MARCH 1997

RESEARCH PAPER FIFTY-SEVEN

POLICY MODELLING IN AGRICULTURE: TESTING THE RESPONSE OF AGRICULTURE TO ADJUSTMENT POLICIES IN NIGERIA

MIKE KWANASHIE,
ABDUL-GANIYU GARBA
and
ISAAC AJILIMA

MIC RESEARCH CONSORTIUM

UR LA RECHERCHE ECONOMIQUE EN AFRIQUE

Policy modelling in agriculture: Testing the response of agriculture to adjustment policies in Nigeria

Other publications in the AERC Research Papers Series:

Structural Adjustment Programmes and the Coffee Sector in Uganda by Germina Ssemogerere, Research Paper 1.
Real Interest Rates and the Mobilization of Private Savings in Africa by F.M. Mwega, S.M. Ngola and N. Mwangi, Research Paper 2.
Mobilizing Domestic Resources for Capital Formation in Ghana: The Role of Informal Financial Markets by Ernest Aryeetey and Fritz Gockel, Research Paper 3.
The Informal Financial Sector and Macroeconomic Adjustment in Malawi by C. Chipeta and M.L.C. Mkandawire, Research Paper 4.
The Effects of Non-Bank Financial Intermediaries on Demand for Money in Kenya by S.M. Ndele, Research Paper 5.
Exchange Rate Policy and Macroeconomic Performance in Ghana by C.D. Jebuni, N.K. Sowa and K.S. Tutu, Research Paper 6.
A Macroeconomic-Demographic Model for Ethiopia by Asmerom Kidane, Research Paper 7.
Macroeconomic Approach to External Debt: the Case of Nigeria by S. Ibi Ajayi, Research Paper 8.
The Real Exchange Rate and Ghana's Agricultural Exports by K. Yerfi Fosu, Research Paper 9.
The Relationship Between the Formal and Informal Sectors of the Financial Market in Ghana by E. Aryeetey, Research Paper 10.
Financial System Regulation, Deregulation and Savings Mobilization in Nigeria by A. Soyibo and F. Adekanye, Research Paper 11.
The Savings-Investment Process in Nigeria: An Empirical Study of the Supply Side by A. Soyibo, Research Paper 12.
Growth and Foreign Debt: The Ethiopian Experience, 1964-86 by B. Degefe, Research Paper 13.
Links Between the Informal and Formal/Semi-Formal Financial Sectors in Malawi by C. Chipeta and M.L.C. Mkandawire, Research Paper 14.
The Determinants of Fiscal Deficit and Fiscal Adjustment in Cote d'Ivoire by O. Kouassy and B. Bohoun, Research Paper 15.
Small and Medium-Scale Enterprise Development in Nigeria by D.E. Ekpenyong and M.O. Nyong, Research Paper 16.
The Nigerian Banking System in the Context of Policies of Financial Regulation and Deregulation by A. Soyibo and F. Adekanye, Research Paper 17.
Scope, Structure and Policy Implications of Informal Financial Markets in Tanzania by M. Hyuha, O. Ndanshau and J.P. Kipokola, Research Paper 18.
European Economic Integration and the Franc Zone: The future of the CFA Franc after 1996. Part I: Historical Background and a New Evaluation of Monetary Cooperation in the CFA Countries by Allechi M'bet and Madeleine Niamkey, Research Paper 19.
Revenue Productivity Implications of Tax Reform in Tanzania by Nehemiah E. Osoro, Research Paper 20.

The Informal and Semi-formal Sectors in Ethiopia: A Study of the Iqqub, Iddir and Savings and Credit Cooperatives by Dejene Aredo, Research Paper 21.
Inflationary Trends and Control in Ghana by Nii K. Sowa and John K. Kwakye, Research Paper 22.
Macroeconomic Constraints and Medium-Term Growth in Kenya: A Three-Gap Analysis by F.M. Mwega, N. Njuguna and K. Olewe-Ochilo, Research Paper 23.
The Foreign Exchange Market and the Dutch Auction System in Ghana by Cletus K. Dordunoo, Research Paper 24.
Exchange Rate Depreciation and the Structure of Sectoral Prices in Nigeria Under an Alternative Pricing Regime, 1986-89 by Olu Ajakaiye and Ode Ojowu, Research Paper 25.
Exchange Rate Depreciation, Budget Deficit and Inflation - The Nigerian Experience by F. Egwaikhide, L. Chete and G. Falokun, Research Paper 26.
Trade, Payments Liberalization and Economic Performance in Ghana by C.D. Jebuni, A.D. Oduro and K.A. Tutu, Research Paper 27.
Constraints to the Development and Diversification of Non-Traditional Exports in Uganda, 1981-90 by G. Ssemogerere and L.A. Kasekende, Research Paper 28.
Indices of Effective Exchange Rates: A Comparative Study of Ethiopia, Kenya and the Sudan by Asmerom Kidane, Research Paper 29.
Monetary Harmonization in Southern Africa by C. Chipeta and M.L.C. Mkandawire, Research Paper 30.
Tanzania's Trade with PTA Countries: A Special Emphasis on Non-Traditional Products by Flora Mndeme Musonda, Research Paper 31.
Macroeconomic Adjustment, Trade and Growth: Policy Analysis using a Macroeconomic Model of Nigeria by C. Soludo, Research Paper 32.
Ghana: The Burden of Debt Service Payment Under Structural Adjustment by Barfour Osei, Research Paper 33.
Short-Run Macroeconomic Effects of Bank Lending Rates in Nigeria, 1987-91: A Computable General Equilibrium Analysis by D. Olu Ajakaiye, Research Paper 34.
Capital Flight and External Debt in Nigeria by S. Ibi Ajayi, Research Paper 35.
Institutional Reforms and the Management of Exchange Rate Policy in Nigeria by Kassey Odubogun, Research Paper 36.
The Role of Exchange Rate and Monetary Policy in the Monetary Approach to the Balance of Payments: Evidence from Malawi by Exley B.D. Silumbu, Research Paper 37.
Tax Reforms in Tanzania: Motivations, Directions and Implications by Nehemiah E. Osoro, Research Paper 38.
Money Supply Mechanisms in Nigeria, 1970-88 by Oluremi Ogun and Adeola Adenikinju, Research Paper 39.
Profiles and Determinants of Nigeria's Balance of Payments: The Current Account Component, 1950-88, by Joe U. Umo and Tayo Fakiyesi, Research Paper 40.
Empirical Studies of Nigeria's Foreign Exchange Parallel Market 1: Price Behaviour and Rate Determination by Melvin D. Ayogu, Research Paper 41.
The Effects of Exchange Rate Policy on Cameroon's Agricultural Competitiveness by

Aloysius Ajab Amin, Research Paper 42.
Policy Consistency and Inflation in Ghana by Nii Kwaku Sowa, Research Paper 43.
Fiscal Operations in a Depressed Economy: Nigeria, 1960-90 by Akpan H. Ekpo and John E. U. Ndebbio, Research Paper 44.
Foreign Exchange Bureaus in the Economy of Ghana by Kofi A. Osei, Research Paper 45.
The Balance of Payments as a Monetary Phenomenon: An Econometric Study of Zimbabwe's Experience by Rogers Dhliwayo, Research Paper 46.
Taxation of Financial Assets and Capital Market Development in Nigeria by Eno L. Inanga and Chidozie Emenuga, Research Paper 47.
The Transmission of Savings to Investment in Nigeria by Adedoyin Soyibo, Research Paper 48.
A Statistical Analysis of Foreign Exchange Rate Behaviour in Nigeria's Auction by Genevesi O. Ogiogio, Research Paper 49.
The Behaviour of Income Velocity in Tanzania 1967-1994 by Michael O.A. Ndanshau, Research Paper 50.
Consequences and Limitations of Recent Fiscal Policy in Côte d'Ivoire by Kouassy Oussou and Bohoun Bouabre, Research Paper 51.
Effects of Inflation on Ivorian Fiscal Variables: An Econometric Investigation by Eugene Kouassi, Research Paper 52.
European Economic Integration and the Franc Zone: The Future of the CFA Franc after 1999, Part II by Allechi M'Bet and Niamkey A. Madeleine, Research Paper 53.
Exchange Rate Policy and Economic Reform in Ethiopia by Asmerom Kidane, Research Paper 54.
The Nigerian Foreign Exchange Market: Possibilities For Convergence in Exchange Rates by P. Kassey Garba, Research Paper 55
Mobilising Domestic Resources for Economic Development in Nigeria: The Role of the Capital Market by Fidelis O. Ogwumike and Davidson A. Omole, Research Paper 56

Policy modelling in agriculture: Testing the response of agriculture to adjustment policies in Nigeria

Mike Kwanashie,
Abdul-Ganiyu Garba
Ahmadu Bello University,
Zaria, Nigeria
and
Isaac Ajilima
Financial Institutions Training Centre
Zaria, Nigeria

AERC Research Paper 57
African Economic Research Consortium, Nairobi
March 1997

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 9966-900-99-3

Contents

List of tables

List of tables

I. Introduction

A proposition that has enjoyed wide acceptance among those concerned with the design and the evaluation of the adjustment process in sub-Saharan African (SSA) countries is that the agricultural sector is critical to a change in the structures of these economies (see for instance, Oyejide, 1990; World Bank, 1990; UN Expert Committee Report, 1990 - quoted in United Nations, 1990). This proposition is on the basis that the structural features of the agricultural sector in these economies places the sector in a strategic position in any programme that aims at:

- arresting the decline of SSA economies in the short run;
- improving trade and payment balances;
- generating medium-term economic growth; and
- engendering a long-term transformation of these economies.

The World Bank (1990) emphasized that the key factors accounting for the importance of the agricultural sector relate to the fact that it is more labour-intensive and less import-intensive than the rest of the economy. It was against this background that the WB-supported structural adjustment programme (SAP), introduced in Nigeria in the third quarter of 1986, made the agricultural sector pivotal to structural change and the growth of the Nigerian economy.

Since the introduction of SAP, several research studies have investigated a broad range of issues relating to structural adjustment and the Nigerian economy. This research seeks primarily to evaluate the response of the Nigerian economy to adjustment or reform policies. The study is in several stages. The study by Kwanashie *et al.* (1991) was the output of the first phase. It focused on agricultural supply response because of the critical role agriculture is expected to play in the entire adjustment process. This current study is an advancement on that.

Review of earlier studies

Of the diverse range of propositions that have emerged in the evaluation of the response of agriculture to policy, the proposition that agricultural supply responds positively to price has received the most attention. In fact, a significant part of the literature on the policy response of agriculture has focused on the short-run and long-run supply response

by individual crops to changes in output or input prices. Olayide (1969, 1972) Owosekun (1976, 1977), and Phillips and Abalu (1987) tested the proposition that the output of Nigerian crops respond strongly and positively to movements in output prices. Their results validated that hypothesis and were also consistent with the findings of similar studies, that short-run elasticities were small in absolute terms and relative to long-term elasticities (see Bond, 1983).

A weakness of these studies is that they seem to have discounted the possibilities of non-price incentives exerting significant influences on the response of agricultural supply. Chhibber (1988), Binswanger (1989), World Bank (1990) and Oyejide (1991) point to an emerging consensus on the importance of non-price incentives. World Bank (1988) identifies inadequate infrastructure, poorly developed markets, rudimentary industrial sectors, and severe institutional and managerial weaknesses in the public and private sectors as the key non-price factors constituting significant constraints to the supply responsiveness of SSA economies to reform policies.

