit investigation of the individual and joint effects of price and non-price factors
   - Problems with the conventional Nerlovian approach, cross-country and general equilibrium methods
   - Data requirements for implementing more appropriate methodologies.

More specific problems of African production systems might be analysed through:

1. Studies of the farming system, its characteristics, and how government actions impinge on them
2. Studies of smallholder decision-making processes to test competing (optimizing versus non-optimizing) behavioural hypotheses
3. Comparative studies of producer responses, in terms of investment and production decisions, with respect to government controlled and uncontrolled commodities to determine the extent to which government intervention affects producer response.

It appears unnecessary to attempt a more detailed articulation of any of the researchable questions identified above. But one should note that some of them could be usefully carried out in a comparative cross-country framework, while others might call for cross-section or time-series single-country approaches. It should also be noted that some of the issues are more micro in nature and may therefore not fit well into the Consortium's traditional concerns with macroeconomic policy issues.

Various structural adjustment policies are currently being implemented in many SSA countries without an adequate knowledge of the links and relationships between policies, reactions and behaviour of economic agents, and ultimately micro, sectoral, as well as macroeconomic performance. Implementation of this research agenda may contribute towards filling some of the gaps in knowledge between policies and their effects.

Appendix 1

Evidence on African smallholder supply elasticities[a]

Product and country	Period	Short-run elasticity	Long-run elasticity	Study by[b]
Cocoa:				
Ghana	1930–1940		0.43	Ady,1949
	1920–1939	0.17		Stern, 1965
	1920–1946	0.15		Ibid.
	1946–1962		0.32–0.87	Baterman, 1965
	1946–1962		0.77–1.28	Ibid.
	1947–1964		0.71	Behrman,1968
Nigeria	1920–1945		1.29	Stern, 1965
	1947–1964		0.45	Behrman,1968
	1948–1967		0.20	Olayide, 1972
Ivory Coast	1947–1964		0.80	Behrman, 1968
Cameroon	1947–1964		1.81	Ibid.
Coffee:				
Kenya, estates acreage	1946–1964	0.16	0.47	Maitha, 1969; Ford, 1971
Kenya, smallholder acreage	1946–1964	0.20	0.56	Ibid.
Kenya, estates yield	1946–1964	0.66	0.71	Maitha, 1970; Ford, 1971
Kenya, smallholder yield	1946–1964	0.64	1.01	Ibid.
Palm Oil:				
Nigeria	1950–1964	0.81		Diejomaoh, 1972
	1949–1963	0.41		Helleiner, 1966
	1948–1967		0.22–0.26	Olayide, 1972
Eastern Nigeria	1949–1966	0.41–0.70		Oni,1969a
Palm kernels:				
Nigeria	1950–1964	0.25		Diejomaoh, 1972
Cotton:				
Nigeria	1950–1964	0.67		Diejomaoh, 1972
	1948–1967	0.21–0.38		Oni, 1969b
	1948–1967	0.3		Olayide,1972
Tanzania	1953–1969		2.44	Malima, 1971
Tobacco, Malawi	1926–1960	0.48		Dean,1966
Rubber, Nigeria	1948–1967	0.21	0.17–0.24	Olayide, 1972
Haricot beans, Ethiopia	1953–1970	1.60		Goering et al.
Civet, Ethiopia	1957–1970	3.16		Ibid.
Pulses, Ethiopia	1952–1970	0.72		Ibid.

Appendix 1 continued next page . . .

Appendix 1 continued

Lentils, Ethiopia	1953–1970	1.30	Ibid.
Sesame, Ethiopia	1957–1970	0.61	Ibid.

a. It is difficult to summarize results in a number or two. A complete assessment of the meaning and value of these various estimates requires reference to the original source.
b. Full references are given in source notes.

Sources: Robert M. Stern. "The Determinants of Cocoa Supply in West Africa", in *African Primary Products and International Trade*, ed. I.G. Steward and H.W. Ord (Edinburgh: Edinburgh University Press, 1965); Merril J. Bateman, "Aggregate and regional supply functions for Ghanian cocoa, 1946–1962", *Journal of Farm Economics* 47, no. 2 (1965): 384–401; S. Olajuwon Olayide, "Some estimates of supply elasticities for Nigeria's cash crops",*Journal of Agricultural Economics* 23, no. 3 (1972); J.K. Maitha, "A supply function for Kenyan coffee",*Eastern Africa Economic Review* 1, no. 1 (1969); J.K. Maitha, "Productivity response to price: A case study of Kenyan Coffee," *Eastern Africa Economic Review* 2, no. 2 (1970); Derek J. Ford, "Long-run price elasticities in the supply of Kenyan coffee: A methodological note", *Eastern Africa Economic Review* n.s. 3, no. 1 (1971); T. James Goerring, Akilu Afework and Abate Temesgen, "The response of Ethiopian farmers to changes in product prices", forthcoming; Victor P. Diejomaoh, "Rural development in Nigeria: The role of fiscal policy" (Paper presented to the Annual Conference of the Nigerian Economic Society, March 1972); Gerald K. Helleiner, *Peasant Agriculture, Goverment, and Economic Growth in Nigeria* (Homewood, Ill: Irwin, 1966); S.A. Oni, "Production response in Nigerian agriculture: A case study of palm produce, 1949–1966", *Nigerian Journal of Economic and Social Studies* 11, no. 1 (1969a); S.A. Oni, "Econometric analysis of supply response among Nigerian cotton growers," *Bulletin of Rural Economics and Sociology* 4, no. 2 (1969b); Edwin Dean, *The supply Responses of African Farmers: Theory and Measurement in Lamawi* (Amsterdam: North Holland, 1966); Jere R. Behrman, "Monopolistic cocoa pricing", *American Journal of Agricultural Economics* 58 (1968); Kighoma A. Malima, "The determinants of cotton supply in Tanzania", Economic Research Bureau Paper 71.4 (Dar es Salaam: University of Dar es Salaam, 1971).

