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THE NIGERIAN ECONOMY: RESPONSE OF AGRICULTURE TO ADJUSTMENT POLICIES

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The Nigerian economy: Response of agriculture to adjustment policies

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By

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AERC Research Paper 78
African Economic Research Consortium, Nairobi
March 1998

© 1998, African Economic Research Consortium.

Published by: The African Economic Research Consortium
P.O. Box 62882
Nairobi, Kenya

Printed by: The Regal Press Kenya, Ltd.
P.O. Box 46166
Nairobi, Kenya

ISBN 9966-900-66-7

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Acknowledgements

The authors acknowledge with gratitude the intellectual and financial support of AERC, without which the study may not have been conducted. We thank without incriminating our peers and the resource persons in group A in the 1989–1991 period for their critical comments and suggestions. Finally, we also thank without incriminating the anonymous referees, in spite of the long delays.

Abstract

This study estimated price and non-price supply response coefficients for nine individual crops, sub-sectoral aggregates and commodity exports using the two-stage least squares (TSLS) and seemingly unrelated regression method (SURM) as tools for evaluating the effects of sub-sectoral aggregates on Nigerian agriculture. The estimates confirm two results in the supply response literature: (1) short-run price elasticities of individual crops are smaller than the long-run elasticities and (2) commodity sub-sectoral aggregates do not respond significantly to prices as individual crops. The results also show that the responses of food crops are sensitive to Nigeria's agro-climate and the traditional cropping patterns of Nigerian farmers, who are mainly smallholders. Moreover, individual crops and sub-sectoral aggregates do not respond significantly to capital expenditure on agriculture (CEA), possibly because of action lags, weak choice of agricultural infrastructures and corruption. Non-tradeable crops are more sensitive to the SAP dummy for institutional change (D2) than to the price support and food import dummy (D1). However, the SAP dummy is likely to indicate the effects of the reverse flow of labour from urban to rural areas following the down sizing that accompanied SAP. This is because food (cassava, millet and groundnut) and cotton (consumed mainly by domestic textile companies) are the only crops that have significant and positive response coefficients. Finally, commodity exports are positively sensitive to terms of trade.

The results point strongly to two conclusions. First, the significant sensitivity of crops to price incentives is not sufficient to generate desired aggregate response. This result is consistent with the findings of the supply response literature and suggests that structural adjustment is more likely to affect the distribution of farm incomes than agricultural productivity and growth. Second, the sensitivity of commodity exports to terms of trade implies that external and, hence, exogenous factors play a critical role in the path of exports. Therefore, getting domestic prices of commodities right would not be sufficient to expand the foreign revenue from commodity exports. This is also consistent with the consensus in the 1970s about the international commodity price and the well-established neoclassical propositions about the short- and long-run paths of commodity prices and income under conditions of free enterprise.

The results suggest that price incentives, shorter policy lags, more efficient infrastructural support to smallholder farm households, and less corruption in the design and implementation of agricultural policies would raise the production possibility frontier of farmers, who make up over 60% of employed Nigerians. Food should be at the core of a socially optimal Nigerian agricultural policy because it has the strongest potential for structural transformation of the economy and better price and policy responsiveness than tradeable crops.

I. Introduction

Agriculture remains the mainstay of the Nigerian economy despite its decline in the 1970s. Greater proportions of the population depend on the agricultural sector for their livelihood and the rural economy is still basically agricultural. The role of the agricultural sector in the overall response of the Nigerian economy to reform and adjustment policies is important because, given its relatively large size, a large positive response to adjustment policies was expected as a means of improving the overall performance of the economy. Since the severe crisis of the 1980s, Nigeria has adopted a series of policies aimed, first, at preventing the collapse of the economy and subsequently targeted at short- to medium-term adjustment to ensure sustainable growth of the economy. The structural adjustment programme (SAP) is the latest in this direction. The SAP was supposedly designed to induce structural and institutional changes necessary to reorganize the productive structure of the economy so that self-sustaining growth could be attained. The performance of the economy prior to SAP suggests that the responses of various sectors of the economy undershoot the targets. It is therefore important to monitor the response of agriculture to SAP.

In ideal circumstances, the economic unit enjoys a high degree of freedom both in terms of the alternative courses of action from which it could choose, and in selecting and implementing the alternative it considers optimal or satisfactory. The choice of this optimal action or policy requires, ex ante, evaluation of all feasible alternatives, while ex ante evaluation is predicted on some model of the relevant variables (targets, constraint and aims at an optimal action, and instruments). The potential effectiveness of policy depends in part on the model. Ex post analysis is necessary because there is no ironclad guarantee that policies perceived as optimal would indeed turn out to be optimal or even satisfactory. Thus, ex post analysis is to policy what quality control mechanisms are to processing and assembling plants.

Research problem

A significant part of the literature on the policy response of agriculture has focused on the short- and long-run supply responses of individual crops to changes in output and input prices. A number of supply response functions have been estimated for individual crops in Nigeria (Oni, 1969a; 1969b; Olayide 1969, 1972; Phillip and Abalu, 1987; Herdt, 1970; French and Mathews, 1971). Most of these studies focus on price elasticities. The studies are important to agricultural response analysis because prices are the conduit

through which structural adjustment policies were expected to affect agricultural variables (output, supply, exports and income). For example, the emphasis on market forces, the elimination of marketing boards and the withdrawal of government from direct production all aim for an environment in which agricultural output is responsive to market conditions. An analysis of agricultural supply responses to changing prices is, therefore, a crucial element in assessing the effects of structural adjustment policies on agriculture.

Non-price incentives are also key complements to the SAP in Nigeria. For example, the Directorate of Foods, Roads and Rural Infrastructures (DFRRI), whose activities are enabled by fiscal allocations, aims to provide roads and rural infrastructure to complement the price incentives in SAP. Therefore, a study of the response of agriculture to adjustment policies would estimate price and non-price elasticities.

The evaluation of supply or output responsiveness of agriculture to adjustment policies faces a key methodological problem: which estimates are more appropriate? Binswanger (1989) argues that the responses of broad agricultural aggregates to the policy changes are more appropriate than individual crop response because adjustment policies may induce intra-crop trade-offs. However, empirical testing of aggregate supply responsiveness is usually problematic. Oyejide (1990) and Braverman (1989) proposed that "grouped data estimators of the supply elasticities are less efficient than those based on single-crop ungrouped data". Available empirical results of studies so far indicate that individual crops do respond strongly to price factors, often with higher price elasticity than aggregate agricultural output.

Individual crop elasticities are needed for policy analysis, particularly if the assessment of policy effects extends beyond output and aggregate employment effects. When objectives associated with spatial equilibrium, income distribution and balance of payments are considered, the impact of policy on individual crops becomes necessary (Braverman, 1989). Given that policy reforms cause domestic relative prices to change, we could witness major resource re-allocation among the various crops and between tradeable and non-tradeable commodities and, in fact, between agriculture and non-agriculture sectors. Also, given the debt and foreign exchange problems associated with the pre-SAP crisis of the Nigerian economy, reform policies have aimed at inducing non-oil exports to enhance foreign exchange earnings and assist in solving the balance of payments crisis. Sub-sectoral aggregate supply functions are necessary to assess the general impact of the multiple targets of adjustment policy.

Although the single-equation time-series approach dominates the empirical literature, we would draw the appropriate caveat in interpreting our results.

Objective

This study has one main objective, which is to estimate price and non-price supply response coefficients for selected tradeable and non-tradeable crops. It is therefore a first step in the assessment of the response of agriculture to adjustment policies.

Organization of the report

The report has five other sections. Section II reviews the evolution of the economy before SAP, while Section III highlights the core policies of SAP. Section IV sets out the methodology adopted in this study and Section V presents and analyses the empirical results. Section VI summarizes the major findings of the study and key conclusions.

II. The Nigerian economy before SAP

Nigeria's growth experience shows a gradual and steady performance in the immediate post-independence period, with a healthy balance of payments position through exports of cash crops. Marketing boards were used to extract surpluses from the agricultural sector, which were used to provide basic infrastructure. The development of the economy since 1960 has witnessed a declining share of agriculture in the gross domestic product (GDP). At constant factor cost, agriculture, which accounted for about 66% of GDP in 1958/59, was estimated at 50% in 1970/71. Part of this decline is traceable to the relatively higher growth rate of manufacturing and mining, which is consistent with the development pattern characteristics of developing countries. Agricultural export was the engine of growth prior to 1973, providing much of the revenue that the government used in developing a basic infrastructural system. Agricultural export also financed the import substitution industrialization programme. Increases in imports due to increasing income and the import requirements of the emerging industrial sector induced balance of payments problems in the late 1960s.

The oil boom of the early 1970s relaxed the financial constraints to development. The GDP at 1977/78 factor cost grew at an average rate of only 5.0% per annum between 1975 and 1980. One major characteristic of this growth was its very unstable nature. The growth rates ranged from -1.3% in 1975/76 to 9.5% in 1979/80. Generally, government services recorded the highest growth of 17.7% in constant terms during this period. Manufacturing grew at 13.3%, while agriculture recorded a growth rate of -2.3%. The performance of the economy suggests that there was more to underdevelopment than financial constraints. The third national development plan acknowledged that the agricultural and manufacturing sectors during the period 1970–1974 performed below expectations. This informed the massive expenditure by government in the following period in an attempt to remedy these and other perceived constraints to growth.

The fourth national development plan observed:

> A situation in which distribution accounts for as much as 21.6 per cent of the GDP while manufacturing accounts for only 4.8 per cent portrays a structural imbalance in the economy set-up.

This imbalance was also manifested in the external sector of the economy. During this period imports were overshooting their anticipated levels — in fact, by about 46.5% more than the planned targets. Food, capital equipment and raw materials were the fastest

growing categories of imports. Food importation increased by almost 400%, indicating the magnitude of the food crisis associated with the expansion of the economy during this period. Exports, on the other hand, fell short of target by about 20%. Crude oil was the dominant item on the export list, targeted to contribute up to 96% of total exports during this period. "By the eve of the Third plan in March 1975, the country's oil production was at a record level of 2.3 million barrel a day, while the price per barrel stood at $13.69, having risen from $3.56 in 1973. Oil production was projected to grow at a modest rate to reach 3.0 million barrels a day by the end of the plan period" (Fourth National Development Plan). The fourth plan observed that barely five months into the plan period, Western nations' demand for oil plummeted, with adverse consequences for price. Nigeria's production dropped drastically, by 35%, to 1.5 million barrels a day as prices also dropped to as low as $12.00 per barrel. The situation improved in 1976 and 1977, but declined again in 1978. "These unexpected developments greatly distorted the expected flow of financial resources, making it necessary for the government to engage in massive borrowing from the Euro-dollar market and from multilateral institutions such as the World Bank" (Fourth National Development Plan). Despite the unexpected events in the export sector, imports continued to climb. Increased domestic spending sustained imports and put serious pressure on the balance of payments.