Against the background of the emerging consensus on the importance of non-price factors, the earlier study (Kwanashie *et al.*, 1991) estimated short-run and long-run price and non-price response coefficients for three non-tradeable crops (millet, maize, sorghum) and five tradeables (cocoa, groundnut, cotton, palm kernel, palm oil). Similar coefficients were computed for four sub-sectors (food, non-food, fisheries and livestock). The study also measured aggregate supply responsiveness.

Some of the results of the empirical analysis based on the Nerlove methodology, indicate that:

1. Response to price was higher relative to non-price responsiveness;
2. Long-run response was higher than that in the shortrun;
3. Non-food and fisheries tend to respond significantly to price incentives, particularly in the longrun; and
4. The responses of food crops and livestock to price were very low, in both the shortrun and the longrun.

Research problem

The 1991 Kwanashie *et al.*, study extends other studies in both breadth (consideration of more crops) and analytical scope (estimation of price and policy elasticities). This study, in turn, extends the 1991 study in five key directions. First, it specifies agricultural import functions to capture the trade-offs or complementarity between domestic production of agricultural products and agricultural imports. This extension makes it possible to track one of the key mechanisms through which exchange rate and liberal trade policies would influence supply response in Nigeria. It is therefore useful to a more precise evaluation of the effects of adjustment policies on agricultural supply response.

Second, the study specifies absorption and export functions of agricultural commodities to trace the expenditure switching that adjustment policies are expected to

bring about. Third, it specifies endogenous functions of commodity prices (prices were assumed to be fixed in the earlier study). This is justifiable given that adjustment policies assume that domestic prices are (or will become) endogenous and that devaluation will affect supply/output through prices. Four, the study estimates and solves what promises to be a significant step towards an agricultural policy model for Nigeria. Finally, the model is used to evaluate the possible impact of exchange rate devaluation on supply, absorption, imports, exports and prices of agricultural products.

Objectives

This study achieves two objectives. First, it specifies, estimates and solves a basic agricultural policy model that could be used to evaluate the effects of policies targeting the agricultural sector such as the adjustment programme. The model captures some of the observed behavioural regularities of Nigerian agriculture, its role and linkages within the economy, and its links to the external economy. To do so, the model contains agricultural supply/output response functions, import demand functions for agricultural products, export supply functions of key cash crops, domestic absorption functions of food and cash crops, and price functions for food and cash crops.

Second, the study applies the model in evaluating the possible effects of alternative exchange rate regimes on agricultural output, imports, exports, absorption and prices.

Limitations

The first limitation of the study is that it does not explicitly specify the resource dynamics within the economy that are necessary to long-term supply responsiveness (see Binswanger, 1989). Apart from data problems, explicit modelling of resource dynamics would require an expansion of the model to include sectors that would lose or gain resources from agriculture in the process of adjustment to changes in incentives. However, this limitation applies more to long-term applications of the model than to short-term uses, of which an evaluation of the obviously short-term effects of adjustment policies is an example.

Second, the model does not cover all crops; and third, government policy is assumed to be exogenous. The coverage would have to be extended, while the assumption that policy is exogenous would have to be relaxed to reflect the sensitivity of policy to exogenous shocks if the relevance of the model were to be improved.

II. Economic policy and Nigerian agriculture, 1970-1990

Nigeria is still basically an agricultural country despite the significant growth of other sectors since political independence in 1960. Agriculture remains the largest single sector of the economy, providing employment for a large segment of the work force and constituting the mainstay of Nigeria's large rural population. Since 1985 the percentage of gross domestic product attributable to agriculture has been maintained at around 31%, well ahead of mining and quarrying - including crude petroleum and gas - as well as wholesale and retail trade, which are the other two major contributors to GDP in Nigeria.

While agriculture remains dominant in the economy, the food supply in Nigeria does not provide adequate nutrients at affordable prices for the average citizen. The nutritional status of both rural and urban dwellers in a largely agrarian country like Nigeria should be better. The food supply does not provide adequate nutrients in terms of either calories or protein balance, (Igene, 1991). The daily per capita protein intake is under 7g/day, while calorie intake is under 2,600 calories per capita per day in spite of the size of the agricultural sector.

From the 1970s Nigerian agriculture has been characterized by excess demand over supply due primarily to high population growth rates, stagnant or declining growth, high rates of urbanization, increased demand for agricultural raw materials by an expanding industrial sector and rising per capita income stimulated by an oil export revenue boom.

In addition to this, the pattern of food consumption has been changing rapidly in terms of quantitative and qualitative adaptations to new food preferences and consumption habits. The increasing emphasis on agricultural growth and development in Nigeria amidst a rapidly growing population in part reflects the alarm with which policy makers have viewed the excess demand for food. Before 1970, Nigeria appeared to have succeeded in achieving a balance between food supply and demand with a moderate level of imports and corresponding low pressure on prices. With a relatively abundant supply of farm labour and cultivable land, agriculture, particularly food production was able to respond quite adequately to a steadily rising demand. An expansion of land under cultivation and an increased absorption of rural labour constituted a ready means for output expansion. However, the 1970s oil boom saw a high rate of rural-urban population migration. The gap between the domestic supply of food and the demand for it has risen since then. Besides the supply-demand imbalance in the food sub-sector, traditional exports declined sharply in both absolute and relative terms.

The trend in domestic agricultural production was a factor in both problems. Table 1

Table 1: Index of output of major food crops, 1970-1990

	Yams	Maize	Millet	Rice	Cassava
1970	236.20	108.01	75.55	98.94	334.02
1971	187.46	95.36	68.94	98.59	288.75
1972	132.46	32.86	58.16	157.95	164.51
1973	133.15	60.33	92.29	172.08	186.19
1974	137.45	39.53	135.10	185.51	229.03
1975	165.48	99.70	62.03	178.09	148.59
1976	124.21	79.94	70.37	77.03	114.19
1977	122.40	48.65	62.73	114.88	105.88
1978	112.61	49.25	57.80	113.07	103.58
1979	100.90	36.53	57.55	56.54	92.46
1980	100.75	45.81	56.77	37.46	90.23
1981	100.06	53.89	65.24	55.83	39.64
1982	103.38	57.34	64.85	74.91	37.85
1983	77.69	44.46	91.53	51.24	32.80
1984	88.31	79.94	81.46	55.48	77.30
1985	90.96	89.07	89.61	69.26	88.11
1986	100.00	100.00	100.00	100.00	100.00
1987	93.80	89.97	95.00	104.95	95.01
1988	175.31	95.58	90.50	186.93	201.73
1989	176.08	100.15	92.50	242.76	238.30
1990	149.99	165.12	81.85	162.90	234.97

Source: CBN (1991), *Statistical Bulletin*, Vol. 1, Nos 1 & 2.

Table 2: Index of output of cash crops, 1970-1990

	Cotton	Cocoa	Palm Kernel	Palm oil	Groundnut
1970	358	305	90	75	247
1971	426	257	88	77	216
1972	105	241	77	71	211
1973	85	215	66	66	137
1974	481	214	89	75	304
1975	313	216	84	77	70
1976	294	181	84	81	72
1977	269	193	81	82	89
1978	211	157	80	82	125
1979	125	151	80	100	79
1980	77	153	80	100	105
1981	48	174	84	82	83
1982	39	156	89	77	67
1983	120	140	80	77	62
1984	108	140	97	85	93
1985	114	160	103	93	97
1986	100	100	100	100	100
1987	80	105	101	105	103
1988	194	230	156	108	103
1989	185	256	171	108	127
1990	215	244	177	111	135

Source: CBN (1991), *Statistical Bulletin*, Vol. 1, Nos 1 & 2.

shows that the agricultural sector declined at an annual average of 0.43% between 1970-1985. The period between 1975 and 1978 recorded the highest level of decline (7.88%). Between 1970 and 1985, domestic production of yams, maize, millet, rice and cassava either stagnated or declined sharply. The output of yams in 1985 was only 38.11% of the value in 1970, Except for millet (118.61%), other food crops had lower outputs in 1985 compared to 1970, with 82% for maize, 69.98% for rice, and 26.54% for cassava.

Table 2 shows the trend of agricultural products that at some point were exportable. Cotton and groundnut output declined sharply within the period. In 1985, the output of cotton and groundnut was 31.48% and 39.28% of their respective 1970 values. The decline in cocoa was less sharp, although the value in 1985 was only about half (52.46%) of the 1970 value. The output of palm oil more or less stagnated over the period. The output of palm oil also more or less stagnated in 1970-1987, but, it rose significantly in 1988-1990.

The decline in aggregate output of agriculture and other sub-sectors coupled with increasing population generates serious problems for food security. Even if the population grows at only 2.5% annually, the decline of 0.43% creates a gap of 2.93% annually assuming that per capita consumption remains constant.

Besides the decline in the major sources of calories, there is evidence that the livestock and fisheries sub-sectors have not matched the increase in population. This adds a nutritional dimension to the overall problem of food security. Nigeria is ranked 142nd among the 160 meat-eating countries of the world. Thus compared to USA (360g/day) and New Zealand (302g/day), an average Nigerian consumes only 20 grammes of meat per day (Alonge, 1991). Nigerians on the average also consume much less than the 65g of protein per day that is the minimum Food and Agricultural Organization (FAO) recommendation for healthy living.

Table 3 shows the trend in guaranteed minimum price (GMP) for selected food crops (non-tradeables) and the producer prices for selected cash crops (tradeables). The decline in the production of tradeables has raised serious domestic and external balancing problems. The output of domestic input-using agro-allied firms is constrained by output fluctuation and decline, while the decline in tradeables output reduces the size of export revenue and market shares. This adversely affects the balance of payments.

The Nigerian government has attempted to improve the performance of the agricultural sector with policies that can be grouped into two periods. The SAP period, which commenced in September 1986, represents a discontinuity from the policy regime that preceded it. As a result, a review of agricultural policies between 1970 and 1990 can be classified into pre-SAP and SAP periods.

Pre-SAP period

This period starts from 1970 and ends in September 1986 when the SAP policy regime began. The era was characterized by direct government participation in agriculture and extensive use of policies that affected both the price and non-price incentive structures of Nigerian agriculture. The broad objectives of policy were to stimulate the growth of

Table 3: Index of commodity prices, 1970-1989

Year	Rice	Cocoa	Cassava	Cotton	Yam	Maize	Millet	Palm kernel	Palmoil	Ground nut
1970	10	8	19	11	12	8	16	57	8	7
1971	13	8	22	12	12	10	16	62	9	8
1972	11	8	16	13	10	8	17	62	10	8
1973	13	15	16	13	19	10	35	69	20	9
1974	19	14	23	16	21	11	37	114	27	15
1975	16	20	69	31	23	12	43	52	27	23
1976	27	19	45	31	22	20	40	58	27	25
1977	23	29	78	33	34	24	68	85	36	28
1978	31	29	83	33	46	23	70	94	36	29
1979	29	34	60	33	54	31	68	120	45	35
1980	4	37	76	40	53	31	63	74	50	42
1981	52	37	117	47	75	49	77	76	50	45
1982	39	37	133	51	89	40	99	70	50	45
1983	46	40	177	56	90	45	92	94	60	45
1984	78	43	171	70	116	64	173	171	60	65
1985	103	43	122	85	86	104	144	106	60	75
1986	100	100	100	100	100	100	100	100	100	100
1987	97	214	137	400	87	94	103	290	120	208
1988	178	314	341	450	165	110	281	516	150	225
1989	266	314	405	450	233	160	286	710	-	225

Source: Central Bank of Nigeria, *Annual Reports* and *Statement of Accounts*, various issues.

output and improve the productivity of agents in the sector.