Appendix 2

Ten Sub-Saharan African countries: cash-crop supply elasticities

Crop Region	Period	Author	(Year)	Short-run elasticity (first year)[a]	Long-run elasticity[a]
Cocoa					
Ghana	1947–1964	Behrman	(1968)		0.71*
Ghana (old areas)	1949–1962	Bateman	(1965)	0.39	0.77
Ghana (medium areas)	1949–1962	Bateman	(1965)	0.42–0.51	1.28
Ghana (new areas)	1949–1962	Bateman	(1965)	0.61–0.87	1.06
Nigeria	1947–1964	Behrman	(1968)		0.71*
Nigeria	1947–1964	Behrman	(1968)		0.45*
Ivory Coast	1947–1964	Behrman	(1968)		0.80*
Cameroon	1947–1964	Behram	(1968)	0.68*	1.81*
Coffee					
Kenya	1946–1964	Maitha	(1970)	0.64*	1.33*
Kenya (estate)	1946–1964	Maitha	(1970)	0.66*	1.38*
Kenya (smallholders)	1946–1964	Maitha	(1970)	0.64*	1.48*
Kenya	1946–1964	Ford	(1971)		1.07*
Kenya (estates)	1946–1964	Ford	(1971)		1.18*
Kenya (smallholders)	1946–1964	Ford	(1971)	1.55*	
Africa	1947–1973	de Vries	(1975)	0.12*	0.44*
Cotton					
Nigeria[b]	1948–1967	Oni	(1969b)	0.23–0.38	0.28
Nigeria	1950–1964	Diejomaoh	(1973)	0.67*	0.67*
Sudan	1951–1965	Medani	(1970)	0.39*	0.50*
Uganda	1922–1938	Frederick	(1969)	0.25*	0.25*
Uganda Buganda	1922–1938	Frederick	(1969)	0.67*–0.73*	0.67*–0.73**
Uganda Buganda	1945–1966	Alibaruho	(1974)	0.50	0.63
Uganda (Eastern Region)[b]	1945–1966	Alibaruho	(1974)	0.23	0.44
Uganda (Western Region)[b]	1945–1966	Alibaruho	(1974)	0.26	0.62
Uganda (Northern Region)[b]	1945–1966	Alibaruho	(1974)	0.02	0.07
Groundnuts					
Nigeria	1948–1967	Olayide	(1972)	0.24–0.79	0.24–0.79
Palm Kernels					
Nigeria	1949–1964	Oni	(1969a)	0.22–0.28	0.22–0.28
Nigeria (Eastern)	1949–1964	Oni	(1969a)	0.28–0.39	0.28–0.39

Appendix 2 continued next page . . .

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Nigeria	1950–1964	Diejomaoh	(1973)	0.25*	0.25*
Palm Oil					
Nigeria	1950–1964	Diejomaoh	(1973)	0.81*	0.81*
Nigeria	1949–1963	Helleiner	(1966)	0.41*	0.41*
Nigeria	1949–1964	Oni	(1969a)	0.29–0.35	0.29–0.35
Nigeria (Eastern)	1949–1964	Oni	(1969a)	0.41*–0.70*	0.41*–0.70*

Crop Region	Period	Author	(Year)	Short-run elasticity (first year)[a]	Long-run elasticity[a]
Rubber					
Liberia	1950–1972	Ghoshal	(1974)	0.14	0.22
Nigeria	1952–1972	Olayemi and Olayide	(1975)	0.04	1.75*
Sisal					
Tanzania	1945–1967	Gwyer	(1971)	0.06*	0.48*–0.76*
Tobacco					
Malawi	1926–1960	Dean	(1966)	0.48*	0.48*
Nigeria[b]	1945–1964	Adesimi	(1970)	0.60*	0.82*

An asterisk indicates that the estimate is significantly different from zero at the 5 percent level of significance.
In these equations, acreage rather than quantity produced was used as the dependent variable.

Source: Bond, 1983.

Appendix 3

Nine Sub-Saharan African Countries: short-run and long-run price elasticities and partial adjustment coefficients for aggregate agricultural supply

Country	Short-run price elasticity	Partial adjustment coefficient	Long-run price elasticity
Ghana	0.20	0.42	0.34
Kenya	0.10	0.36	0.16
Ivory Coast	0.13	—	0.13
Liberia	0.10	0.08	0.11
Madagascar	0.10	0.31	0.14
Senegal	0.54	—	0.54
Tanzania	0.15	—	0.15
Uganda	0.05	0.30	0.07
Upper Volta	0.22	0.08	0.24
Average	0.18	0.17	0.21

Source: Bond, 1983.

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