One of the identified problems in Nigeria in the articulation of SAP is that of policy-induced distortions. A key proposition is that policy responses to the oil boom increased the level of distortions within the economy. Some of the key propositions on policy distortions in the economy are:

- Pre-SAP policies encouraged the growth of domestic demand far beyond the productive capacity of the economy, resulting in distortions in relative prices and serious internal imbalance.
- Rapid expansion of public sector investment created serious distortions in resource allocation.
- Investment was biased toward unproductive ventures and investment projects were unviable and poorly implemented, and the rate of their expansion easily over tasked the capacity of the public sector, which was dominant in this area.
- Rapid expansion of the public sector was also characterized by increasing deficit spending by both federal and state governments in very unproductive sectors of the economy.
- Dependence on external financing generated unsustainable financing needs.
- Trade policies during this period encouraged massive importation of foreign inputs for industries with unnecessary protection for very inefficient firms.
- Import licensing systems enhanced and encouraged inefficiencies in the allocation of resources and an over-valued domestic currency.
- The general level of subsidy, which was maintained under a defective development strategy, undermined competition within the economy and led to inefficiencies, which in turn undermined growth.

The collapse of the international oil market was the immediate cause of the economic crisis of the 1980s. Foreign exchange earnings dropped significantly, causing adverse balance of payments. Despite events in 1981 and the clear signs before then, the first

main policy action by government came in April 1982 with the promulgation of the Economic Stabilization Act. The set of policies was aimed at halting the rapid decline of 1981. It contained very stringent exchange control measures and import restrictions to address the serious problem of external imbalance caused by the fall in foreign earnings. This was also backed with appropriate monetary and fiscal policies.

Between 1982 and 1985, the government applied austerity measures. The main objective of policy during this period was to reduce aggregate demand in the economy in order to dampen the pressures on the balance of payments. At the same time, attempts were made to stimulate production in productive sectors of the economy, particularly the agricultural and manufacturing sectors, to reduce domestic price inflationary pressures. Monetary policy control instruments such as the ceiling on the rate of aggregate credit distribution, minimum ratio of credit to indigenous borrowers, reserve requirements, compulsory advance deposit for imports and new interest rates structure were used. For example, the permissible rates of credit expansion for big and small banks, which had been fixed at 30% and 40% since 1975–1979, were reduced to 25% and 35% respectively. The monetary authorities changed interest rates three times in 1982; they were raised in January and again in April but lowered in November. The minimum proportion of total loans and advances that each bank could give to indigenous borrowers was fixed at 80% in 1982.

This period also witnessed tight fiscal policy. The austerity measures reduced government expenditures sharply. The public sector deficit was reduced from 11.6% of GDP in 1983 to 2.7% in 1985. This was caused largely by reduction in federal expenditure by 28% in 1984 and 36% in 1985.

III. SAP policies

The structural adjustment programme introduced in July 1986 intended to restructure the production and consumption pattern of the economy; remove price distortions; and enhance the role of the free market in resource allocation. The SAP literature also claims that it aimed to reduce dependence on the oil sector and on imports and lay the basis for sustainable non-inflationary growth through diversification of the productive base of the economy and reduction of unproductive public investments.

Although the initial programme package was projected to last for two years, various policies came into being at different times, some after the two-year period. The monetary policy was summarized in the SAP document as follows:

> The programme envisages that monetary and credit policy will be consistent with the targets set for balance of payments; the increase in reserve; fiscal policies and for control of domestic inflation ... a common feature of the various scenarios is a deliberate pursuit of a tight monetary policy throughout the programme period. Overall net domestic credit to the economy is envisaged to increase by 5 per cent and 6 per cent in 1986 and 1987 respectively from their 1985 levels ... It is expected that the desired movements in interest rate will form part of the programme review discussions. A review exercise of the restructuring of the financial sector and providing a plan of action for improved financial intermediation, will be set in motion during the second half of 1986. The government proposes meanwhile to maintain the policy of real positive rates that was established in 1985. (Federal Government of Nigeria, 1986)

The 1986 budget proposed to adjust public expenditures to reflect the revenue constraint and to limit budget deficit to 3% of GDP. The SAP document also proposed that "expenditure reallocation will accompany general expenditure reduction in order to ensure that the net benefits obtained from the limited funds are maximized". In addition, commercialization/privatization of government parastatals was also proposed.

The remaining part of this section highlights the trade and exchange rate and sectoral policies in SAP that could alter the incentive environment. This is important since the incentive environment is the key mechanism through which adjustment policies were expected to affect agriculture.

External trade and exchange rate policy

Removal of bureaucratic controls on trade was a key institutional change of SAP.

According to the SAP document, the "medium-term policy objective is . . . to gradually eliminate the existing administrative controls on trade, in line with the progressive take-off of the second-tier foreign exchange market". The central element in the incentive framework is the nexus of policies pertaining to the price and allocation of foreign exchange. The second-tier foreign exchange market (SFEM), which was expected to merge with the first-tier to achieve a single and market-determined exchange rate for the naira by the end of the adjustment period, became a major instrument of policy under SAP.

The import licensing system together with exchange control on all current transactions was abolished as soon as exchange liberalization began in September 1986. The number of prohibited import items was drastically reduced. In 1987 the system of advance payment of import duties was modified and in 1988 a new tariff structure was introduced. This new structure provided for tariffs for a seven-year period to enable adequate planning by both producers and customers. In order to reduce dependence on the oil sector as the principal earner of foreign exchange, the present administration is deeply committed to promoting non-oil exports. The SAP document set a "floor target" of $1 billion from non-oil exports by the end of 1990. According to the document,

> The government believed that the correction of cost-prices distortions through a realistic exchange rate, combined with other positive export incentives and institutional reforms, should make it possible for Nigeria to earn at least $1 billion from non-oil exports by the end of 1990. (Federal Government of Nigeria, SAP Document 1986)

Under SFEM, non-oil exporters were permitted to retain 100% of their foreign exchange earning in domiciliary accounts. Export prohibitions were abolished for most items. In 1987, a new export finance facility was introduced by the central bank. The *refinancing and rediscounting facility was to assist private exporters by providing* refinancing for the export of both agricultural and non-agricultural products. In 1987, also, a duty draw-back/suspension scheme was introduced to enable exporters to import raw materials and intermediate products for use in the manufacturing of export products free of import duties.

Sectoral policies

Apart from the monetary, fiscal and trade policies, sectoral policies are an important part of the SAP policy package. The SAP expected strong short-term agricultural supply response as a counter to inflationary pressures. A comprehensive policy package for agriculture is touted as the cornerstone of the programme. The major objectives of agricultural sector policies are:

- To increase domestic food production in order to improve nutritional standards and reduce (and eventually eliminate) external dependence on food supply.
- To increase domestic supply of agricultural raw materials such as cotton, cocoa, oil palm, sorghum, rubber, millet, sugar cane and maize to the manufacturing sector,

thereby increasing local value added and reducing dependence on imported raw materials.
- To increase production of exportable cash crops thereby diversifying the export base of the economy.
- To raise rural employment and income.
- To achieve regional optimal crop production mix, reflecting the comparative advantage of each agro-ecological zone.

The industrial strategy under SAP aimed at:

- Encouraging the acceleration, development and use of local raw materials and intermediate inputs rather than depend on imported ones.
- *Developing and using local technology.*
- Maximizing the growth in value added of manufacturing production.
- Promoting export-oriented industries.
- Generating employment through the encouragement of private sector small and medium-scale industries.
- Resolving bottlenecks and constraints that hamper industrial development, including infrastructural, workforce and administrative deficiencies.
- Liberalizing controls to facilitate greater indigenous and foreign investment.

Pre and post SAP performance of agriculture

The role of agriculture remains significant in the Nigerian economy despite the strategic importance of the oil sector. The need to restructure the agricultural sector in an effort to enhance its role in the transformation of the Nigerian economy had long been recognized in Nigeria. All of the four development plans after 1960 targeted agricultural productivity and rural welfare. A number of strategies have been articulated and implemented in a bid to improve on agricultural output, notably the River Basin Development Authority, integrated rural development programmes, national accelerated food production programme, Operation Feed the Nation, and green revolution and agricultural development programmes. These programmes have combined various price and non-price incentives in attempts to restructure the agricultural sector, increase efficiency and raise production. These programmes notwithstanding, the growth rate of agricultural production has remained below expectations, as Table 1 shows.

A comparison of the growth rate of agricultural production with those of GDP and industrial production in the 1980s reveals to some extent the crisis of agricultural production in Nigeria. Table 1 shows that agricultural production in the first half of the 1980s remained below the output level of 1972. Industrial production, on the other hand, showed a better performance. Although the industrial base remained small, the index of industrial production was higher than the base year. The performance of agriculture as shown in Table 1 – despite the numerous pre-SAP policies and programmes – did not support the high expectations of SAP on the responsiveness of agriculture to

policy. In addition, the pre-SAP performance of agriculture suggests that it may be unreasonable to anchor the success of SAP in the responsiveness of agriculture to it.

Table 1: Domestic production (₦ million)

Year	GDP	Growth %	Industrial production index 1972=100	Growth %	Agricultural production index 1972=100	Growth %
1981	78.1	7.0	185.5	-2.8	90.1	0.5
1982	78.3	0.0	197.2	6.3	92.1	2.2
1983	73.8	-5.1	154.6	-21.6	83.9	-8.9
1984	70.0	-5.1	147.0	-4.9	91.4	3.5
1985	75.5	7.9	169.4	15.2	95.8	4.8
1986	77.9	3.8	196.4	2.0	100.1	6.6
1987	79.3	1.8	197.6	19.0	100.3	1.8
1988	82.5	4.0	220.0	11.3	100.3	2.9

Source: Ojo (1989).

Table 2 shows the performance of five key cash crops. In the table, the 1985 outputs of cocoa, cotton and groundnuts were significantly less than their respective 1970 levels. Though the outputs of all three have risen in post 1985, they have remained below their respective 1970 levels. The pre and post 1985 outputs of palm kernel and palm oil are higher than the 1970 levels; however, neither output has doubled in almost 20 years.

Table 2: Output of principal agricultural commodities ('000 tons)

Year	Cocoa	Cotton	Groundnut	Palm kernel	Palm oil
1970	305	358	1581	315	488
1975	216	313	449	295	300
1980	153	77	674	279	650
1985	160	114	621	360	615
1986	100	100	640	350	650
1987	105	80	696	353	680
1988	230	194	686	545	700
1989	256	185	815	600	700

Source: *The Nigerian Economist*, vol. 4, no. 16, 1991.

Table 3 shows performance of agricultural exports. The table shows that cocoa earnings peaked in 1980 in real terms. It also shows that much of the increase in nominal revenue

reflects devaluation not increase in foreign earnings. The export of groundnut after 1970 is almost insignificant. Similarly, the earnings from exports of palm kernel and rubber are insignificant relative to oil and cocoa.