Some of the policies were targeted at improving infrastructure such as irrigation (for dry-season farming in the North), roads, storage facilities, etc. Other policies sought to provide inputs at subsidized rates, e.g., the subsidized tractor-hire services most state governments provided to farmers and the importation and distribution of fertilizers at subsidized rates through federal government agencies. Some state governments intervened directly through state farms.

To facilitate the procurement of inputs by farmers, the agricultural sector received tariff concessions to ease the importation of inputs. Other non-price incentives included credit policies that sought to make bank credit accessible to farmers. Agriculture was listed as one of the priority sectors to which a specified percentage of total lending had to be allocated at concessionary interest rates. This policy was complemented with the establishment of specialized institutions such as the Nigerian Agricultural and Co-operative Bank (NACB) established in 1973 by the federal government; the Agricultural Credit Corporation (ABC); and the Agricultural Credit Guarantee Scheme, which began in 1977.

Research institutes were also founded as vehicles for providing critical extension services. International organizations such as the World Bank (WB) participated in the design of extension services to rural farmers through various agricultural development

programmes (ADP).

Some policies were also targeted at improving agricultural infrastructure, with others aimed at improving the marketing of agricultural commodities. In 1977, for instance, a new commodity marketing system consisting of a Price Fixing Authority (PFA) and seven new national commodity boards (NCB) replaced the State Controlled Marketing Board (CBN, 1977). The new arrangement was designed to organize the marketing of all the major agricultural commodities for local consumption. Thus, food crops such as Guinea corn (grain sorghum), millet, maize, wheat, rice, beans, yams and cassava came under the marketing board system. As a result, a guaranteed minimum price (GMP) per metric tonne of food crops was introduced in the 1976/77 season. Before the 1976/77 season, the government fixed producer prices only for traditional export commodities. The government usually announced the producer prices in the April preceding the farming season.

In spite of the agricultural policy adopted in the pre-SAP era, as Table 1 and 2 clearly show, the output of the agricultural sector declined in absolute and relative terms. This development has been explained by different schools of thought. One explained the decline in food crops in terms of demand diversion. The government adopted a short-term measure to reduce the supply-demand imbalance for food by inducing a diversion from home food products towards imports, which were said to be cheaper, easier to prepare and of "better quality". In this context, the concessionary tariff for food inputs directs purchase and distribution of food imports through the Nigerian National Supply Company (NNSC); exchange rate over-valuation seems to have facilitated a change in consumption patterns against home food products.

Table 4: Index of selected agricultural imports, 1970-1990 (1986=100)

Year	Food and live animals	Beverages and tobacco	Animal and vegetable oil	Total (Index)	Total (₦ Millions)
1970	7	28	0.6	4	72.91
1971	11	31	0.5	8	132.57
1972	12	30	0.8	9	145.57
1973	16	36	1.1	12	201.06
1974	19	62	2.8	16	254.86
1975	37	331	7.1	35	600.14
1976	55	436	19.7	52	895.94
1977	92	920	37.6	79	1302.30
1978	127	488	58.7	99	1637.86
1979	96	343	41.9	85	1414.00
1980	179	83	92.1	122	2023.10
1981	264	122	98.6	182	3100.20
1982	243	110	91.5	185	3084.20
1983	167	61	78.0	128	2129.40
1984	131	48	68.0	108	1694.30
1985	86	43	63.9	76	1265.50
1986	100	100	100	100	1653.00
1987	234	212	52.7	133	2239.10
1988	243	593	66.2	144	2276.00
1989	250	1064	74.1	138	2252.80
1990	469	1251	108.9	251	4080.90

Source: Central Bank of Nigeria, *Annual Reports*, various issues.

Table 4 shows the trend of Nigeria's agricultural imports, with an increase in food imports from ₦72.91 million in 1970 to a peak of ₦3.1 billion in 1981. The steady expansion in imports contrasts with the decline in agricultural exports as shown in Table 5. While export revenue stood at ₦808.81 million in 1970, it declined to ₦364.22 million in 1982.

Table 5: Index of selected agricultural exports, 1970-1990 (1986=100)

Year	Food and live animals	Cocoa	Palm kernel	Total (Index)	Total(₦ Millions)
1970	38	36	75	95	808.81
1971	38	39	89	46	396.70
1972	28	28	54	21.8	185.60
1973	36	30	65	46	388.98
1974	45	43	150	56	474.12
1975	50	59	46	56	479.22
1976	59	84	93	73	617.91
1977	89	85	112	89	753.50
1978	101	103	36	102	864.45
1979	69	117	41	92	779.76
1980	50	84	48	68	576.31
1981	49	38	62	47	399.83
1982	42	41	38	43	364.22
1983	62	61	57	63	536.83
1984	53	49	29	53	447.60
1985	51	49	21	51	436.36
1986	100	100	26	100	850.91
1987	196	404	207	289	2457.92
1988	38	398	698	217	1850.66
1989	24	281	1747	195	1660.85

Source: Central Bank of Nigeria, *Annual Reports*, various issues.

Table 6 shows some important agricultural balances and indicates that, except in the case of food and live animals whose trade balance was in surplus between 1970 and 1974, other balances were in deficit from 1970-1990. The total agricultural trade balance of ₦221.4 million in 1974 turned into a deficit of ₦96.6 million in 1975. Since then, the sector recorded increasing levels of deficit peaking at ₦2.6 billion in 1982. At 1982 prices, this deficit is indeed substantial. In fact, it was 53.42% of Nigeria's deficit on current account. Evidently the crisis of Nigerian agriculture spilled over into other external sectors.

The supply-side shows the factors causing the problem in Nigerian agriculture. Oyejide (1991) and Bevan *et al.* (1988, 1992a, 1992b) saw the phenomenon as a classic example of the Dutch disease effect of an export revenue boom. They analyse oil export revenue within a general equilibrium framework as a primary cause of the collapse of Nigerian agricultural production in the pre-SAP era. Specifically, the observed massive increase in public spending, most of which was channelled to investments in large-scale industry,

Table 6: Selected agricultural trade balances, 1970-1990 (₦ millions)

Year	Food and live animals	Beverages and tobacco	Animal and vegetable oil	Total (₦ millions)
1970	110	-3.9	32.0	736.9
1971	79	-3.5	21.7	265.1
1972	30	-4.3	15.6	41.5
1973	34	-5.1	30.4	191.7
1974	44	-9.0	29.9	221.3
1975	-81	-47.9	2.5	-96.6
1976	-177	-63.1	-21.0	-238.4
1977	-344	-133.0	-43.4	-534.8
1978	-573	-70.6	-63.7	-753.9
1979	-460	-49.7	-36.0	-600.1
1980	-1216	-12.0	-99.1	-1411.7
1981	-1900	-17.6	-116.5	-2576.9
1982	-1766	-15.9	-111.8	-2644.5
1983	-1067	-8.7	-93.1	-1540.6
1984	-817	-6.9	-80.0	-1235.4
1985	-442	-6.2	-79.4	-810.4
1986	-359	-14.4	-123.8	-775.9
1987	-1003	-19.0	-63.8	286.2
1988	-1780	-85.9	-82.0	-497.4
1989	-1899	-154.2	-91.6	-591.9

Source: Central Bank of Nigeria, *Annual Reports*, various issues.

is argued to have exerted a pull on mobile resources (in particular labour) into the government sector (where employment expanded rapidly) and into construction. Thus, agriculture lost much of its labour, causing a decline in both export and food crop production.

Institutional structures, such as the marketing board system, have been analysed as having adverse effects on farmers' income and product prices. Export crops were heavily taxed since a substantial surplus accrued to the commodity boards through a policy that ensured a profitable margin between producer prices and world agricultural prices.

The decline in output was also analysed as having been influenced by the fixed exchange rate policy adopted in the pre-SAP era. Bevan *et al.* (1992a) argued that an alternative policy of exchange rate depreciation would have moderated "the price squeeze on export which ..... hastened the agricultural decline". The major propositions of the Dutch disease school provided the basis for the policy shift in September 1986.

The SAP era

The structural adjustment policy represents a sharp break both in the perception of the Nigerian agrarian crisis and in terms of the broad range of problems that confronted the Nigerian economy after 1981. While the set of SAP policy instruments is broad, the mechanisms driving each one are similar. These instruments were expected to alter the

domestic price incentive structure in favour of agriculture (non-tradeables and tradeables). Even then, tradeables were expected to benefit more than non-tradeables. The aim was to increase the level of output and hence agricultural export revenue. Exchange rate reform was the centrepiece of structural adjustment in the macroeconomy, while specific institutional reform was expected to strengthen the anticipated positive impact of exchange rate reform on the agricultural sector and, in particular, its tradeable component.

Exchange rate reform saw the market as a framework for determining the exchange rate and allocating available foreign exchange. This arrangement was expected to correct the supposed over-valuation of the domestic currency. The expected impact of the market-determined exchange rate on agriculture was to be transmitted through a realignment of the prevailing structure of relative prices prior to SAP.

One of the necessary conditions for this realignment was a depreciation of the Nigerian currency. It was assumed that depreciation would induce increases in the price of agricultural products, with tradeables, e.g. cocoa, rubber, palm kernel, etc., benefiting most. The general equilibrium effect of the realignment in relative prices was assumed to be that the sector could in the shortrun attract back the mobile resource (labour) it had lost during the oil boom to government and construction. In the longrun, agriculture was expected to attract other resources, particularly capital. Institutional barriers to agricultural trade, such as the seven commodity boards and export tariff, were dismantled.

The SAP policies targeted both price and non-price incentives to agricultural trade. First, the tax imposed on agriculture through tariffs and the activities of commodity boards was removed. Second, adjustment was expected to ease the domestic and external marketing of agricultural commodities.

Table 7 shows the growth rate of commodity and related prices. It shows sharp increases in 1987 in the price of tradeables - cocoa (114%), cotton (300%), palm kernel (190%) and groundnut (106%). Except in the case of cassava (37%) and millet (3%), the price of non-tradeables declined in the same year - yams by (13%), maize (6%) and rice (3%). In 1988, while prices of tradeables sharply declined (except in the case of palm oil), the rate of growth of the price of food crops rose sharply. In 1989, the prices of cocoa, cotton and groundnut remained stable, while the price of all food crops and palm kernel rose but at sharply declining rates.

Other salient features of Table 7 are:

- The prices of cash crops rose with few or no lags while the price of food crops, except cassava, rose in 1988 after a decline in 1987.
- The price increase was highest in 1987 for tradeables and in 1988 for non-tradeables.
- The trend in prices indicates a declining rate of increase after the peak levels. For cocoa, cotton and groundnut (all tradeables), the prices stabilized in 1988.
- The price of other products, including transport, rose persistently.

These trends raised questions about absolute and relative agricultural prices. Engel's

law indicates that a sustainable increase in the absolute prices of agricultural products may not be guaranteed without deliberate public policies to support prices. This is because as per capita income rises, less is spent on agriculture and if agricultural output rises persistently, supply would outpace demand and prices would fall.

The data on the prices of other products indicate that increases in absolute prices may not lead to increases in relative prices given that the price of everything seems to be rising. It is difficult to make precise statements, given the constraints of data. However, if the elements of costs to farming households in Table 7 are considered, it would appear that a situation in which these cost elements rise persistently while those of commodities rise unsteadily indicates strongly that the agricultural sector can achieve relative price advantages only in the short run in the absence of an effective price support programme. In this circumstance, if output responds to prices, the medium and long-term path of agriculture may be a reversal of short-run output growth.

Table 7: Growth rates of prices of commodities and other products, 1987-1989

	Cocoa	Cotton	Palm kernel	Palm oil	Rice	Cassava	Millet
1987	114	300	190	20	-3	37	3
1988	47	13	78	25	82	148	172
1989	0	0	37	n.a.	50	16	1.5
	Groundnut	Yams	Maize	HHG	Clothing	Transport	Other
1987	108	-13	-6	18	12	13	22
1988	8	89	17	13	20	23	10
1989	0	41	45	61	52	39	18

HHG= Household goods and other purchases
n.a= not available

Sources: Growth rates of commodities were computed from Table 3.
Growth rates of other products were calculated from Table C3.1 in CBN, 1990.

Table 8 shows the growth of output of selected commodities between 1987-1990 and indicates instability in the growth of output of the major commodities within the period. The best year for output for six crops (cocoa, cotton, palm kernel, rice, cassava, yams) was 1988. Thus, if one were to consider the growth rates of the six crops in 1988 and the fact that the SAP ended in June 1988, one could infer that the short-term objective of the programme in terms of output growth was realized. However, this would be misleading because (a) the growth rates of the six crops before and after 1988 are not impressive and (b) the performances of the other four crops (palm oil, groundnut, millet and maize) were unimpressive. The growth rates of cocoa, cotton, palm kernel, rice, cassava and yams declined in 1989 by 118%, 147%, 44%, 48%, 94% and 91%, respectively. In addition, the growth rates of cocoa, rice, cassava and yams were negative in 1990. In 1990, except for maize and palm oil, the growth rate of crops that did not experience

Table 8: Growth rates of output of selected commodities, 1987-1990

	Cocoa	Cotton	Palm kernel	Palm oil	Groundnut	Rice	Cassava	Millet	Yams	Maize
1987	5	-20	1	5	3	5	5	-5	-6	-10
1988	119	142	54	3	0.4	78	112	-5	87	6
1989	11	-5	10	0	24	30	18	2	0.4	4
1990	-5	16	3	3	6	-33	-1.4	-12	-15	65

Source: Calculated from Tables 1 and 2

negative growth sharply declined. For example, the output of groundnut declined from 23% in 1989 to 6% in 1990. Thus, the inference that SAP attained its short-term objective of output response is not supported by the growth rates of food and cash crops.

Tables 5, 6 and 7 do not show that the objective of diversified export revenue and reduced import levels was realized after 1986. Levels of imports could have been considerably higher, except that in 1987 wheat and rice imports were banned, in apparent contradiction to the trade liberalization policy adopted by government. Rather than reducing the size of Nigeria's import bill, this policy succeeded only in reducing the official import bill, while creating a parallel import market for wheat and rice.

The precise causal effects of adjustment policies are set out later in the paper. However, some broad statements can be made at this stage about Nigerian agricultural policy from 1970 to 1990.

First, agricultural policy in Nigeria over the period was characterized by inconsistencies between agricultural and other macroeconomic policies. For instance, a fixed exchange rate and food import policy discouraged exports and production in the pre-SAP era. Thus, while the government tried on the one hand to support agriculture through fiscal, monetary and price support policies, on the other hand, it also implemented policies that encouraged a "snob-effect" on home food. In fact, it could be argued that policies whose effects are potentially negative (import of food, restriction of social amenities to urban centres and increase in urban income) are more likely to be effectively implemented than those with potentially positive impacts (subsidies on fertilizer, price support programmes, storage facilities, support for agricultural infrastructure). Such policies were seen as more strategic for the redistribution of national wealth to the favoured class and individuals rather than a genuine attempt to increase growth and productivity.

Second, there appeared to be a fundamental misconception in the articulation of agricultural policy. Agriculture was seen as crop production. As a consequence, fisheries and livestock, both major sources of necessary nutrition, were neglected. Policies that frustrated their development, such as the ban on imports of wheat and poultry feeds, were implemented without consideration of their impact on the output of these sub-sectors. This misconception strongly remains, even in the SAP era.

The agricultural sector is also confronted with the general problem of co-ordination in public policy. The weakness of policy design manifests itself in agricultural

programmes that approach the sector as an isolated entity rather than an integral part of the Nigerian economy. This may be deliberate, since those who engage in agriculture, i.e., rural farmers, are largely politically impotent - quite unlike the farmer lobbies in Japan and France, for instance, which have continued to delay the ratification of the GATT agreement on commodity trade.

It also appears that the openness of the economy and the enclave character of formal activities encourage disarticulation in policy. However, to the extent that the realization of the objective of public policy for any economy requires harmony between production, service delivery and consumption, the problem in Nigeria appears to be one of a general failure of policy analysis and design.

III. Modelling for agricultural policy: Issues

Effective policy must be anchored in specific objectives. This section identifies two of the major issues in the design of a Nigerian agricultural policy.

Policy objectives

The major issue in the analysis of Nigerian agricultural policy is the set of objectives. This is far more important than the choice of instruments, given that instruments are *means* rather than *ends*. Moreover, it is the realized ends of an implemented means that provide the basis for the evaluation of the means and its implementation. Notice that we have made a distinction between means and implementation. This is deliberate and seeks to address the usual excuse for policy failures in Nigeria. Almost all policy failures in Nigeria are blamed on implementation. This can only be a convenient excuse since implementability should guide an optimal choice of means. Thus, for instance, if there is a "Nigerian factor" such a factor must be an integral part of policy analysis.

The state of the economy, the role of agriculture within it, the expected future state of the economy and the expected future role of agriculture are issues from which the static and the dynamic objectives of agricultural policy can be determined.

In the pre-SAP era, the major objective of agricultural policy was to increase production. The objective in the SAP era is similar, except for a preference for a change in output mix in favour of tradeables. Agricultural production involves the use of resources (labour, land, capital). It leads, on the other hand, to the generation of farmers' incomes, food for the population, export revenue and supply of raw materials to domestic industrial firms. Clearly, therefore, agricultural production is a means rather than an end. By and large, the ends provide useful guidelines for identifying the objectives of agricultural policy.

A focus on these ends reveals a well accepted fact of macroeconomic policy: trade-offs, particularly in the short run. For instance, an expansion in export quantities in the short run is achieved through a decline in the supply of agricultural raw materials to domestic industrial firms. Even in the long run, a trade-off exists if production is not elastic enough to match domestic and foreign demands. Similarly, in the short run an intrasectoral trade-off exists. For instance, given their agro climatic zone, farmers can choose among several food crops to produce, and between food crops and export crops. The latter case implies a trade-off between the objectives of feeding the domestic population and earning export revenue.

Tracing other links between agriculture and the economy could reveal similar trade-offs. When these are clearly identified, the realization of the ends of policy becomes potentially frustrating, since unforeseen multiplier effects could easily negate expectations.

The focus on these ends thus discriminates against partial conceptualizations, ad hoc policies and non-specific ends. On the contrary, it shows that policy design, even for short-term objectives, is a difficult task that requires careful and serious study. The normative content of the requirement for effective policy is relevant since policy design is itself anchored in values. The ends identified above are basically general. The specifics depend on the present state and the expected present and future states of the economy. Whether the choice of the present and future states of the Nigerian economy is best actualized through private or public choice is irrelevant at this stage.

For Nigeria, a minimum end of agricultural policy is the attainment of the FAO minimum nutritional requirement. The design of optimal means of policies must thus be guided by the capacity of alternative policy regimes to gain this end. Of course, the objectives of supplying agricultural raw materials, income for farmers, export structures and revenue levels are important. Nevertheless, all invariably aim at the health of the population, with nutrition basic to this. The consequence of the choice of this end is that agricultural, demographic and all other macroeconomic policies must be consistent with its realization. However, irrespective of the objective chosen, macroeconomic, trade and exchange policy must provide an enabling environment.

Policy analysis

The selection of an optimal policy mix is indeed a difficult task even for most developed economies. Even satisfactory policy mix is no less difficult. Both are constrained by the lack of appropriate data and the limitation of analysis. Gardner (1981) classified data constraints as:

- Absence or low quality of data for empirical modelling, and
- Absence of past experience with which to assess effects of proposed policies.

He decomposed the limitation of analysis into:

- Inability of economic analysis to forecast correctly answers to questions which policy raised, and
- Weaknesses of political economy.

The critical limitations are those of data and weaknesses of conventional theory in reflecting realities. Analytical weaknesses lead to "classical optical illusions", which make a phenomenon appears the way the analyst wants to see it or to be interpreted only within the orthodoxy the analyst subscribes to.

Data constraints and analytical crises create measurement difficulties. For instance, even in the computation of supply response within Nerlove's framework, the following problems have emerged:

- The type of data to use: time series, cross-section, cross-country, any combination of the three (see Binswanger, 1989);
- Measurement of long-run and aggregate supply response (see Oyejide,1991; Binswanger, 1989; Chibber, 1988);
- Simultaneity in the dynamic process of demand and supply (see Binswanger, 1989).

Data and analytical problems do not provide alibis for ineffective policy. Rather, they point to the need for deliberate efforts targeted at a relaxation over the long run of the constraints to policy analysis. Policy research, which inevitably involves quantitative modelling, can still be usefully done within the constraint of data and analytical limitations. One lesson from the past is that results must be reported with appropriate caveats. The major lesson, however, is that the evaluation of policy does not end with selection and implementation of a policy. Rather, it is a continuous process involving ex post analysis, ex ante analysis, policy adjustment and observation. Because it is a dynamic process, every stage is critical. The dynamic character of global socioeconomic processes discriminates against complacency and adaptive responses. It is on this basis that the adjustment programmes put into place from September 1986 are evaluated. The next section specifies the framework within which such an evaluation is conducted.

IV. Evaluating agriculture's response to adjustment policy: Methodology

The evaluation of the effect of adjustment policies on Nigerian agriculture necessitates the specification of a suitable framework. Some of the methodologies used in evaluating adjustment policies were reviewed in Garba (1989). They include:

1. The before-and-after approach.
2. A comparison of performance with targets.
3. A comparison of the performance of the adjusting economies to a reference group not adjusting.

The first two approaches are weakened by the fact that causation cannot be ascribed in either case. The third approach, which shares the same weakness, is also "subjective and amenable to fraudulent (or biased) assessment" (Garba, 1989).

A causal model circumvents the weakness of the first two approaches, while an empirical analysis of the model makes it less susceptible to bias and provides quantitative answers to policy questions. As emphasized earlier, the causal models that are used in evaluating agriculture's response in Nigeria are limited by their partial frames.

An integrated causal model that specifies the linkages within agriculture, those between agriculture and the domestic economy, and those between agriculture and the global commodity market has more potential to capture the multiple effects of adjustment policy.