Table 3: Export earnings from major agricultural exports (₦ million (excluding oils)

Year	Cocoa		Groundnut		Palm kernel		Rubber	
	A	B	A	B	A	B	A	B
1970	133.0	191.52	43.6	62.78	21.8	31.39	17.4	25.06
1975	181.8	295.23	-	-	13.5	21.92	15.2	24.68
1980	311.1	568.88	-	-	14.1	26.33	14.1	26.33
1985	182.0	203 95	-	-	6.2	6.95	3.8	4.56
1986	370.0	291.04	0.1	0.08	7.5	5.89	29.1	22.89
1987	1497.0	363.47	-	-	60.5	14.69	-	-
1988	1475.0	325.38	1.4	0.31	203.2	44. 83	1.4	0.31
1989	1043.5	141.19	-	-	508.3	68.77	1.6	0.22

A = Nominal earnings
B = Earnings deflated by the exchange rate

Table 4 shows the prices of selected principal agricultural commodities. The key inferences from the table are:

- prices of all commodities oscillate
- pre 1986 nominal prices were more unstable and lower than post 1986 prices
- real prices are more unstable than nominal prices
- real prices have not grown as fast as nominal prices

Table 4: Principal agricultural prices in ₦/tonne

Year	Cocoa		Cotton		Groundnut		Palm Kernel	
	A	B	A	B	A	B	A	B
1970	297	1248.42	1086	453.97	67	281.63	59.4	248.00
1975	690	1530.27	308	683.08	230	510.09	150	332.67
1980	1300	1300.00	400	400.00	420	420.00	180	180.00
1985	500	636.13	850	360.47	360.47	742.15	400	169.63
1986	3500	1406.75	1000	401.93	401.93	401.93	4001	160.77
1987	11000	2735.23	4000	1458.79	1158.79	756.75	850	309.99
1988	11000	2903.14	4500	1187.65	1187.65	593.82	1000	263.92
1989	1043.5	1924.42	4500	787.26	787.26	393.63	1000	174.95

A = Nominal prices
B = Real prices

IV. Theoretical and methodological issues

It is important to review and specify the various conceptual, theoretical and methodological issues central to policy analysis in general, and a policy evaluation of SAP in particular. First, this study is primarily an ex post evaluation. Second, the ex post evaluation has two forms: theoretical and empirical. The theoretical part involves a theoretical evaluation of the process that generated SAP. This is very important because consistency in the process that generates SAP, with well-established economic principles governing policy choice, is necessary to the success of SAP. The first issue that concerns us therefore is whether SAP is an optimal choice. The second issue is the key mechanisms through which SAP policies would affect agriculture and how the effects can be measured.

Is SAP an optimal choice?

In the absence of a counterfactual analysis of SAP and all its possible alternatives, it would not be possible to rank the alternatives and then determine if SAP is the optimal policy. However, it is possible to determine if SAP itself was a product of an evaluation of the set of all feasible alternatives. The genesis of SAP indicates two key facts:

- SAP is a policy conditionally of the World Bank.
- Both the government and the World Bank touted SAP as the "only alternative."

The concept and practice of policy conditionality restricts the policy choice of an implementing economic entity to the conditional set of policies. This raises an important theoretical and practical problem: *Is it possible for a policy to be optimal if the choice set consists only of policy bundles selected by an agent whose objectives are likely to conflict with those of the implementing agent?* Economic literature has not directly analysed this problem. In neoclassical literature, in which free choice is a basic precondition for optimal choice and efficiency, restricted choice has similar effects as overbearing government control. Therefore, if an overbearing government policy is a constraint to competitive behaviour and efficiency, so is a set of conditional policies. *Just as the government is best that governs least, an external controlling agent is best that controls least.*

The idea of "only" alternative is an antithesis of the notion of "best feasible" alternative. The latter is consistent with neoclassical thoughts and doctrines of optimal behaviour; the former is not. Therefore, based on neoclassical concepts, principles and thought, SAP is not an optimal policy.

Key transmission mechanisms of SAP and estimation problems

SAP consists of economy wide (e.g., exchange rate policy) and sectoral (specific institutional changes, removal of supposed tax on agriculture, removal of protection of industry) policies. This implies multiple channels of impacts. A complete evaluation would, therefore, require an analysis of the responses of not only all the sectors within the economy but also of the aggregate economy. This is by no means an easy task. The focus of this study on agriculture restricts the mechanisms considered to those that affect agriculture. We recognize the limitations of detaching the sector from the rest of the economy for the purpose of analysing its response structure. This limitation is due, in the main, to the effect that a sectoral analysis is unable to include all indirect impact channels, all types of trade-offs and all the multiple effects of economy-wide policies. This is why this study is only a first step.

The reference points of this exercise are the diverse theoretical and empirical literatures on the response of agriculture to policy in general and those that investigate the Nigerian agricultural response in particular. While the theoretical literature specifies theoretical propositions about the responsiveness of economic agents, particularly farmers, to price and non-price variables, the empirical literature tests the theoretical propositions. The theoretical literature can generally be classified into three arguments:

- That economic agents are responsive entirely to price variables.
- That because of the structural rigidities that are dominant characteristics of less-developed economies, price mechanisms are less capable of inducing significant response among economic agents.
- That economic agents respond simultaneously to price and non-price variables.

The World Bank (1981), Kuester et al. (1990), Mundlak et al. (1989) and Krueger et al. (1990) belong to the first group, whose propositions are classified as the neo-classical counter-revolutionary paradigm. The group is neo-classical because its propositions are neo-classical and it is counter-revolutionary because it represents a negation of the revolution of Keynes. Three core propositions of the paradigm are:

- The market is perfectly competitive, implying that agents are rational and fully informed while economic resources are perfectly mobile.
- Prices are "the most efficient system of information and incentives".
- Adjustment is made fairly smoothly through price signals, the mobilization of factors between alternative uses, and the ability of entrepreneurs to exert foresight and anticipate future needs in the search for maximum rates of return on capital (Killick, 1990a).

Though market failures and externalities justify government intervention, especially in less-developed countries, the World Bank justification of SAP is anchored on the grounds that state intervention has distortionary effects in three key areas: resources use, domestic absorption and use of scare foreign exchange. The economic crisis of Nigeria

in the 1980s, which is well documented in the Central Bank of Nigeria (CBN) Annual Reports 1981–1989, appears at face value to vindicate the WB's position that poor domestic policies are the causal factors.

Killick (1990a/b), and Yagci et al. (1985), suggest the need for caution in ascribing the crisis of less-developed economies entirely to domestic policies. At least two sets of factors could be identified. The first, referred to as external factors, are linked to the asymmetrical relationship that exists between less developed and developed capitalist countries. These factors include dependence on a few primary exports and on capital goods imports, low income elasticities for primary products, competing synthetics, terms of trade deterioration, weak infrastructure of international trade, and so on. The second set consists of internal factors, which include policies, climatic vagaries, population growth, political instability, wars, etc. The rather restricted analytical base of SAP raises two analytical problems:

- Is getting policies right sufficient to counteract all external and other internal constraints?
- Is getting policies right synonymous with getting prices right?

It is clear from SAP that the answer to both questions is yes. It is important to point out that if these propositions were invalid, the effects of SAP on the domestic economy would be significantly adverse. The empirical exercise that we perform in this study is therefore a *partial test* of the validity of the underlying premises of SAP.

Some amount of consensus on the importance of both price and non-price factors is shared by an increasing number of economists. Killick (1990a), Oyejide (1990), Binswanger (1989), Diaskosavvas (1989) and Chibber (1988) emphasize the importance of price and non-price variables for the response of agriculture. The consensus is also reflected in studies that have investigated empirically the response of agriculture to prices as evidence supporting the relevance of price variables. In Nigeria, Phillips (1987), Oni (1969), Owosekun (1976), and Barau and Isitor (1988) are among several studies that have provided econometric evidence that some Nigerian crops respond significantly to price incentives. Generally these studies investigate the supply response of either one or two crops. For evaluation of the structural adjustment programme, however, the range of crops has to be made wide enough to include both tradeables and non-tradeables. It must also investigate sub-sectoral aggregate and sectoral aggregate response and not just individual crop responses.

Even more fundamental, the issue of policy evaluation occupies a broader frame than supply response analysis. This is because supply by definition connotes a one-to-one correspondence between prices and quantities. When it is the intention to investigate the impact of policy, it would be necessary to consider output response to price and non-price variables. It must also be recognized that the objectives of policy are multiple. Beyond changing the structure of domestic output (increments along the production possibility frontier – PPF), policy also expects improvement in efficiency and innovation, i.e., movement towards the PPF. These changes would have consequences for employment, income distribution, social balance and external balance. Thus, the elements that qualify for a set of evaluation indexes would normally include most, if not all, of the aforementioned variables.

The dominant evaluations, however, have tended to investigate supply response to price and are therefore inadequate to provide insight into, for example, the effect of policy on export revenue, employment, income distribution (national) and social balance. The sectoral pattern of income distribution may be inferred from the evaluation of the response of individual output to policy. Besides the limited indexes of policy impacts that output response could analyse, it has also generated methodological problems of how to analyse the aggregate response for agricultural output. Oyejide (1990) and Binswanger (1989) reviewed some of these methodological problems. Kuester et al. (1990), in their criticism of Bond (1983), also provided some other limitations of aggregate supply response. It seems that it has become generally agreed that grouped data estimators of the supply elasticities are less efficient than those based on single-crop ungrouped data (Oyejide, 1990). Methodological problems apart, a clear distinction is made in the empirical literature about elasticities in the short run and in the long run. Short-run impact multipliers are expected to be lower than those for the long run. Binswanger (1989) linked the difference to differential variability of input size between short and long runs. For example, input size is more variable in the long run than in the short run. As a result, intersectoral resource flows occur mainly in the long run. It is for this reason that Binswanger insists that even though tradeables may expand in the short run, non-tradeables (food) would be less responsive in the short run. As a result, the adjustment would be at the cost of food security. Besides this, cost may rise since the fiscal activity that SAP requires would reduce the state's infrastructural support for agriculture as a whole. As a result, the intra sectoral resource shift would be in favour of tradeables to the detriment of non-tradeables.

The roles of expansionary monetary and fiscal policies have not been given adequate attention in the discussion of agricultural supply response. It is important to recognize that these policies have increasing impact on commodity prices and on the adjustment process through the expectation formation process of decision-making units. Supply response in agriculture cannot be fully understood outside of commodity price dynamics. Macroeconomic and financial factors play increasingly greater roles in this process, particularly under SAP. Many studies still rely on the exchange rate as the sole mechanism of transmission from monetary policy to agricultural commodity prices. The point remains, however, that monetary policy affects the real prices of agricultural commodities. As noted in a World Bank study (1990), four major effects of an expansionary monetary and fiscal policy can be derived:

> First, it will lead to current account balance of payments deficit since the increased demand generated for tradable will raise imports, and direct exports to the home market. Second, the excess demand for non-tradable will raise P_n, so that P_n/P_t will rise, inducing resource transfers into non-tradable. Thirdly, factor prices will change in response to these sectoral shifts: in the short-run, real wages will fall if the tradable sector is relatively labour intensive; in the long-run, they will fall if the tradable sector is relatively labour-intensive. Finally, increased government expenditures may affect the economic and social infrastructure, depending on the nature of the fiscal expansion.

It is therefore important to be very mindful of the role of monetary and fiscal policies in the adjustment process.

V. Empirical Model, Estimates and Analysis

The Model

The sectoral model consists of three major blocks. Blocks one and two model domestic production of commodities; block three models exports of cocoa (XA) and palm kernel (XPA).[1] Block one has five non-tradeable crops (cassava, maize, millet, rice, yams) and four tradeable crops (cocoa, cotton, groundnut, palm kernel). Two criteria influenced the selection of the commodities: importance, i.e., contribution to total output, and data availability. The second block has five aggregates: non-tradeable crops (NTC); tradeable crops (TC); total agricultural crops (TAC); GDP fisheries (YS); and GDP livestock (YL).