Of the existing economy-wide model structures, a macro-econometric model is chosen because of the need for the quantitative indicators required by policy evaluation. Futher, such a framework allows us to capture the specifics of Nigerian agriculture easily. In spite of these advantages, this approach is constrained by the availability of data and as a result major analytical structures cannot be parameterized. As we indicated earlier, this imposes important caveats on results. However, as long as results are interpreted as indications only, the evaluation is legitimate and admissible. Since this study is a step in the construction of a policy model for the evaluation and design of agricultural policy, the focus is on achieving a high degree of disaggregation of agricultural variables. The major variables are output, domestic absorption, imports, exports, and prices. A relevant causal model could specify production, input demand, price dynamics, policy dynamics, import demand and export supply. We did not model input demand mainly because of lack of data and because we did not specify those sectors that are likely to gain or lose labour to agriculture. As for the latter, we assume that policy is exogenous. Even though

this is the norm in policy modelling, it is valid only as a heroic assumption given that external influence on Nigerian policy before and after SAP is significant.

Production

Ten commodities consisting of five tradeables (cocoa, cotton, palm kernel, palm oil, groundnut) and five food crops (maize, millet, cassava, yams, rice) were modelled in the production block. Nerlove's "adaptive dynamics" was adopted in modelling. It was assumed that commodities respond positively to lagged values of own prices and to prices of complements, but negatively to prices of substitutes. The notion of complement is intended to reflect, where applicable, the practice of mixed cropping either for agroclimatic reasons or as a deliberate strategy to mitigate the effects of uncertainties. In all equations, the influences of rainfall and policy - both fiscal and monetary - are examined.

The models for the commodities are as follows:

$$YQ = F(YP(-1), CA(-1), RF1, TEA, LA\ YQ(-1) \quad (1)$$
$$MZQ = F(YQ1, TEA, RF1, MZQ(-1)) \quad (2)$$
$$CAQ = F(CA(-1), MZQ, YP(-1), RF, CAQ(-1)) \quad (3)$$
$$RQ = F(RC(-1)\ RF1, RM(-1)) \quad (4)$$
$$MLQ = F(MZQ, ML(-1), RM(-1), TEA, MLQ(-1)) \quad (5)$$
$$GNQ = F(GP(-1), RFK1, TEA, SS, GNQ(-1)) \quad (6)$$
$$CTQ = F(CT(-1), ML(-1), RFK1, CTQ(-1)) \quad (7)$$
$$CQ = F(LA, CO, CX, CQ(-1)) \quad (8)$$
$$POQ = F(TEA, AV, SS, POQ(-1), PO(-1)) \quad (9)$$
$$PQ = F(PK(-1), RFB, PX, TEA, PQ(-1)) \quad (10)$$

Yams (*YQ*) and cassava (*CQ*) were modelled as substitutes. Thus, besides their respective prices they are assumed to respond to each other's prices. Farmers of yams and cassava also plant maize, thus it is expected that increase in yam output would increase maize (*MZQ*). Similarly, increase in maize output would have a positive influence on cassava output. Cotton (*CTQ*) is assumed to have a similar relationship with millet (*MLQ*).

Millet, maize and sorghum (not modelled due to data constraints) are related where they share the same agroclimatic zones. Usually during the second round of maize planting in the wetter areas of northern Nigeria, the three crops are substitutes. Thus, millet output is expected to respond to maize output. Food imports are assumed to have positive effects on rice (RQ) and palm oil (POQ). Rice imports (RM), which rose sharply in 1977, are assumed to have negative effects on domestic rice production, not necessarily through prices but through differences in quality, packaging and ease of cooking. Similarly, animal and vegetable imports (AV) provided an alternative cooking oil to palm oil. In this linkage, non-price competition was assumed to be important. It is further assumed that these imports have negative effects on the respective outputs. The effect of export stimulus was reflected in palm kernel (PQ) and cocoa (CQ).

The effects of government policy were captured by expenditure on agriculture (TEA) and social infrastructures (SS) and banking sector credit to agriculture (LA). The effect of interest rates was assumed to be negligible since credit allocation guidelines exerted more impact on access to credit.

The data constraints did not permit us to match the degree of disaggregation of crops. It was expected that TEA and LA would have positive effects while SS, which was biased against rural activities, would have negative effects. Note that even though input demand was not explicitly modelled, SS provides an indirect way of capturing labour availability: the concentration of social services in urban centres was an important catalyst for the loss of agricultural labour to urban areas through rural-urban migration.

Absorption

Block 2, which consists of the domestic absorption of a commodity, was the most difficult to model due to data constraints. For instance, even though output of a food crop is absorbed by consumption (either final or intermediate) and investment, it is not possible to identify which part of it is final, intermediate or investment. In addition, it was not possible to determine what part of output was for farmers' subsistence. Therefore, rather than model investment and/or consumption functions we decided to model domestic absorption functions of food. In so doing, current rather than lagged values of commodity prices are assumed to have negative influences. This circumvents the simultaneity problem in the interaction between supply and demand for food crops. In all equations, national income(YN) was specified as having a direct effect on absorption. It was thus assumed that the commodities were normal goods. Engel's law (income elasticity of demand for food is less than unitary) is also assumed to hold.

The absorption functions for non-tradeables are:

$$YD = F(YP, CA\ RM, YN) \quad (11)$$
$$CAD = F(CA, YN\ RC) \quad (12)$$
$$RD = F(RC, F\ RM\ YN) \quad (13)$$
$$MLD = F(ML, F, MZ, YN) \quad (14)$$
$$MZD = F(MZ, F, RM, YN) \quad (15)$$

In addition to own prices, related prices i.e., the price of maize (MZ) in millet function (Equation 14) and cassava (CA) in yams function (Equation 11) were considered to exert a positive impact on respective absorption. This corresponds to the assumption that millet and maize, and yams and cassava substitute for each other. A general assumption was that food imports as a substitute to domestic food had a depressing effect on the absorption of domestic food. Thus, for yams, rice (Equation 13) and cassava (Equation 12), rice imports are expected to exert a negative influence on absorption, while food and live animal imports were expected to have a similar effect on maize (Equation 15), millet and rice.

For tradeables, domestic absorption is assumed as a residual. Thus for cocoa, domestic

absorption (*CD*) is given by;

$$CD = CQ - CX \tag{16}$$

where CX = quantity of cocoa exported.

For groundnut, palm kernel, palm oil and cotton, the equivalent equations are, respectively:

$$GND = GNQ - GX \tag{17}$$
$$PD = PQ - PX \tag{18}$$
$$POD = POQ - POX \tag{19}$$
$$CTD = CTQ - CTX \tag{20}$$

Imports

In block 3, the total agricultural import (TAM) equation provides the reference point for modelling. The equation is given by:

$$TAM = AV + BT + F + S + SF + RM + W + FL \qquad 21$$

where,

AV = Animal and vegetable imports
F = Food and live animals
S = Sugar
BT = Beverages and tobacco
SF = Stock fish
RM = Rice
W = Wheat
FL = Flour

All components of food imports are assumed to be influenced by income (YN), the exchange rate (ERN) and the price of imports. While import price data are not available, a weighted index of the consumer price index of Nigeria's six major trading partners (CPTP), computed in Ojameruaye (1991), was used as a proxy.

The possibility of habit persistence was investigated in the case of AV, W, BT and S. The effect of import tax (TM) was also investigated. It must be mentioned that available data can only be used to compute an aggregate import tax rate. This may not capture the import tax effect since most products were granted concessionary tariffs.

The ban placed on the import of stock fish prior to Nigeria's Second Republic was dismantled by the civilian regime. A dummy (DD1) was thus used to study its impact. Both the Obasanjo regime and the civilian regime that succeeded it used rice and wheat imports for patronage and as a short-term solution to the persistent problem of excess demand for food. Thus the lagged value of domestic price (CPN(-1)) was assumed to have positive impacts on W, while a dummy variable (DD4) representing the period of the Obasanjo/Shagari regime was used to capture the effect on the food import policies

on rice (RM).

The following are the import demand functions or equations:

$$AV = f(EPN, CPTP, YN, AV(-1)) \quad (22)$$
$$BT = f(ERN, CPTP, YN, BT(-1)) \quad (23)$$
$$F = f(ERN, CPTP, YN) \quad (24)$$
$$S = f(SGR, ERN, CPTP, S(-1)) \quad (25)$$
$$SF = f(ERN, CPTP, DD1) \quad (26)$$
$$RM = f(CPTP, DD4, TM, ERN, YN) \quad (27)$$
$$W = f(ERN, CPTP, YN, CPN(-1), W(-1) \quad (28)$$

Flour import (FL) was assumed to be exogenous because it was very small. Notice that SGR (domestic sugar output) was included in the sugar function. This was necessary to capture the fact that some sugar companies simply packaged imported sugar. Domestic production of confectionaries would similarly have been included in the W function but for the constraints of data.

Exports

Block 4 consists of export supply functions. The total agricultural export (TAX), like the total agricultural import (TAM), provided the reference point for modelling. TAX is given by:

$$TAX = CX + FX + AX + GX + RX + PX \quad (29)$$

where
CX = Cocoa
FX = Food and live animals
AX = Animal and vegetable export
GX = Groundnut
RX = Rubber
PX = Palm kernel

Groundnut, rubber and palm kernel were treated as fixed because we did not have data on export prices.

$$GX \text{ is exogenous} \quad (30)$$
$$RX \text{ is exogenous} \quad (31)$$
$$PX \text{ is exogenous} \quad (32)$$

Cocoa, food and live animals, and animal and vegetable exports were modelled, respectively, as:

$$CX = f(CO(-1), CX(-1), ERN, TX) \quad (33)$$
$$FX = f(ERN, FX(-1)) \quad (34)$$
$$AX = f(ERN, GNQ) \quad (35)$$

The effect of the domestic supply on export supply was reflected in prices. The assumption is that since output responded positively to price, this should induce an increase in exports. It was assumed that exchange rate (ERN) devaluation and export taxes have positive and adverse effects, respectively, on cocoa export. For both CX and FX, partial response is assumed. For AX, GNQ (groundnut output) is assumed to have a direct effect. ERN is also assumed to have similar effects.

Prices

Prices are modelled in block 5. The classic price dynamic cannot be applied to Nigerian commodity prices between 1970 and 1986. This is because the government administered the prices. Even though the rules adopted are not specified, *it could be deduced* from observation of the trend in prices that immediate lag values influence current prices. Similarly, the price of related products and the expected output of the commodity could also have influenced price determination. For cocoa prices (*CO*), the world price of cocoa (*CW*), the exchange rate and export tax (tx) rather than the domestic output are also assumed to have influenced price administration.

An output expectation function is not modelled. We simply used current output as a proxy for it. This assumes that output expectations are realized. We recognized the weakness of this assumption given the possibilities for non-realization of expected output. These are some of the weaknesses of the study that would be corrected in later stages.

The price functions for rice (*RC*), cassava (*CA*), groundnut (*GP*), cotton (*CT*), yams (*YP*), maize (*MZ*), millet (*MC*), palm kernel (*PK*), palm oil (*PO*) and cocoa (*CO*) are:

$$RC = f(RM, RD, RC(-1)) \quad (36)$$
$$CA = f(CA(-1), CAQ) \quad (37)$$
$$GP = f(GP(-1), GNQ) \quad (38)$$
$$CT = f(CT(-1), CTQ) \quad (39)$$
$$YP = f(YP(-1), YQ, CA) \quad (40)$$
$$MZ = f(MZQ, ML, MZ(-1), RC) \quad (41)$$
$$ML = f(ML(-1), PQ) \quad (42)$$
$$PK = f(PK(-1), PQ) \quad (43)$$
$$PO = f(PO(-1), POQ) \quad (44)$$
$$CO = f(CW, ERN, CO(-1), TX) \quad (45)$$

Over all, there are 34 stochastic equations in the model. Before applying this model to measure the impact of adjustment policy, the causal model was estimated and solved. It was then evaluated using standard evaluation procedures. In the next section, the estimation and solution processes are outlined. The results of both processes are also presented and analysed.