In this study we measure the agricultural supply response to reform and adjustment policies via numerical estimates of the elasticities of sub-aggregate and individual crop output to price and non-price policy variables. Most agricultural supply response studies have been influenced by Nerlove's model. In actual estimations the original model has been modified in many diverse ways (see, for example, Askari and Cummings, 1974; Phillips, 1987; Herdt, 1970; Nowshirvani, 1971). Most studies of agricultural response include some form of price expectation and partial output (area) adjustments. In these studies a distinction is often made between actual and desired levels of production (area cultivated) and also between actual and expected prices (Phillips and Abalu, 1987; Oni, 1969, Owosekun, 1976; Nowshirvani, 1971; Herdt, 1970; Barau and Isitor, 1988). It is assumed that the desired output Y^* is a function of a set of variable Z. $Y^* = F(Z_t)$, where Z_t includes expected price at time t ($P_t e$). Other exogenous factors affecting supply t and changes in actual output will only be some fraction (g) of the difference between the desired and the previously achieved output. The formation of the price expectation is often taken to conform with the adaptive expectations hypothesis,

$$P^e - P^e_{t-1} = b_t (P_{t-1} - P^e_{t-1}) \; 0 < b_t \leq 1.$$

We modify the basic model to account for monetary and fiscal policies. This modification is a direct application of Frankel (1986). We assume that the expected rate of price change P_c^e for agricultural commodities is equal to the short-term nominal interest rate i plus storage cost S_c

$$Pc^e = i + S_c \qquad (1)$$

We also assume a simple money demand equation:

$$m\text{-}p = \Theta y - \lambda i \quad (2)$$

where
m is the nominal money supply, p is the overall price level, y is the total output, Θ is the elasticity of money with respect to output, and λ is the interest rate (2) in log form.

$$P = \alpha Pm + (1\text{-}\alpha)\, Pc \quad (3)$$

The overall price level is an average of manufacture prices, with weights α, and commodity prices, with weight (1-α). The long-run equilibrium version of the money demand equation is given as

$$m\text{-}\alpha Pm\ \text{-}(1\text{-}\alpha)Pc = \Theta\text{-}\lambda_i = \Theta y - \lambda(r+u) \quad (4)$$

where
r is the long-run real interest rate

The difference between Equation 2 and Equation 4 gives us

$$m\text{-}m^*+(Pm\text{-}Pm^*)+(1\text{-}\lambda)(Pc\text{-}Pc^*) = \Theta(Y\text{-}Y^*)+\lambda(i\text{-}u\text{-}r)(1\text{-}\alpha)$$

$$i=1/\lambda(m\text{-}m^*)\text{-}\Theta/\lambda(Y\text{-}Y^*)+u+r+\alpha/\lambda(Pm\text{-}Pm^*)+(r\text{-}\alpha)/\lambda(Pc\text{-}Pc^*)$$

Combined with Equation 1 we have:

$$Pc^e = 1/\lambda(m\text{-}m^*)\text{-}\Theta/\lambda(Y\text{-}Y^*)+u+r+\alpha/\lambda(Pm\text{-}Pm^*)+(r\text{-}\alpha)/\lambda(Pc\text{-}Pc^*)+S_c \quad (5)$$

Equation 5 shows the relationships among the long-run expected price of agricultural commodities and deviation of money supply from its long-run level (m-m^*), the deviation of output from its long-run equilibrium level, the expected long-run rate of money growth (u), long-run real rate of interest (r), deviation of agricultural commodity prices from their long-run equilibrium path (Pc-Pc^*) and the deviation of manufactured goods prices from their long-run equilibrium path (Pm-Pm^*). In this formulation money supply influences price expectation directly. Fiscal policy acts to eliminate (Y-Y^*) the GNP gap. Government expenditure targeted at the GNP gap affects price expectations and thus supply response. Given structural rigidities in most developing countries, the GNP gap seems to persist. Government expenditure, particularly on infrastructure, has been found to be important for agricultural response to prices. To obtain a more comprehensive view of the real economic effects of adjustment, it is important to take into account the effects of adjustment on infrastructure (World Bank, 1990). Available evidence suggests that agricultural output is particularly sensitive to both economic and social infrastructure (World Bank, 1990; Binswanger, 1989; Lele, 1986).

The basic specifications in the various blocks form a modified Nerlove type model with price expectation influenced by monetary and fiscal policies as derived above.

Block A: Individual crops

The block was specified as a general equilibrium macro econometric model. It is made up of nine equations each for five non-tradeable crops (cassava, millet, maize, rice, yams) and four tradeable crops (cocoa, cotton, groundnut, palm kernel). Non-tradeable refers to crops that are not traditional exports and tradeable refers to traditional exports. We are adopting this definition for simplification.

The general specification is in the Nerlovian spirit; that is, we assume partial adjustment. Each equation is specified generally as:

$$X_i = f[Pi^*, Pj^*, W, Z_i, X_i(t\text{-}1)] \quad (6)$$

i = 1,2,3,4,5, for non-tradeable
j = 1,2,3,4 for tradeable

$$Y_j = f[Pi^*, Pj^*, W, Z_k, Y_j(t\text{-}1)] \quad (7)$$

where

X_i = output of non-tradeable crops
Y_j = output of tradeable crops
W = weather (represented by a weather dummy that assumes the value of unity for the drought year D_3 1972, 1973, 1982 and 1983 and zero for other years)
Z_i = various policy variables, which are incorporated through price expectation P_e^e
P_i^* = relative price of crop in terms of crop i in terms of the price of maize
P_j^* = relative price of crop in terms of crop j in terms of the price of maize
F_t = Other variables
e = exchange rate

$$P_i^* = P_i^*(Z_i, F_t) \quad (8)$$

$$P_j^* = P^*_j(Z_i, e, F_t) \quad (9)$$

The price of maize was selected as the deflator for agricultural prices because of the wide cultivation of the crop all over the country. Though numerous other deflators are possible and have been used in the literature, maize seems to be best suited for capturing inter-crop substitution, which is a key attribute of Nigerian agriculture. Appendix A shows a different set of estimations in which the consumer price index is used as the deflator; this index affects the results quite significantly in some cases. We also considered using input prices but for the difficulty in obtaining a consistent and reliable data on this series. The state of the farm input supply system in Nigeria does not make for easy collection of

data. Middlemen who gain more by smuggling farm inputs easily expropriate government subsidies and, in some cases, raise input prices above competitive prices. A direct incorporation of subsidies in response equations would generate imprecise and misleading results.

Conceptually, changes in patterns of supply and demand operate through the price mechanism. Relative price changes reflect changes either on the supply side or on the demand side. An increase in demand will be reflected in an increase in price, necessitating changes in supply and vice-versa. An identification problem may exist particularly in the case of non-tradeable food crops if the observed prices are not exogenous. We would have tried to resolve this by using farm-gate prices in our estimation. Unfortunately, we couldn't obtain a consistent series of farm-gate prices for most of the crops in the study.[2] Instead, we have assumed that farmers' decisions are based on observed market prices in the immediate past period.

In the equations, besides the weather dummy (D_3), a second dummy (D_1) was used to represent government policies that targeted prices, i.e., imports, minimum-guaranteed prices. This assumed the value of unity for the pre-SAP years and zero for the SAP period. The sign of D_1 is indeterminate *a priori* because foods imports and minimum price guarantees have conflicting effects on prices. A third dummy (D_2) was used to capture the impact of institutional changes that were parts of SAP.

In Appendix B, instead of the weather dummy, we used data on rainfall in the area in which each crop is grown. The rainfall data, theoretically, form a better variable to capture the impact of weather. It is expected that the variable would have a significant impact on crops, particularly since in most official explanations for poor agricultural performance, the weather is cited most frequently.

Block B: Sub-sectoral aggregates

The crop sub-sectors were treated separately since they are more likely to be inter-related. The tradeable and non-tradeable crops were each aggregated thus:

$$X = X(P^*_1, Z_t, W, X_{t-1}) \tag{10}$$

where

$X = \sum_i X_i$

$P^* = \sum P_i^{*\alpha i}$; $\alpha_i = 1$

$$Y = Y(P^*_2, Z_t, W, Y_{t-1}) \tag{11}$$

$P2^* = \sum P_j^{*\beta j}$ $\qquad B_j = 1$

$$X + Y = XY(P^*_1, P^*_2, Z_t, W, (X + Y)_{t-1}) \tag{12}$$

Fisheries and livestock had similar specifications. We adopted the aggregation procedure of Mundlak et al. (1989).

Block C: Commodity exports

The modeling approach is based on the conceptualization of exports as the excess of domestic production over domestic absorption, i.e.:

$$XY_j = Y_j^S - Y_j^D \tag{13}$$

Y_j^D = domestic absorption

Domestic absorption is simply specified as:

$$Y_j^D = f(P_j^*, Z_i) \tag{14}$$

Equations 7 and 14 imply that:

$$XY_j = f(P_j^*, Z_i, W XY_j) \tag{15}$$

Alternatively,

$$XY_j = f(P_j^*, G_i) \tag{16}$$

where
G_i = absolute levels of domestic absorption

Estimation technique and sources of data

The study relied on data from three main data sources: the Central Bank of Nigeria, the Federal Office of Statistics (FOS), and the Food and Agriculture Organization of the United Nations (FAO). For instance, we collected the data on output volumes and prices directly from the Statistical Division of the Central Bank of Nigeria (CBN). The data on other variables were collected from the publications of the CBN, the FOS and the FAO.

Data posed a major problem to the study mainly because of differences in the data published by the three main sources. Appendix C shows estimation results for data from the Central Bank of Nigeria and the Food and Agriculture Organization. The results are obviously sensitive to data. For example, the FAO data fit a simple trend equation while the CBN data do not. This is hardly surprising, since the FAO data are mainly projections. The CBN data are based on survey data and, as a result, are more reliable. Two other reasons justify our reliance mainly on CBN data.

- CBN data are the most comprehensive; that is, most of the data variables are contained in its publications. The use of a single source for most of the variables minimizes consistency problems generated by source differences. Besides, the CBN reconciles its data with the FOS set.
- CBN data are the basic data set for policy articulation, sectoral and macroeconomic policy analysis, and choice. Therefore, if ex ante decision making is based on these data, it is consistent that ex post evaluations be based on them also.

We divided block A into two sub-blocks based on regional cropping patterns in Nigeria. Each sub-block consists of maize and four other crops. Maize was included in both groups because it is cultivated in both regions, a fact that also justifies the choice of maize as the *numeraire* commodity. Each sub-group was estimated in block using the two-stage least squares method (TSLS) and seemingly unrelated regression method (SURM). The seemingly unrelated regression estimation technique, or the Zellner's method, was used for estimating this block because factors such as the cost of chemicals, fertilizers and farm implements, prices of manufactured products, the rate of exchange, etc., commonly affect the output and productivity of the crops.[3]

Blocks B and C were estimated using TSLS. The TSLS became necessary since it was found that a few of the prices were correlated to very few policy variables (see Appendix B).