The evaluation procedure uses a counterfactual or simulation approach. First, the model is estimated for the pre-SAP era (1970-1986). The end point, 1986, is based on the assumption that the effect of the reform would be less significant in 1986 since reform began in the last quarter of the year. Moreover, it was in the 1987 budget that the other components of the SAP policy besides exchange rate were put into operation. Within the period, agricultural structures were assumed to be relatively stable. Thus, the estimation would reflect pre-SAP behavioural regularity. The evaluation of the effects of adjustment policies begins after we evaluate the dynamic simulation properties of the model and find it acceptable. Alternative assumptions about the major instrument in SAP, i.e., exchange rates, form the basis for this evaluation of SAP. Two assumptions are investigated and both assumed that the fixed exchange rate regime was continued. In the first case, the rate of exchange rate depreciation in 1985-1986 was maintained post 1986. In the second case, a 5% annual devaluation was assumed.

We must re-emphasize that the analytical and data limitations of this study as caveats to inferences are acknowledged. Since policy analysis is a continuous rather than a static activity, the potential for improvement in the evaluation and the design of policy is reassuring.

Thus, for instance, the model can be improved by explicitly modelling non-agricultural sectors, particularly their output and input demands. Further, the assumption that policy is autonomous can be relaxed to reflect the endogenous character of policy within the broad content of the global economy. An improvement in data, in terms of range, length and reliability, would improve considerably the credibility and reliability of empirical results.

V. Empirical analysis: Model estimation and solution

Data and estimation technique

Data published by the Central Bank of Nigeria (CBN) were used in estimating the model outlined above. Three CBN publications, i.e., *Annual Report and Statement of Accounts, Economic and Financial Review,* and the more recent *Statistical Bulletin* provided the data for the estimation. There are other Nigerian and international sources of data, of course, but the CBN publications were chosen for three reasons:

1. They are the most comprehensive sources of economic data on Nigeria.
2. CBN data are usually based on the surveys by the Federal Office of Statistics (FOS) of Nigeria, its own surveys and other Nigerian data sources. International organizations base their data on CBN data. As a result, CBN is to be preferred for a Nigerian study for the reason that in spite of its weaknesses, it is arguably the most credible.
3. Policy in Nigeria is formulated using CBN data.

For most of the equations, ordinary least squares (OLS) was used in estimation. In a few cases, where specification errors were observed, the two-stage least squares (TSLS) method was adopted.

For block 1, a Cobb-Douglas production function was assumed. Thus, a log-linear estimation process was utilized to generate single-equation response coefficients. In the case of the other blocks (with the exception of wheat, sugar, rice and stock-fish imports) both the log-linear and linear specifications were adopted. The best results in terms of R-square, t and F values, and D-W statistics are reported. The exception was informed by the fact that quantitative controls adopted in freezing recorded imports to zero make a log-linear specification inappropriate for post-SAP simulation exercises. All equations were estimated for the 1970-1986 period.

All figures in parentheses are t-values.

Subscript 1indicates that a variable is in log, and subscript 2 indicates the lagged values of a variable in log.

Estimation Results

Block 1: Production

$$\begin{aligned} YQ1 = {} & 2.30 + 0.15\,YP2 - 0.24\,CA2 + 0.49\,RF1 \\ & (1.03) \quad (1.38) \quad (-2.98) \quad (3.05) \\ & + 0.02\,TEA - 0.21\,LA1 + 0.47\,YQ2 \\ & (0.65) \quad (-1.43) \quad (2.74) \end{aligned} \tag{46}$$

$R^2 = 0.87 \qquad F = 18.30$

$$\begin{aligned} MZQ1 = {} & -16.53 + 0.60\,MZ2 + 2.06\,YQ1 + 0.27\,TEA \\ & (-3.13) \quad (3.61) \quad (3.21) \quad (0.27) \end{aligned} \tag{47}$$

$R^2 = 0.55 \qquad DW = 2.06 \qquad F = 5.67$

$$\begin{aligned} CAQ1 = {} & -9.00 + 0.05\,CAZ + 0.73\,MZQ1 - 0.21\,YP2 \\ & (-2.54) \quad (0.18) \quad (2.67) \quad (-0.80) \\ & + 1.33\,RF1 + 0.42\,CAQ2 \\ & (2.23) \quad (1.69) \end{aligned} \tag{48}$$

$R^2 = 0.87 \qquad F = 20.82$

$$\begin{aligned} RQ1 = {} & 0.55 + 0.08\,RC1 + 0.78\,RF1 - 0.13\,RM \\ & (0.13) \quad (0.55) \quad (1.18) \quad (-2.70) \end{aligned} \tag{49}$$

$R^2 = 0.55 \quad DW = 2.14 \qquad F = 6.80$

$$\begin{aligned} MLQ1 = {} & 6.95 + 0.44\,ML2 - 1.08\,MZQ1 - 0.14\,RM1 \\ & (6.66) \quad (2.36) \quad (-0.21) \quad (-2.74) \\ & + 0.07\,TEA \\ & (0.77) \end{aligned} \tag{50}$$

$R^2 = 0.24$ DW = 1.93 F = 2.16

$$GNQ1 = \underset{(1.68)}{3.89} + \underset{(0.54)}{0.07\,GP2} + \underset{(1.76)}{0.65\,RFK1} + \underset{(0.26)}{0.05\,TEA} - \underset{(-2.13)}{0.34\,SS1} \quad (51)$$

$R^2 = 0.48$ DW = 2.71 F = 4.96

$$CTQ1 = \underset{(-1.54)}{-7.87} + \underset{(1.57)}{1.39\,CTZ} + \underset{(2.83)}{1.58\,MLZ} + \underset{(0.88)}{0.48\,RFK1} + \underset{(0.24)}{0.05\,TEA} - \underset{(-3.86)}{1.43\,LA1} \quad (52)$$

$R^2 = 0.67$ DW = 2.19 F = 7.08

$$CQ1 = \underset{(5.87)}{5.63} - \underset{(-2.04)}{0.14\,LA1} + \underset{(0.19)}{0.04\,CO2} \quad (53)$$

$R^2 = 0.80$ DW = 2.08 F = 31.46

$$POQ1 = \underset{(0.94)}{1.35} + \underset{(2.92)}{0.20\,PQ} - \underset{(-3.76)}{0.13\,TEA} - \underset{(-0.47)}{0.02\,AV1} + \underset{(1.73)}{0.07\,SS1} + \underset{(3.13)}{0.64\,POQ2} \quad (54)$$

$R^2 = 0.75$ F = 9.88

$$PQ1 = \underset{(-0.68)}{-1.64} + \underset{(2.60)}{0.21\,PK1} + \underset{(1.94)}{0.31\,RFB} + \underset{(0.98)}{0.06\,PX1} + \underset{(1.94)}{0.05\,TEA} + \underset{(2.35)}{0.69\,PQ2} \quad (55)$$

$R^2 = 0.44$ F = 3.3

Block 2: Absorption

$$YD1 = \underset{(0.17)}{1.02} - \underset{(-2.71)}{0.26\,YP1} + \underset{(1.69)}{0.16\,CA1} - \underset{(-2.28)}{0.08\,RM1} + \underset{(1.52)}{0.79\,YN1} \quad (56)$$

$R^2 = 0.79$ DW = 2.22 F = 15.28

$$\begin{array}{l} CAD1 = 9.34 - 0.26\ CA1 + 0.20\ RC1 - 0.59\ YN1 \\ \qquad\quad (0.97)\ (-1.17)\ \ (1.65)\ \ (-0.66) \\ \\ \qquad + 0.62\ CAD2 \\ \qquad\ \ (2.83) \end{array} \qquad (57)$$

$R^2 = 0.79$ F = 14.75

$$\begin{array}{l} RD1 = -17.42 + 0.12\ RC1 - 0.59\ F1 + 0.004\ RM1 \\ \qquad\ (-0.97)\ \ (0.75)\ \ (-2.23)\ \ (0.03) \\ \\ \qquad\qquad + 2.41\ YN1 \\ \qquad\qquad\ \ (1.47) \end{array} \qquad (58)$$

$R^2 = 0.42$ DW = 2.12 F = 5.89

$$\begin{array}{l} MLD1 = -4.90 - 0.04\ ML1 - 0.50\ F1 + 0.55\ YP1 \\ \qquad\quad (-0.62)\ (-0.15)\ \ (-3.40)\ \ (1.91) \\ \\ \qquad\qquad + 0.20\ YN1 \\ \qquad\qquad\ \ (1.55) \end{array} \qquad (59)$$

$R^2 = 0.41$ DW = 2.04 F = 3.84

Block 3: Imports

$$\begin{array}{l} AV1 = -56.31 - 0.02\ ERN1 + 0.87\ CPTP + 4.99\ YN1 \\ \qquad\quad (-3.96)\ (-0.03)\ \ (1.05)\ \ (4.12) \\ \\ \qquad\qquad + 0.50\ AV2 \\ \qquad\qquad\ \ (2.56) \end{array} \qquad (60)$$

$R^2 = 0.97$ F = 139.0

$$\begin{array}{l} BT1 = -58.19 + 1.76\ ERN1 - 1.66\ CPTP + 6.36\ YN1 \\ \qquad\ (-2.23)\ \ (1.78)\ \ (-2.88)\ \ (2.41) \\ \\ \qquad\qquad + 0.57\ BT2 \\ \qquad\qquad\ \ (2.60) \end{array} \qquad (61)$$

$R^2 = 0.73$ F = 11.32

$$F1 = \underset{(-3.25)}{-26.58} - \underset{(-3.80)}{1.69\ ERN1} + \underset{(6.96)}{2.04\ CPTP1} + \underset{(2.34)}{2.05\ YN1} \quad (62)$$

$R^2 = 0.93 \qquad DW = 1.83 \quad F = 79.47$

$$S = \underset{(-0.95)}{-135.82} + \underset{(2.08)}{6.11\ SGR} + \underset{(0.50)}{128.63\ ERN} - \underset{(-0.40)}{0.41\ CPTP} + \underset{(1.79)}{0.55\ SL} \quad (63)$$

$R^2 = 0.66 \qquad DW = 2.49 \quad F = 8.26$

$$SF = \underset{(-0.17)}{-8.01} - \underset{(1.98)}{13.31\ ERN} + \underset{(1.82)}{0.16\ CPTP} + \underset{(2.49)}{36.91\ DD1} + \underset{(0.21)}{0.0002\ YN} \quad (64)$$

$R^2 = 0.47 \qquad DW = 2.08 \quad F = 5.49$

$$RM = \underset{(-1.70)}{-204.75} + \underset{(0.83)}{0.18\ CPTP} + \underset{(5.02)}{149.72\ DD4} - \underset{(-0.22)}{0.05\ TM} + \underset{(3.27)}{258.06\ ERN} + \underset{(0.20)}{0.0006\ YN} \quad (65)$$