Estimation results

Block A

(1) YM = 6.41 + 0.13PM(t-1)-0.10PC(t-1)+0.0005CEA(t-2)
(4.58) (1.04) (-1.29) (0.0007)

+ 0.09TC(t-2)-0.13LA(t-2)+0.36YM(t-1)-0.50D1-0.03D3
(0.38) (-2.67 (2.32) (-3.68) (-0.32)

R^2 0.78 N = 20 F = 23.89

(2) MZ =0.42 + 0.86Pmz(t-1) - 0.24Pca(t-1) + 0.60Pml(t-1)
(2.76) (1.93) (-1.82) (2.37)

+0.22CEA(t-2) - 0.005TC(t-2) + 0.56D(1) - 0.13(D3)
(1.74) (0.07) (-2.3) (-0.8)

+0.23MZ(t-1)
(1.06)

R^2 = 0.54 N = 20 F = 11.03

(3) CS =9.57 + 0.90Pcs(t-1)-0.43Pm(t-1)-0.34CEA(t-1)
(4.92) (2.65) (-2.25) (-1.73)

-0.89LA + 1.71D2 - 0.74D3 - 0.166CS(t-1)
(-5.96)(3.89) (-3.75) (-0.98)

$R^2 = 0.82$ N = 20 F = 24.13

(4) COA = 1.60 + 0.30Pca(t-1) - 0.04CEA(t-2) - 0.074TC(t-1)
(1.76) (6.96) (-0.07) (-2.52)

-0.02LA + 0.077D2 + 0.422COA(t-1)
(0.077) (1.008)(3.04)

$R^2 = 0.84$ N = 20 F = 17.42

(5) PK =2.29 + 0.23Ppk(t-1) - 0.076LA - 0.89D1
(2.58) (5.72) (4.53) (-1.33)

+ 0.42PK(t-1)
(2.76)

$R^2 = 0.90$ N = 20 F = 22.22

(6) RC =0.95 + 0.33Pre(t-1) - 0.08Pm(t-1) - 0.54CEA
(0.6) (1.38) (0.50) (-1.55)

+0.64La + 0.17D1 + 0.84D3 + 0.91RC(t-1)
(2.3) (0.51) (3.32) (2.1)

$R^2 = 0.99$ N = 20 F = 11.62

(7) ML =6.23 + 0.57Pml(t-1) - 0.35Pgn(t-1) - 0.0009CEA
(1.76) (1.76) (-1.31) (0.007)

+ 0.702D2 + 0.22D3 + 0.057ML(t-1)
(1.91) (1.47) (0.14)

$R^2 = 0.55$ N = 20 F= 10.35

(8) CT =0.69+ 0.53Pct(t-1) + 1.33Pml(t-1) - 0.82Pgn(t-1)
(0.22) (1.4) (2.65) (-1.64)

+ 0.44CEA-0.11LA+1.59D2-0.62D3-0.017CT(t-1)
(0.21) (-0.50) (2.93) (1.80) (-0.07)

$R^2 = 0.80$ N = 20 F = 14.50

(9) GN =9.70 + 0.49Pgn(t-1) + 0.78Pml(t-1) - 0.18Pct(t-1)
(3.45) (1.42) (2.21) (-0.65)

- 0.08LC + 1.04D2 + 0.42D3 - 0.32GN(t-1)
(0.48) (2.65) (2.20)

$R^2 = 0.73$ N = 20 F = 13.0

Block B

(10) TAC =12.28 + 1.22P1*(t-1) + 0.56P2*(t-1) + -0.33CEA
(3.01) (4.13) (1.24) (-1.23)

+ 0.40LA + 0.02TC - 0.43D2 + 0.16D3
(0.91) (0.11) (-1.6) (1.21)

R^2 0.99 N = 20 F = 40.34

(11) TC(Q) = 13.6 + 0.62(PTC/PNTC)(t-1) - 0.25LA - 0.16CEA
(3.17) (1.69) (-1.7) (-2.68)

+ 0.08D2 + 0.15D3 - 0.18TC(t-1)
(0.36) (1.23) (-0.72)

R^2 = 0.67 N = 20 F = 9.69

(12) NTC = 13.6 + 0.62(PNTC/PTC)(t-1) + 0.56LA + 0.24CEA
(3.7) (1.6) (4.8) (1.46)

-0.42D2 - 0.84NTC(t-1)
(-2.19) (-1.69)

R^2 0.99 N = 20 F = 54.85

(13) TC = 12.05 + 1.07(PTC/PNTC)(t-1) + 0.41CEA + 0.04LA
(16.9) (3.58) (0.18) (3.32)

R^2 = 0.84 N = 20 F = 16.69

(14) YL =1.29+ 0.02DL(t-1) + 0.02FP(t-1) + 0.06LA(t-1)
(0.82) (0.39) (0.49) (1.98)

+ 0.001CE(t-1) + 0.02CET(t-1) + 0.03CESS + 0.78YL(t-1)
(-0.82) (1.52) (-1.36) (3.36)

R2 = 0.98 N = 20

(15) YFS = 3.24 + 0.40DF(t-1) - 0.16FP(t-1) + 0.15LA(t-1)
(1.49) (1.68) (-1.35) (1.16)

+ 0.05CEA(t-1)+0.09CET(t-1)-0.12CESS(t-1)+0.15YFS(t-1)
(0.64) (0.81) (-1.37) (2.11)

R^2 = 0.70 N = 20

Block C

(16) XC(t) = 2.26 + 0.042PXC(t-1) + 0.25PX/Pm + 0.0006XC(t-1)
(2.01) (2.42) (0.94) (0.58)

$R^2 = 0.49$ N = 20

(17) XPK = 4.73 - 1.2PXPK(t-1) + 0.68PX/Pm + 0.13XPK(t-1)
(2.62) (-4.08) (2.38) (0.76)

$R^2 = 0.64$ N = 20

List of variables

YM = estimated output of yams in '000 tonnes
MZ = estimated output of maize in '000 tonnes
CS = estimated output of cassava in '000 tonnes
COA = estimated output of cocoa in '000 tonnes
PK = estimated output of palm kernel in '000 tonnes
RC = estimated output of rice in '000 tonnes
ML = estimated output of millet in '000 tonnes
CT = estimated output of cottonseed in '000 tonnes
GN = estimated output of groundnuts in '000 tonnes
YFS = GDP fisheries
YL = GDP livestock
NTC = valued output of non-tradeable crops
TC = valued output of tradeable crops
TAC = valued output of all crops
XC = cocoa export
XPK = palm kernel export
Pmz = relative price of maize
Pm = relative price of yams
Pcs = relative price of cassava
Prc = relative price of rice
Pct = relative price of cottonseed
Pca = relative price of cocoa
Ppk = relative price of palm kernel
Pml = relative price of millet
Pgn = relative price of groundnut
P* = relative price of non-tradeables
P*2 = relative price of tradeables
Pnt = price of non-tradeables
PT = price of tradeables
CEA = capital expenditure on agriculture

CESS = capital expenditure on social services
CET = capital expenditure on transport and communication
LA = loans to agriculture
FP = price index (food)
D1 = dummy representing government policies to support non-tradeable prices and output
D2 = SAP dummy
D3 = weather dummy
PXC = export price cocoa
PXPK = export palm kernel
PX = index export prices
PM = index import prices
DF = GDP deflator fisheries
DL = GDP deflator livestock

* The relative prices are obtained by dividing the price of each commodity by the price of maize.

$$P_{NTC} = \sum_{i=1}^{5} P^{\alpha i} \alpha^{i} \qquad \text{non-tradeable crops}$$

$$\alpha^{i} = P_i X_i / PX$$

$$P_{TC} = \sum_{j=1}^{4} P_{xj}{}^{B} j$$

X_j = tradeable

$$B_j = P_j X_j / PX$$

Analysis

Short- and long-run price responsiveness

The coefficients of the estimates in block A are elasticities because we estimated log-linear forms of output response. This makes it easy to directly obtain short-run own and cross elasticities, and also to compute long-run elasticities. All the estimations were good fit of the data used. The estimates explain between 54% (maize) and 99% (rice) of the variations in crop output over the period of the data (1970–1989). The F-statistics support the conclusion that the models were good approximations of the behaviour of crop response.

As was expected, the individual crops had different patterns of responses to price and policy instruments. Some crops were more responsive to prices than others. Some crops showed little relationship to the variables in the equations, suggesting that they may be influenced more by variables not included in their specification. In such a case, this study simply demonstrates that the policy instruments and transmission mechanisms of the present structural adjustment programme may be inadequate for addressing the supply response of such a crop. For example, in Equation 1 the price of yams is not significant at 5% level. In fact only three variables – the adjustment coefficient, the dummy representing government policies supporting non-tradeable prices and output (D_1), and loans to agriculture (with the wrong sign) – were significant at that level. The result for maize given in Equation 2 is not much different, as the coefficient of D1 was found to be relatively high and significant. Cassava in Equation 3 had better results in terms of the number of significant variables. Own price effect of .90 is very high and significant at the 5% level. The cross-price elasticity with respect to yam is also relatively high and significant, while D2 and D3 are also significant. Loans to agriculture had the wrong sign, but were significant at less than 5% level. For cocoa, own price and the price of tradeable commodities were significant and both had the expected signs. In Equation 5, own price of palm kernel was significant with the correct sign, while loans to agriculture were significant but with a wrong sign. Loans to agriculture was significant, however, and with the correct sign in Equation 6 (rice). D2 is significant in the response of millet, cotton and groundnut, while D3 was a significant determinant of groundnut. Own price was not a significant determinant of cotton and groundnut, and though it was significant in the case of millet, it was so only at the 10% level.

Table 5 shows the short-run and long-run price elasticity and adjustment coefficients for the crops in block A. As expected, the short-run elasticities are generally smaller than the long-run elasticities. This is true of seven out of nine crops; cotton and groundnut were the only exceptions.

Cassava and maize have short-run elasticities closest to unity, while millet, cotton and groundnut have short-run elasticities of about 0.5 and yams, palm kernel, cocoa and rice have short-run elasticities of between 0.13 and 0.33. In general, non-tradeable crops were more responsive to short-run changes in prices than tradeables. These findings were, to some extent, expected. The characteristics of each crop are different, the climatic conditions and spatial distribution are also different. These factors influence responses of individual crops to various price and non-price incentives. It is not accidental that cotton, for example, has higher short-run responsiveness than palm kernel and cocoa. The lag structure for cotton is much smaller than for palm kernel or cocoa because cotton requires a relatively short time between planting and harvesting.

The results indicate competition between yams and cassava, maize and cassava, maize and rice, millet and groundnut, and groundnut and cassava for agricultural resources (land, labour and capital). However, only the competition between maize and cassava appears to be significant. Cassava response to yam price of 0.43 and response to millet of 0.60, and groundnut response to millet of 0.78 and cotton of -0.18, generally reflect the mixed cropping by small landholders. The results also show that maize and millet, cassava and millet, and groundnut and millet were complements. These results are

consistent with Nigeria's agro-climatic cropping patterns. It seems, therefore, that the cross-prices effects are indicative of Nigeria's agro-climatic and traditional cropping patterns of Nigerian farmers, who are mainly small holders.