$R^2 = 0.84 \qquad DW = 2.84 \quad F = 18.18$

$$W = \underset{(-2.12)}{-256.06} + \underset{(0.96)}{86.25\ ERN} - \underset{(-1.65)}{0.95\ CPTP} + \underset{(2.78)}{0.007\ YN} + \underset{(3.22)}{1.15\ CPN(-1)} - \underset{(-2.86)}{0.89\ W(-1)} \quad (66)$$

$R^2 = 0.88 \qquad F = 23.93$

Block 4: Exports

$$CX1 = \underset{(2.07)}{2.24} + \underset{(0.51)}{0.24\ ERN} + \underset{(1.04)}{0.19\ CO2} + \underset{(1.45)}{0.36\ CX2} \quad (67)$$

$R^2 = 0.30 \qquad F = 3.17$

$$FX = -96.42 + 250.66\,ERN + 0.73\,FXL \quad (68)$$
$$(-1.14)\quad (2.77)\quad (3.66)$$

$R^2 = 0.54 \qquad F = 9.79$

$$AX1 = -1.31 - 0.01\,ERN + 0.93\,CNQ \quad (69)$$
$$(-0.22)\quad (-2.88)\quad (1.78)$$

$R^2 = 0.68 \qquad DW = 2.39 \qquad F = 11.42$

Block 5: Prices

$$RC1 = -5.53 - 0.02\,RM1 + 0.84\,RD + 1.21RQ1 \quad (70)$$
$$(-1.96)\quad (-0.19)\quad (2.48)\quad (4.4)$$

$R^2 = 0.70 \qquad F = 12.71$

$$CA1 = 5.99 + 0.58\,CA2 - 0.46\,CAQ1 \quad (71)$$
$$(2.43)\quad (3.51)\quad (-2.08)$$

$R^2 = 0.82 \qquad F = 34.05$

$$GP1 = -0.37 + 1.01\,GP2 + 0.08\,GNQ1 \quad (72)$$
$$(-0.33)\quad (13.99)\quad (0.64)$$

$R^2 = 0.96 \qquad F = 177.21$

$$CT1 = -0.51 + 0.79\,CT2 + 0.08\,CTQ2 \quad (73)$$
$$(-0.74)\quad (5.07)\quad (1.15)$$

$R^2 = 0.94 \qquad F = 79.39$

$$YP1 = 9.26 + 0.44\,YP2 - 0.88\,YQ1 + 0.31\,CA1 \quad (74)$$
$$(1.73)\quad (2.12)\quad (-1.68)\quad (2.07)$$

$R^2 = 0.94 \qquad F = 73.91$

$$MZ1 = -1.02 + 0.10\,MZQ1 + 0.67\,MZ2 + 0.27\,ML1 \quad (75)$$
$$(-0.85)\quad (0.53)\quad (4.50)\quad (1.49)$$

$$+ 0.13\,RC$$
$$(1.25)$$

$R^2 = 0.93 \qquad F = 52.80$

$$ML1 = \underset{(1.08)}{2.71} + \underset{(8.49)}{0.85\,ML2} - \underset{(-0.70)}{0.22\,MLQ1} \qquad (76)$$

$R^2 = 0.82 \qquad F = 36.01$

$$PK1 = \underset{(-0.70)}{-2.25} + \underset{(0.01)}{0.003\,PK2} + \underset{(1.89)}{1.29\,PQ1} \qquad (77)$$

$R^2 = 0.20 \qquad F = 2.89$

$$PO1 = \underset{(-0.39)}{-1.33} + \underset{(7.77)}{0.87\,PO2} + \underset{(0.59)}{0.36\,POQ1} \qquad (78)$$

$R^2 = 0.89 \qquad F = 60.67$

$$CO1 = \underset{(1.12)}{0.84} + \underset{(2.17)}{0.33\,CW1} + \underset{(1.54)}{0.53\,ERN1} + \underset{(1.24)}{0.72\,CPTP} + \underset{(0.34)}{0.15\,C02} \qquad (79)$$

$R^2 = 0.90 \qquad F = 34.60$

Analysis

The results indicate a good fit for most of the equations. In only a few cases is the adjusted R square less than 50%. Even then, it was only in the case of Equation 77 (20%), Equation 50 (24%) and Equation 60 (30%) that the results were very poor. For analytical convenience the results are analysed according to the blocks.

Production

The results indicate that the partial adjustment hypothesis that was assumed to reflect commodity output dynamics is inappropriate for maize (Equation 47), rice (Equation) 49, millet (Equation 50), groundnut (Equation 51), cotton (Equation 52) and cocoa (Equation 53). It was, however, appropriate in the case of the root crops, i.e., yams (Equation 46) and cassava (Equation 48) and the palm products, i.e., palm oil (Equation 54) and palm kernel (Equation 55). This suggests that grains, cocoa and cotton respond faster than root crops and palm products.

The rain variable was surprisingly insignificant in the output response of maize, rice, millet, cocoa and palm kernel. In fact, we had to exclude it in the maize and millet equations to get better results. The national average rainfall (RF) was used in all the equations except for groundnut, and cotton (RFK) and palm oil (RFB). The average rainfall for Kano (RFK) was used in the case of groundnut and cotton because they are grown in the area, while the rainfall of the former Bendel State (RFB) was used in the palm oil equation for similar reasons.

Table 9, derived from the results, reveals some of important implications such as:

1. Food output responded more significantly to non-price, non-policy variables - the cropping pattern permitted by agroclimatic zones had a dominant influence on output. For instance, while only maize and millet responded to prices, the cropping pattern was significant in three out of four cases. Besides, while the elasticity for cropping pattern ranged from 0.73 (MZQ in Equation 48) to 2.06 (YQ in Equation 47), the corresponding range for price was 0.05 - 0.60 and for policy -1.43 (LA in Equation 52) to 0.27 (TEA Equation 47).
2. Except in the case of cotton (1.39), the response of the output of both food crops and export crops was low, ranging from 0.04 (cocoa) to 0.60 (maize). This is consistent with the results of earlier studies.
3. Rice imports significantly influenced the domestic production of rice and millet.
4. Policy, monetary and fiscal, had more impact on export crops than on food crops. For instance, while neither TEA nor LA influenced food output significantly, they influenced all export crops significantly.
5. Credit to agriculture had a negative impact on output of yams (-0.21), cotton (-1.43) and cocoa (-0.14). This may be an indication of a diversion of credit by non-farmers and/or farmers away from agricultural production. This is a strong possibility since

Table 9: Production elasticities

Variables	Own prices	Substitutes	Complements	Total expenditure on agriculture	Loans to agriculture	Expenditure on social services
Yams	0.15	0.24(CA)		0.02	-0.21	
Maize	0.16[1]		2.06(YQ)[1]	0.27		
Cassava	0.05	-0.21(YP)	0.73(MZQ)[1]			
Rice	0.08	-0.13(RM)[1]				
Millet	0.44[1]	-1.08(MZQ)		0.07		
		-0.14(RM)[1]				
Groundut	0.07					-0.34[1]
Cotton	1.39			0.05	-1.43[1]	
Cocoa	0.04		1.58(ML)[1]		-0.14[1]	
Palm oil	0.20			-0.13[1]		0.07[1]
Palm kernel	0.21[1]			0.05[1]		

Note: 1. Significant at 5% (otherwise not significant).
Source: Estimation results.

speculative activities generate more returns than agriculture; also, yam, cotton and cocoa farmers among farmers are more likely to have access to credit.

6. Output responded more to prices than to policy. However, this result should not be taken as validating the premise that public policy per se causes adverse effects. On the contrary, it may reflect the weakness of selected policies and their implementation. Policies such as the massive import of inputs (fertilizer, tractors etc.), World Bank-supported ADP, irrigation projects, etc., which were motivated more by socio-political considerations than the objective of providing a functional and efficient infrastructural support base, were doomed to fail in inducing positive response.

Absorption

Equations 56 to 57 present estimated absorption functions. Table 10 summarizes some of the important results. It should be emphasized that what is modelled here is the domestic absorption of domestic output of commodities. Output series were used on the assumption that effective absorption equals effective output.

Table 10 shows that except for RD (rice), all functions are well behaved - absorption responds inversely to prices. The results also show that only YD (yams) respond significantly to prices (own and substitute, CAD). The price response coefficient, which ranged from 0.04 to 0.26 (ignoring signs), indicates that food is a necessity. Similarly, except for rice, Engel's law holds for the case of Nigeria. Moreover, imports are shown to exert the most significant impact on absorption. For instance, YD and RD were significantly influenced by rice imports and the import of food and live animals (F). This negative sign of the response coefficients tends to provide empirical support to the hypothesis of demand diversion reviewed in Section II.

Imports

Equations 60 to 66 report the results for the import functions. These are summarized in Table 11, which indicates a high income elasticity, ranging from 2.05 (food) to 8.14 (rice). Further, exchange rates (ERN) and CPTP (proxy for import price) tend to have counteracting effects in all cases except RM (rice imports). The results suggest that currency depreciation had negative effects on AV (animal and vegetable oil), F (food) and SF (stock fish), while its effects on other imports were positive. However, the effects were significant only in the cases of BT (beverages and tobacco), SF, RM and F. The results for RM and BT contradict expectations. The results, however, support *a priori* expectations that DD1 (second republic dummy), DD4 (Obasanjo/Shagari regime dummy) and CPN(-1) (lagged values of consumer price index) would significantly influence SF, RM and W, respectively. The positive response of all three variables also fulfils expectations. Over all, these results confirm the critical importance of non-price factors as determinants of Nigerian imports. Thus, national income, stable exchange rate policy and the political regimes of Obasanjo and Shagari exerted a strong stimulus on imports.

Table 10: Absorption elasticities

Variables	Own price	Substitutes	Imports	Income (YN)
Yams	-0.26[1]	0.16 (CA)[1]	-0.08 (RM)[1]	0.79
Rice	0.12		-0.59 (F)[1]	2.41
Millet	-0.04	0.55 (YP)[1]	0.004 (RM)[1]	0.20
Cassava	-0.26	0.20 (RC)	-0.5	-0.59

Note: 1. Significant at 5% (otherwise not significant).
Source: Estimation results.

Table 11: Import elasticities

Variables	Exchange rate (ERN)	Import prices (CPTP)	Income (YN)
Animal and vegetable oil	-0.02	0.87	4.99[1]
Beverages and tobacco	1.76[1]	-1.66[1]	6.38[1]
Food and live animals	-1.69[1]	2.04[1]	2.05[1]
Wheat	0.66	-0.57[1]	2.62[1]
Stock fish	-1.47[1]	1.57[1]	5.15
Sugar	-2.08	2.22	
Rice	0.67	3.41	8.14

Note: 1. Significant at 5% (otherwise not significant).
Source: Estimation results.

Exports

Only three components of exports were modelled. Their results are given in Equations 67 to 69. Table 12 captures some of the critical results. The estimated equation for cocoa exports (CX), i.e., Equation 67, indicates a poor fit. However, it shows that depreciation/appreciation of the exchange rate led to an increase/decrease in CX. The producer price of cocoa lagged by a period (CO2) has similar effect. This implies that the dynamic adjustment of cocoa exports is adaptive rather than instantaneous. Food and live animals exports (FX) also respond positively to exchange rates.