Table 5: Short-run and long-run price elasticities and adjustment coefficients for individual crops

Crop	Elasticities		Adjustment coefficient
	SR	LR	
1. Yam	0.13	0.20	0.36*
2. Maize	0.86*	1.12	0.23
3. Cassava	0.90*	1.07	0.16
4. Cocoa	0.30*	0.52	0.42*
5. Palm kernel	0.23*	0.40	0.42*
6. Rice	0.33	3.67	0.91*
7. Millet	0.57*	0.61	0.06
8. Cotton	0.53	0.50	-0.07
9. Groundnut	0.49	0.37	-0.23

* Significant at 10% or less.

Official explanations of poor performance of the sector often give weather conditions significant weights. The use of rainfall dummy in these estimations has not captured this phenomenon. The results in Appendix A also show that even when we use the average rainfall of states of the federation that dominate the production of the crops, the rainfall variable was not significant at the 5% level. This suggests that weather may not be as crucial as is often assumed. However, the insignificance of rainfall may simply be an indication of serious methodological problems. For example, relating average rainfall to output may be flawed given that rainfall level over a given period of time is critical to crops. Second, other weather conditions such as sunshine or wind may counter the positive effects of rainfall. Unless these methodological lapses are shown to have insignificant effects on the results, it would be premature to conclude that weather is not a significant factor.

Equations 10 to 15 show estimates of the five sub-sectoral aggregate supply functions. The estimated coefficients are indicators of short-run elasticity because log linear functional forms were estimated. All the equations were good fit of the data. Table 6 shows the short-run and long-run price elasticities as well as the adjustment coefficients. Three key inferences may be drawn from Table 6. First, the agricultural sub-sectors do not respond significantly to prices. This is because the coefficient of responsiveness to prices is only significant in one of the five cases reported. This result vis-a-vis the result for individual crops suggests that trade-offs among crops offset responsiveness to prices. This result is very important in the evaluation of adjustment policies because it indicates

that the significant sensitivity of crops to price incentives is not sufficient to generate desired aggregate response. Second, short-run elasticities for sub-sectoral commodity aggregates are higher than long-run elasticities. Therefore, the results in this study point to aggregation inconsistency: the behaviour of aggregates is contrary to that of individual crops. Third, the short-run elasticity coefficients for non-commodity sub-sectoral aggregates (livestock and fisheries) are smaller than the long-run ones.

Tables 5 and 6 show that the short-run elasticity coefficients for crops are comparable to those of sub-sectoral commodity aggregates (except for all crops). This suggests that the marked difference between the individual crop response and sub-aggregate response does not hold here. The key caveat, of course, is that while the latter is not statistically significant, the former is. It is also the case that the long-run elasticity coefficients in Table 5 are higher than those in Table 6. This follows from point two above.

Table 6: Short-run and long-run elasticities for agricultural sub-sectors and exports

	Elasticities		Adjustment Coefficient
	SR	LR	
1. All crops	1.22*/0.56**	0.53/0.24	-1.33
2. Tradeable	0.62	0.42	-0.18
3. Non-tradeable	0.62	0.34	-0.84
4. Livestock	0.02	0.09	0.78
5. Fisheries	0.40	0.47	0.15
6. Cocoa exports	0.42*	0.42	0.0006
7. Palm kernel export	-1.2*	-1.38	0.13

* Significant at 10% or less
** Output/acreage.

The results for commodity exports show that the estimates were good fits of the data. Table 6 shows that cocoa and palm kernel exports responded significantly to prices. However, while the coefficient of 0.42 for cocoa has the right sign, that for palm kernel has the wrong sign. Agricultural exports collapsed in the 1970s. In fact, most agricultural exports were dropped from the export table and have since not reappeared. Table 3 shows the example of groundnut. The time lag necessary to rehabilitate crops with long gestation and the changing domestic demand profiles for local industrial raw materials are bound to affect the present effort at stimulating agricultural exports. The competition from local domestic demand would affect the impact of price incentives. The negative response coefficient for palm kernel is likely to be the product of higher competitiveness of domestic demand. If this is true, the appropriate price variable should be the ratio of export to home prices.

It is possible that the long-term relocation of resources away from cash crops since their collapse may be reversed if farmers expect that the present exchange rate regime

will continue and that the present relative policy advantage for cash crops will be sustained. This could be enhanced for crops for which increasing industrial demand forces up prices. Expansionary monetary and fiscal policies could ordinarily lead to a balance of payments deficit as the increase in demand for tradeables would raise imports and direct exports with its home market. Prices of non-tradeables would rise, inducing resource movements into non-tradeables. Under this scenario, expansionary monetary and fiscal policies would work against price incentives. Similarly, an exchange rate devaluation may have unexpected effects if it raises domestic prices more than it raises export prices. For example, a higher relative price in favour of inputs would raise production costs and reduce returns. Therefore, a domestic price biased devaluation combined with fiscal and monetary expansion would contract agricultural exports. The key point here is that *SAP may generate undesirable effects if its multiple policies send conflicting signals to farmers.*

The results also indicate that terms of trade could counter or boost export response to prices. In either case, a favourable term of trade boosts price sensitivity, while a negative one counters it. This suggests that price sensitivity is not enough to boost exports. Most importantly, external and, hence, exogenous factors play a critical role in the path of exports. This implies that there is more to agricultural exports than getting prices right. Put another way, *getting the price right is not sufficient to expand primary exports.*

Non-price responsiveness

Agricultural response to policy in Nigeria manifests itself through channels other than prices. In fact, government policies have been targeted directly at agricultural production and growth. Both monetary and fiscal policies have been designed to increase agricultural output. Both sets of policies affect agriculture in two ways. First, specific policies are expected to have direct impact on output. Thus increase in loans to the agricultural sector is expected to increase agricultural output directly, while government expenditures on the agricultural sector are also supposed to affect the sector directly.

Second, these policies have indirect impact on the sectors. Numerous side effects of other sector specific policies have negative or positive impacts on agriculture. We have at the modeling stage integrated monetary and fiscal policies through the price expectation formation process. In the model we arrived at a situation in which changes in the monetary growth rate would influence the real prices of agricultural commodities thus the response of these commodities to monetary policies. Expectation of inflation due to expansionary monetary policies causes investors to shift out of money and into commodities. Expected future inflation has a positive effect on commodity prices in the present. However, an increase in real interest rates (an increase in nominal interest rate in excess of the expected inflation) resulting from expansionary monetary or fiscal policies would cause investors to shift out of commodities into bonds.

The SAP induced continued depreciation of the naira, and the scarcity of foreign exchange in Nigeria, have made commodity trading a means of obtaining scarce foreign exchange by non-farming individuals and firms. Thus, observed increase in commodity exports is not entirely caused by favourable commodity prices. More importantly, to the

extent that non-farmers use commodity exports as a means of generating foreign exchange, the benefits hardly trickle down. The enhanced demand is hardly sustainable.

Expansionary monetary and fiscal policies have increased liquidity within the economy, which has put serious pressure on the exchange rate, raising the differential between official and parallel market rates. The differential and the persistent depreciation of the naira place further pressure on prices of exportables due to the increased in demand.

In our estimations, however, we have not used direct monetary and fiscal aggregates. For monetary policy we have used domestic credit to agriculture as a more relevant proxy for monetary policy, while capital expenditure on agriculture, social services, transport and communication were used as proxies for fiscal policies. Two dummies, D1 and D2, were also used to capture the combined effects of policies. Since the estimations are in log form we can consider relevant policy elasticities. A quick look at the three blocks reveals that these policy elasticities did not perform particularly well. Yet we can gain some insight into the impact of policy response with some further refinement of the model. While all these results are indicative, it is nevertheless clear from the estimations that serious response problems exist in Nigeria's agricultural sector.

Table 7 shows the short-run elasticity for the four policy variables. The key inferences from the table are:

1. The response of crops and sub-sectoral aggregates to capital expenditure on agriculture (CEA) is significant in only 3 of 11 cases. Of the three, it has a positive sign for maize but negative for cassava and tradeables. It has a positive sign in four (yams, cotton, tradeable acreage and non-tradeable) and a negative sign in the other four (cocoa, rice, millet, total crop). The positive sign implies that CEA had positive impact on the variables while a negative sign implies negative effects. Clearly, therefore, the short-term impact of CEA on agriculture is not significantly positive. Action lags, weaknesses in choice of infrastructure, leakage and methodological problems may explain the result. For example, not all capital expenditure on agriculture becomes agricultural capital goods within a budget year. In the case of long action lags, regressing current output on current CEA is most likely to generate negative and insignificant coefficients. Without a breakdown in CEA, it is difficult to identify the appropriate lag structure. It is interesting to note that the variables with a positive sign are those on which land improvement (a key capital formation activity) has short-term impacts.[4] Thus, while the coefficient of tradeable output is negative, that for tradeable acreage is positive. Weak choice of agricultural infrastructures and leakages arising from corruption would have similar short-term effects as long action lags.

2. The response of crops and sub-sectoral aggregates to capital expenditure on agricultural loans (LA) is significant in 6 of 11 cases. Of the six, it has a positive sign in three cases (rice, non-tradeable and tradeable acreage) and a negative sign in the other three (cassava, palm kernel and tradeable). It has a negative sign in four of the remaining five variables. The positive sign implies LA had positive impact on the variables while a negative sign implies negative effects. A most important observation

from the result is that all tradeable crops respond negatively to agricultural loans, which suggests diversion of agricultural loans to other purposes. This result is important because tradeable crop farmers have better access to credit than non-tradeable farmers have, because the latter are less commercial and operate on smaller scales than the former. It seems, therefore, that the mechanism offering the most potential benefit is improving access of small-scale food producers to domestic credit.

3. Non-tradeable crops appear to have responded more significantly and more positively to the SAP dummy for institutional change (D2) than to the price support and food import dummy (D1). This is hardly surprising given that whereas the latter sends opposing signals, the former sends a clear one. Two inferences could be drawn from this result. First, policy compatibility promotes desired response and vice versa. Second, institutional problems are critical constraints to the behaviour of farmers. The results may also easily be indicative of the reverse flow of labour from urban to rural areas following the down sizing that accompanied SAP. This seems plausible considering that the four significant products are food (cassava, millet and groundnut) and cotton that is consumed mainly by domestic textile companies.

Table 7: Short-run elasticity for policy variables

Crop/sub aggregate	CEA	LA	D1	D2
Yam	0.0005	-0.13	-0.50*	
Maize	0.22*		-0.56*	
Cassava	-0.34*	-0.89*		1.71*
Cocoa	-0.04	-0.02		0.077
Palm kernel		-0.076*	-0.89	
Rice	-0.54	0.64*	0.17	
Millet	-0.0009			0.70*
Cotton	0.44	-0.11		1.59*
Groundnut		-0.08		1.04*
Total Crop	-0.33	0.40		0.43
Tradeable	-0.16*	-0.25*		0.08
Non-tradeable	0.24	0.56*		-0.42*
Tradeable acreage	0.41	0.04*		

* Significant at 5%.

Food production remains a problem in Nigeria's agricultural sector. While the collapse of Nigeria's agricultural commodity exports was compensated for by rising oil revenue, the collapse of the food sub-sector, which initially was compensated for by importation, has since the present crisis become quite problematic. The roots of the current food crisis can be traced to Nigeria's long-term agricultural policies. Studies have shown clearly that numerous factors including weather, research and basic rural infrastructure influence food production and farm profits. Early research on commodities focused primarily on

cash crops because these crops served colonial interests. Nigeria's first agricultural research station, the Moor Plantation, started in 1899 by the British Empire Cotton Growing Association, was for cash crop research. In Nigeria, large-scale plantations were not used to promote commodity trade. Rather, small-scale farmers were encouraged to produce cash crops – often at the expense of food crop production – and the practice flourished under the prevailing prices (Okigbo, 1982).

Since then, until quite recently, the focus of agricultural research in Nigeria has been on cash crops. In the immediate post-independence period the foreign exchange realized from cash crops and the revenues they provided through the marketing boards made them great attractions to government. The need for a balance between food and cash crops was taken for granted until the collapse of cash exports in the 1970s. This problem was, however, addressed in the first long-range plan for agricultural development in Nigeria (FA), 1966. The document emphasized the importance of food production and nutrition in agricultural development and the need to strike a meaningful balance between cash and food crop production. Yet during the second national development plan (1970–1974), 63% of total allocation for agricultural research went to export crops, compared with the 33% for food crops (Idachaba, 1980). In the 1970s, with the emergence of petroleum as the leading foreign exchange earner, government's interest in Nigeria's cash crops declined and its commitment to the sector's growth and development also declined.

A close look at the performance of the agricultural sector could explain the response captured by the estimations above. Long-term growth in agriculture requires investment and capital accumulation in that sector and increasing utilization of the relatively abundant labour in the economy. Investment in the agricultural sector is also required to stem the continuous migration of rural workers into urban areas. It has been observed that only a very small proportion of public sector investment spending goes to agriculture. For example, although 13% of planned public sector investment in the 1962–1968 development plan was targeted at agriculture, by the end of the period it had accounted for only 9.9%. During the second plan period the actual percentage was 9.7% as against the planned 6.6%. This relatively small share of agriculture in public sector investment has created a serious bias against the sector in the provision of basic social and economic infrastructure. The cumulative effect of this development is at the root of the present state of technological development and the harsh burden on agricultural production in Nigeria.

Although the share of agriculture in total public sector investment is relatively low, the actual expenditure has been on the increase. In fact, a huge amount of resources has been pumped into the agricultural sector, on paper, in Nigeria within the last decades. The issue is the extent to which these expenditures actually go for what they are meant. The leakages in the sector, as with nearly all government expenditures, could be very high, accounting for the low response of the sector to increased expenditures.

In the 1970s, Nigeria started what could be considered a determined effort to transform the agricultural sector. Efforts to rehabilitate oil palm and cocoa growing activities resulted in some improvements in the performance of these commodities. The Tiga Dam was built to irrigate 5,600 hectares of land and tractor-hiring units were established to facilitate

large-scale farming in various parts of the country. However, the large-scale programme for food production that the government had emphasized in many states produced disappointing results. The National Accelerated Food Production Programme (NAFPP) was "the boldest programme so far aimed at increasing food production by small farmers.... the first well planned and well conceived food crop production programme for small-holders in Nigeria" Okigbo, 1982). The NAFPP concept was articulated and launched in 1972 but the pilot projects began in 1974. The aim was to make Nigeria self-sufficient in six basic staple food crops – maize, rice, millet, sorghum, wheat and cassava – by using individual farmers to produce and multiply improved seeds for wider distribution to farmers for planting.

The programme had great potential for increasing the yield of the six crops, as shown in Table 8. The third national plan indicated clearly that the programme would continue during that plan period in view of its potential.

Table 8: Comparison of yields for NAFPP packages, practices and local practices

Crop and state	Local yield (T/hectare)	NFPP yield (T/hectare)	Potential yield increase
Cassava (Imo)	9.29	15.0	+60%
Maize (Oyo)	1.3	2.8	+115%
Rice (Oyo)	1.1	2.2	+100%
Sorghum (Kano)	0.65	1.5	+130%
Millet (Kano)	0.65	1.5	+130%
Wheat (Kano)	1.3	3.0	+130%

Source: Federal Department of Agriculture: Consolidated Report 1971-1978; Okigbo (1982: 319).

Unfortunately, in 1975 the NAFPP was de-emphasized to make room for the launching of another programme, Operation Feed the Nation. The reasons for this action, according to Okigbo (1982), were the slow progress made with the NAFPP, the continuing increase in food prices and imports, and a change in the Government of Nigeria. It should be noted that this was only one year after the pilot projects of the NAFPP had started, definitely not enough time to justify the allegation of "slow progress". Again, the NAFPP could not justifiable be blamed for the "continuing increase in food prices". How could food prices be expected to stabilize or even drop because a well-articulated food production programme had been tested at the "pilot project" level for one year? Obviously, the main reason for de-emphasizing the NAFPP was the change in government.

Two other factors help to explain why agricultural development programmes in the past failed to stimulate the agricultural sector to produce the desired results. These have to do with policy articulation and policy/programme implementation. The Operation Feed the Nation programme provides a good example of both poor policy articulation and poor implementation. Like the NAFPP with which it was expected to complement, the OFN aimed at getting as many people as possible in Nigeria, including non-farmers,

to farm so that self-sufficiency in food crops with possible excess for export could be attained in the shortest possible time. Because of poor articulation, the OFN succeeded only as a slogan . Okigbo (1982) diagnosed the problem as follows: From its inception, the OFN was doomed to failure because it was begun without up-to-date statistics for planning, with neither a clear definition of responsiblities nor an effective organization. No consideration was given to the shortage of personnel, the logistics for input distribution, the potential problems or the resources needed to provide effective support to those who decided to participate in the campaign..

From such a confused start, implementation was definitely a lost battle. The programme did not contribute significantly to increased food production, to a drop in food prices, or to a reduction of mounting imports. It represented an example of government throwing money at a problem. Its main success was that it disrupted the NFPP, which had been started by the previous regime.

Nigeria has also experienced numerous World Bank assisted integrated rural development projects. The integrated rural development strategy has not achieved its targets. The activities of the agencies involved in the rural development drive have remained largely uncoordinated and not properly focused. The Ministries of Agriculture and Rural Development, the River Basin Development Authorities, and the National Seed Service have all carried out their activities without proper acknowledgement and coordination of their collective efforts. The obvious waste arising from conflict of authority and administrative duplication has cost agricultural development quite heavily. Thus, we could identify the following factors as the key causes of the cumulative degeneration of the agricultural sector:

- poor policy articulation
- the desire of each political regime to put in place its own programme irrespective of the merits of the previous one
- poorly conceived and uncoordinated rural development programmes

It is clear that policy effectiveness in Nigeria has been hampered by policy inconsistencies and the lack of a will to follow through in a determined manner once a policy is put in place. The lag between the announcement of policy and the implementation of policy is sometimes very long. The signals that individual units get from such policies are thus confused, and the uncertainty dampens response to the policies. Units adopt a wait-and-see attitude to policy announcements to see if the policy will be implemented and if it will be sustained. Where policy targets are set, they are never adhered to.

Table 9 shows that the actual growth of money supply exceeded target levels in 1987 and 1988. For example, actual growth of money supply overshot target level by 5.3% and 28.9% in 1987 and 1988 respectively. Similarly, credit to the government sector was above target levels as was credit to the economy and to the private sector. Generally, monetary policy in Nigeria has been expansionary mainly because it accommodates fiscal policy. Government in Nigeria has not been willing or able to use monetary policy as a lead policy instrument and this is clearly reflected in the performance of the policy under SAP. Therefore, fiscal accommodation is causal to overshooting of monetary policy targets.

Table 9: Monetary and credit development (Nmillion)

	1986	1987	1988
Credit to domestic economy	36,820.3	41,390.8	52,210.6
% growth	12.7	12.4	26.1
% target	8.7	4.4	8.1
Credit to private sector	17,305.0	19,125.8	23,247.4
% growth	26.7	10.1	13.3
% target	12.8	8.4	13.3
Credit to government sector	19,455.3	22,265.0	28,954.2
% growth	2.5	14.4	30.0
% target	5.9	1.5	2.5
Money supply (M1)	12,728.3	14,905.9	21,446.4
% growth	-4.1	17.1	43.9
% target	-	11.8	15.0

Source: Ojo (1989).

The fiscal operations of the federal government during the period did not conform to targets. In 1986, for example, a budget deficit of ₦8,254.3 million was incurred by the federal government, which was 10.3% of GDP in comparison with the target of 3.5%. In 1987, the deficit/GDP ratio declined to 4.2% but in 1988, it increased to 8.5%. The level of deficit persisted in both 1989 and 1990. Government expenditures continue to rise faster than realized revenue. The fiscal performance of government in 1986 showed a 25.5% decline in government deficit, from ₦3,580.2 million in 1985 to ₦2,666.8 million in 1986. Federal government finances improved considerably in 1987 due to higher crude oil prices and depreciation of the value of the naira. Retained revenue of the government increased by 102.4% from ₦16,129.0 million in 1987. Despite this, Government recorded a deficit of ₦5,889.7 million, which was nevertheless lower than the ₦8,254.3 million in 1986. Government expenditures in 1987 increased by 32.8%. In 1988 an overall deficit of ₦12,160.9 million was recorded. The increase in deficit resulted from a shortfall of ₦540.4 million or 3.4% in federal government retained revenue. The overall budget deficit represented 8.5% of nominal GDP, compared with 10.3% in 1987.

The picture that emerges is that government remains a big spender in Nigeria. Resources appropriated by Government under SAP have continued without much change. Debt servicing, transfer payments, social and community service, and spending on economic services dominate budget allocations. These are not particularly the productive sectors of the economy. Increased government appropriation of resources, apparently for less productive sectors of the economy, cannot enhance the overall efficiency of the economy. Under these conditions the general response of the various sectors of the economy to policy is highly undermined.

VI. Conclusion

The key findings of the study are:

- Short-run price elasticities of individual crops are smaller than the long-run elasticities.
- Non-tradeables are more responsive to short-run changes in prices than tradeables.
- Cross-price elasticities are indicative of Nigeria's agro-climate and the traditional cropping patterns of Nigerian farmers, who are mainly small holders.
- Commodity sub-sectoral aggregates respond differently from individual crops. For example, agricultural sub-sectors do not respond significantly to prices. In addition, short-run elasticities for sub-sectoral commodity aggregates are higher than long-run elasticities.
- Short-run elasticity coefficients for non-commodity sub-sectoral aggregates (livestock and fisheries) are smaller than long-run ones.
- Commodity exports respond positively to terms of trade.
- The response of crops and sub-sectoral aggregates to capital expenditure on agriculture (CEA) is significant in only 3 of 11 cases.
- All tradeable crops respond negatively to agricultural loans, while most food crops respond positively.
- Non-tradeable crops appear to have responded more significantly and more positively to the SAP dummy for institutional change (D_2) than to the price support and food import dummy (D_1). However, the SAP dummy is likely to be indicating the effects of the reverse flow of labour from urban to rural areas following the down sizing that accompanied SAP, considering that the four significant products are food (cassava, millet and groundnut) and cotton that is consumed mainly by domestic textile companies.
- The negative sign and insignificance of D_1 implies that SAP may generate undesirable effects if its multiple policies send conflicting signals to farmers.

The price and non-price response coefficients estimated in this study from which the findings were deduced should be taken as indicative. This is because the scope of the study is restricted, a few of the estimation results point to methodological limitations, and, of course, data are weak. These weaknesses notwithstanding, the results point strongly to two conclusions. First, the significant *sensitivity of crops to price incentives is not sufficient to generate desired aggregate response*. This result is consistent with the findings of the supply response literature. Therefore, SAP is more likely to affect the distribution of farm incomes than it is agricultural productivity and growth.

Second, the sensitivity of commodity exports to terms of trade implies that external and, hence, exogenous factors play a critical role in the path of exports. Therefore, *getting domestic prices of commodities right would not be sufficient to expand the foreign revenue from commodity exports.* This is also consistent with the consensus in the 1970s about the international commodity price and the well-established neoclassical propositions about the short- and long-run paths of commodity prices and income under conditions of free enterprise. The significant sensitivity of crops to price incentives is not sufficient to generate desired aggregate response. This result is consistent with the findings of the supply response literature.

It is obvious that an efficient system of basic infrastructure through an effective integrated rural development programme is necessary to expand agricultural productivity, output and incomes. The capital expenditure on agriculture could enhance the productivity base through increased agricultural research on food and non-food crops, extension services, and rural infrastructures. Clearly, even a 1% increase in yield out of the potential range of 60%–130% multiplied by the acreage cultivated by the over 60% of employed Nigerians engaged in small scale food production would translate into a significant expansion in output. It is clear that the potential productivity and output gains from investments in yield research on food production is very significant.

Our analysis shows that price incentives, shorter policy lags, more efficient infrastructure support to small holders and less corruption in the implementation of agricultural policies would raise the production possibility frontier. The economies of scale of such an economic environment could induce the structural shifts of resources that propel economies from primary production to industrialization. The higher sensitivity of food crops to agricultural loans suggests that most agricultural credit should be allocated to small-scale farmers of food crops. The results show higher social returns than loans to farmers of tradeable crops. That the latter have more access than the former under free market conditions implies that government must devise effective means of generating the socially optimal allocation.

The role of fiscal and monetary policy and external factors in export supply, the relative price and non-price sensitivity of tradeable and food crops are objective bases for solving the policy dilemma posed by trade-off between tradeable and non-tradeable crops. The findings of this study show that food is less sensitive to external factors but more responsive to domestic prices and policy than are tradeable crops. This suggests that the emphasis of SAP on tradeables would not raise aggregate agricultural productivity or output, or put the economy on the path of structural transformation. In addition, discrimination in favour of tradeable crops violates the requirement for optimal social use of resources if it is less responsive to prices and policy than food. We suggest that more research should be undertaken to test the robustness of our estimates. If our results are found to be robust, food should be the core of a socially optimal Nigerian agriculture policy, which should aim at creating the best enabling environment for food production and farmers' incomes.

Notes

1 Cocoa and palm kernel were chosen because together they account for most of the exports; in some years cocoa accounts for the entire agricultural export revenue.

2 A close look at the evolution of prices within agriculture and between agriculture and the overall economy shows some stability in agricultural prices relative to the consumer price index (CPI) in the 1970s. The implicit deflators for agriculture and the CPI were quite close and so were inter-sectoral prices in agriculture. Since the 1970s, the food components of the CPI representing the retail prices of food products, which reflect the price paid by the consumer, and the farm-gate price, representing the price received by the farmers, have diverged significantly. Thus developments in more recent years have made the use of farm-gate prices far more relevant in estimations like ours.

3 Se Chow (1987) for further explanation.

4 Land improvement requires a very short action lag.

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Appendix A

Estimation of block A with consumer price index as deflator (1973=100)

(1) YM =5.39 - 0.0025PM(t-1)+0.31Pc(t-1)+0.021CEA(t-2)
(3.16)(-0.96) (1.63) (0.43)
- 2.7E - 0.6TC + 0.0002RF + 0.34YM(t-1)
(-0.03) (0.91) (1.75)

R^2 0.84 N = 20 F = 6.36

(2) MZ =6.40 + 0.86Pmz(t-1)+0.73Pca(t-1)-0.50Pml(t-1)
(3.40) (0.70) (2.03) (-0.80)
+ 0.06CEA-5.91E TC(t-2)-0.37D3-0.0002RF-0.09Mz(t-1)
(1.02) (0.39) (-2.27) (0.88) (-0.29)

R^2 = 0.72 N = 20 F = 3.027

(3) CS = 3.80 + 1.35Pcs(t-1) + 0.07Pm(t-1) - 0.00002CEA(t-1)
(1.92) (2.17) (-0.13) (0.41)
-0.26D3 + 0.32CS
(-0.82) (1.07)

R^2 = 0.73 N = 20 F = 4.30

(4) COA = 2.86 + 0.08Pca(t-1) - 0.04CEA(t-2) + 0.0002LA
(1.30) (0.28) (-0.93) (1.04)
- 0.0001TC - 0.0001RF + 0.51COA(t-1)
(0.85) (1.41) (0.63)

R^2 = 0.53 N = 20 F = 2.30

(5) PK = 4.7 - 0.02Ppk(t-1) + 0.0002LA + 0.19D1
(3.4)(1.51) (3.28) (1.21)
- 8.94E-0.5RF + 0.13Pk(t-1)
(2-1.81) (0.54)

R^2 = 0.86 N = 20 F = 15.92

(6) RC =6.36 + 2.10Prc(t-1) - 0.76Pm(t-1) - 0.11CEA
(2.25) (2.41) (-1.66) (-0.79)
+ 0.0005LA - 0.1000RF - 0.23RC(t-1)
(1.16) (-0.76) (-0.05)

R^2 = 0.71 N = 20 F = 4.80

(7) ML =5.54 + 0.68Pml(t-1) - 0.53Pgn(t-1) - 0.02CEA
(2.41) (1.9) (-0.36) (-0.31)
+ 0.001RF + 0.19D2 + 0.26ML(t-1)
(0.40) (0.60) (0.87)

R^2 = 0.44 N = 20 F= 1.27

(8) CT =3.12+ 0.10Pct(t-1) + 1.16Pml(t-1) - 0.01Pgn(t-1)
(1.08) (0.21) (1.08) (-0.02)
+ 0.09CEA - 0.0006LA - 0.0009RF + 0.32CT(t-1)
(-0.48) (-0.84) (-0.92) (0.93)

R^2 = 0.46 N = 20 F = 1.37

(9) GN =4.25 + 0.11Pgn(t-1) + 0.12Pml(t-1) - 0.06Pct(t-1)
(2.39) (-0.35) (0.17) (-0.22)
- 0.0002CEA -0.0005RF + 0.37GN(t-1)
(0.89) (-1.12) (1.47)

R^2 = 0.31 N = 20 F = 0.91

Note: The deflator for the prices is the CPI, with 1973=100.

Appendix B:

Summary: Impact of Policy on relative prices

Relative price of	Significant variables	Non-significant variables
1. Cocoa	D_1	CEA,LA, D_3, Pca(-1)
2. Millet	LA (negative)	CEA, D_1, D_3, Pml(-t)
3. Cottonseed	CEA, Pcs(t-1) LA (negative)	La, D_2, D_3
4. Cassava	D_2	LA, CEA, D3
5. Maize (absolute)	La	CEA, D_2, D_3, Mzp(t-1)
6. Yams	None	La, CEA, D_1, D_3, Ym(t-1)
7. Groundnut	D_1	CEA, LA, D_3 Pan(t-1)
8. Palm kernel	D_2	CEA, DE, LA
9. Rice	D_2	CEA, LA, D_3, Pc(t-1)

Impact of policy on relative prices

(i) Pza =6.20 + 0.12CEA - 0.24LA - 1.8D1 - 0.14D3 + 0.2Pca(t-1)
(4.17) (0.56) (-1.55) (-3.12) (-0.51 (0.09)

R = 0.55 N = 20 F = 7.813

(ii) Pml =5.86 + 0.18CEA - 0.23LA + 0.013D1 - 0.14D3+0.24Pca(t-1)
(4.54) (1.16) (-2.06) (0.05) (0.69) (0.89)

R = 0.36 N = 20 F = 1.37

(iii) Pct = 7.57 + 0.37CEA - 0.76LA + 0.13D1 - 0.21D3 + 0.24Pml (-1)
(4.51) (2.34) (-4.97) (0.44) (-0.39) (-0.99)

(iv) Pcs =1.21 + 0.38CEA - 0.08LA + 0.26D2 - 0.21D3 + 0.57Pcs(-1)
(1.12) (3.02) (-0.44) (1.00) (-0.03) (2.25)

R - 0.92 N = 20 F = 38.27

(v) Pc =5.27 - 0.09CEA - 0.04LA - 0.70D2 + 0.16D3 + 0.07PC(t-1)
(2.53) (-0.43) (-0.29) (1.75) (0.49) (0.23)

R = 0.30 N = 20 F = 1.03

(vi) Mzp =4.08 - 0.07CEA + 0.51LA + 0.07D2 - 0.12D3 - 0.05Mzp(t-1)
(2.96) (-0.14) (2.56) (0.21) (0.44) (0.14)

R = 0.85 N = 20 F = 24.40

(vii) Pm =4.67 + 0.22CEA - 0.11LA + 0.1D1 + 0.08D3 - 0.15Ym(t-1)
(3.7) (1.4) (-1.0) (0.34) (0.39) (-0.49)

R = 0.16 N = 20 F = 0.45

(viii) Pgn =6.35 + 0.21CEA - 0.15LA - 0.73D1 - 0.31D3 - 0.36Pgn(t-1)
(4.5) (1.14) (-1.38) (-2.11) (-1.25) (-1.38)

R = 0.41 N = 20 F = 1.67

(ix) Ppx =3.44 + 0.16CEA + 0.17LA + 0.8D2 - 0.12D2
(10.8) (1.5) (1.8) (3.5) (-0.69)

R = 0.89 N = 20 F = 30.42

Appendix C

Trend estimates of selected agricultural variables using FAO and CBN data

Variable	Data source	Constant term	Trent	Adjusted R^2	DW	F statistics
Total agriculture	FAO	-7449.52 (-11.00)*	3.81 (11.16)	0.92	1.95	125.58
	CBN	-3404.14 (-3.37)	1.77 (3.48)	0.48	0.33	12.09
Crop production	FAO	-6981.2 (-8.08)	3.57 (8.21)	0.86	1.86	67.36
	CBN	-7006.06 (-3.34)	3.59 (3.39)	0.43	0.37	11.51
Livestock production	FAO	-9.258.75 (-14.83)	4.73 (15.01)	0.95	0.94	225.18
	CBN	-213.56 (0.32)	-0.06 (-0.19)	0.07	1.67	0.04
Cereals production	FAO	-14561.21 (-9.31)	7.40 (9.39)	0.89	2.06	88.12
	CBN	-8161.33 (-2.82)	4.18 (2.87)	0.34	0.26	8.24

* T-statistics

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ISBN 9966-900-66-7

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