In addition, only in the case of AX (animal and vegetable) does the result have the wrong sign. Table 12 shows that while ERN was not significant in CX, it was in FX and AX. Besides ERN, GNQ (groundnut output) had a significant influence an AX. Moreover, AX was more responsive to GNQ (0.93) relative to ERN (-0.01). Even though the modelling of export supply can be improved, the results indicate that exchange rate policy and domestic production are important explanatory variables.

Table 12: Export elasticities

Variables	Exchange rate (ERN)	Price	Domestic production	Lag
Cocoa	0.24	0.19		0.36
Food and live animals	1.61[1]			0.73[1]
Animal and vegetable oil	-0.01[1]		0.93[1]	

Note: 1. Significant at 5% (otherwise not significant).
Source: Estimation results.

Prices

The ten prices estimated are reported in equations 70 to 79. Except for PK (palm kernel), specified functions of all other prices fit the data. The adjusted R square ranged from 0.73 (RC) to 0.96 (GP). As can be seen from the results the dominant factor is previous period values of price. Even though rice imports (RM) had the right sign as a determinant of the price of rice (RC), it was not significant. The price of cocoa (Equation 79) was positively influenced by exchange rate depreciation, foreign prices and foreign price levels. The implication of these results is that the effect of any domestic exchange rate policy can be effectively neutralized by developments in other countries, particularly those of the global commodity market, such as world commodity prices and market share.

Thus, the domestic prices of food or non-tradeables are easier to administer than those of tradables. Moreover, in a liberal environment, the instability in the global commodity market is easily transmitted to domestic prices with serious consequence for the production and input plans of farmers and the absorption plans of households.

It needs to be emphasized that the stabilization of farm incomes in the United States, the European Economic Community and Japan, which are anchored in the need to promote agricultural production in their respective economies, revolves around price and input support programmes. Thus, in a global environment characterised by protection and controls, it is not controls by the Nigerian government per se but the type of controls and their underlying motivations that frustrate a realization of the benefits from the Nigerian agricultural sector. Without any fear of contradiction it can be asserted that there is no economy today whose agriculture has developed without the deliberate efforts of government to support farm incomes and farm productivity. Engel's law seems to have established the unsustainability of a purely market-driven growth in commodity prices, income or output.

Model solution

The 34 estimations (Equation 46-79) constitute the stochastic part of the model that was solved. There were two identities in the model. They reflect the respective sums of imports and exports. It was not possible to generate the relevant identities for the absorption of non-tradeables. Recall that by the analysis in Section IV:

AT = TQ - TX
where,
AT = domestic absorption of tradeables
TQ = domestic production
TX = exports.

While the data for TQ is in quantities, the available series for TX is the product of quantities, prices and the nominal exchange rate. Even though a reliable series for exchange rate was available, those for prices and quantities were not. As a result, it was not possible to generate the series for quantities. For now, the domestic absorption of tradeables is not captured in the model. In the next stage of the study, when the industrial sector is modelled, the absorption of tradables will be integrated, data permitting

The model was solved using Time Series Processor (TSP) software, version 7.0. Appendix A, which summarizes some of the statistics for evaluating the dynamic properties of the model, indicates that it performed well. The Theil's inequality was above 0.20 in only two cases - CX (0.23) and RC (0.27). Even though this could be improved over time it is still useful for policy evaluation. Besides the Theil's inequality, figures B1 to B8 in the appendix show the tracking efficiency of the model, indicating that it was able to track the historical data well. The model is thus suitable for an empirical evaluation of the effect of adjustment policy on agriculture.

VI. Effects of adjustment policy on agriculture

The reform of exchange rate policy is the pivot of the SAP. This reform is complemented by the dismantling of the commodity boards, liberal export rules, fiscal austerity and monetary restraints. Thus, an evaluation of the reform policies requires a measurement of the total effects of all policies. This would necessarily involve a more complete model of the economy than the one adopted for this study.

However, the model can still be used to assess the effects of exchange rate policy, which our evaluation of adjustment policy proceeds to do. The model presented in the preceding section is employed for this purpose. Recall that the equations for the model were estimated for the period 1970-1986. The model was also solved for the same period. The evaluation process proceeds by assuming that the pre-SAP economic structure remains the same. This assumption is based on the premise that production technology, cropping patterns, productivity and other structural variables were unlikely to change in 1987-1989, the period of the simulation analysis. The model is then solved for the 1987-1989 period with the historical values of the market-determined exchange rate for that period. The simulated values generate the bench mark for comparative dynamics. Two other scenarios are generated and compared to it, with the assumption that the government maintained its pre-SAP policy of exchange rate administration in generating the scenarios.

The two exchange rate series are derived from the assumption of:

A. 50% annual exchange rate depreciation; and
B. 5% annual exchange rate depreciation.

Note that in both cases a stable exchange rate is assumed. Table 13 compares the actual exchange rate with the two alternative exchange rate regimes.

Table 13: Alternative exchange rates

Year	A	B	Actual
1987	2.57	1.41	4.01
1988	3.85	1.49	4.48
1989	5.13	1.56	7.51

Source: Computed from CBN (1990).

The first simulation uses A while the second uses B. Both are compared with the bench mark solution, i.e., the one where historical values were used. Thus the effect of the reform is evaluated against other alternative policies that the government could have adopted.

The result of the exercise is presented in tables 14 to 18. For ease of comparison the results are presented in percentages. These were computed as:

$$A = ((BM - S_a) * 100\%) / BM \quad (80)$$

$$B = (BM - S_b)/BM * 100 \quad (81)$$

where,

BM = Bench mark

S = Simulated values

a = Simulated values of a constant 50% annual depreciation of the naira

b = Simulated values of a constant 5% annual depreciation of the naira.

Effects on domestic production

Table 14 presents the results for domestic production. The table reports the results for three non-tradeable food crops (maize, cassava, millet) and two tradeables (palm oil and palm kernel). Five commodities (yams, rice, cocoa, cotton, groundnut) were immune to exchange rate regimes.

Table 14: Effects of exchange rate on production (%)

Year	Maize		Cassava		Millet		Palm oil		Palm kernel	
	A	B	A	B	A	B	A	B	A	B
1987	3.83	8.93	-0.77	-1.83	-1.05	-2.51	0.016	0.039	0.001	0.0025
1988	1.48	9.63	-0.29	-1.98	-0.40	-2.72	0.006	0.042	0.0004	0.0027
1989	3.38	13.28	-0.66	-2.80	-0.92	-3.84	0.014	0.059	0.001	0.0043

Source: Computed from simulation results.

Of the three food crops the exchange reform had positive impacts only on maize, while its impact on millet and cassava was negative. A key feature of the result is that the magnitude of B exceeds that of A. For instance, while the positive effect of exchange rate on maize was 1.48% in 1988 in the case of A, the corresponding B value was 9.63%. Similarly, the effect was 3.38% in 1989 for A and 13.28% for B. This tends to indicate that for those variables that respond positively/negatively to exchange rate depreciation, the positive/negative impact is magnified by the size of difference between actual values of exchange rate and the counterfactuals. This is reflected in all the results.

From the results for production it could be inferred that:

- The effect on food crops is mixed.
- The effect on non-tradeables is either positive or neutral.
- The overall effect on aggregate agricultural output is indeterminate unless an aggregate agricultural function is specified. We have not specified such a function because we supposed that such a function is a policy issue that should be articulated within the requirement of achieving at least the minimum FAO food requirements of the population, the supply of agricultural raw material to the domestic industry and any other goal of agricultural policy.

Effects on domestic absorption

Table 15 presents the results for the four domestic absorption functions modelled. While the impact on aggregate domestic production is indeterminate, the direction of impact on absorption is. This is because exchange rate reform seems to have increased the domestic absorption of domestic food crops, with millet and rice the major beneficiaries. The absorption of millet increased by 30.76% in 1987, 12.93% in 1988 and 27.41% in 1989, in the case of assumption (A), with a corresponding increase in the absorption of rice of 37.05% (1987), 16% (1988) and 33.2% (1989). Thus, since all components of aggregate absorption were affected positively, the aggregate effect is positive. An important result to note is that while assumption B shows a steady increase in impact, assumption A shows a decline in 1988 with sharp up-swing in 1989.

Table 15: Effects of exchange rate on absorption (%)

Year	Yams		Millet		Cassava		Rice	
	A	B	A	B	A	B	A	B
1987	0.028	0.067	30.76	58.09	8.93	19.85	37.05	66.55
1988	0.011	0.072	12.93	60.98	3.46	21.29	16.00	69.43
1989	0.024	0.101	27.41	73.40	7.81	28.60	33.20	81.13

Source: Computed from simulation results.

Effects on imports

The impact on total imports is positive, as shown in Table 16. It ranged from 12.01% to 29.61% for assumptions A, and 37.13% to 54.48% for assumption B. However, the effect on components is mixed. It was negative for food and live animals, animal and vegetable oil, and stock fish, but positive for beverages and tobacco, sugar, wheat, and rice. The result for imports reflects naira values of imports. Thus, it does not measure quantities. It is possible that the increase in rice and wheat imports may have been nominal rather than real. To determine the real effect of exchange reform, a decomposition of the components of the import bill is necessary. As reliable series were not available to us, the result focuses on nominal imports. It should be noted that both rice and wheat

were banned in 1987. Thus, the results indicate that, given pre-SAP import structures, a significant level of demand for wheat and rice exists irrespective of exchange rate regime or trade control. This suggests that it would be very difficult to eliminate this demand by merely banning the product. Thus, while official data show zero levels of import, unofficial observations reveal a large illegal trade in both wheat and rice. Trade restrictions *have thus only forced demand underground, they have not eliminated it.*

Table 16: Effects of exchange rate on imports (%)

Year	Food and live animals		Beverages and tobacco		Sugar		Animal and vegetable oil	
	A	B	A	B	A	B	A	B
1987	-108.95	-471.72	52.53	83.69	38.32	68.95	-0.80	-1.90
1988	-32.00	-569.88	25.08	85.95	17.61	84.32	-0.30	-2.06
1989	-90.11	-1322.90	48.73	98.68	33.86	84.83	-0.70	-2.91

Year	Stock fish		Wheat		Rice		Total	
	A	B	A	B	A	B	A	B
1987	-19.18	-34.51	124.28	223.62	371.83	669.07	28.59	37.13
1988	-8.44	-39.90	54.66	258.58	163.56	773.66	12.01	39.39
1989	-31.60	-79.15	204.77	512.94	371.83	1534.72	29.65	54.48

Source: Computed from simulation results.

Effects on exports

Table 17 shows the impact on exports. It shows that the impact on aggregate export is positive, and except in the case of animal and vegetable export (AX), the impact on components of exports (i.e., cocoa and food and live animal) is also positive. Moreover, while the magnitude in the case of AX is very small (-0.004 - -0.05), it was large for coco (CX) and food and live animals(FX).

Table 17: Effects of exchange rate on exports (%)

Year	Cocoa		Food and live animals		Animal and vegetable oil		Total	
	A	B	A	B	A	B	A	B
1987	10.12	22.30	29.33	52.77	-0.05	-0.38	22.35	41.41
1988	3.94	23.90	9.55	43.17	-0.01	-0.40	6.82	34.23
1989	8.88	31.91	31.19	78.13	-0.004	-0.21	19.09	51.21

Source: Computed from simulation results.

Effects on prices

Table 18 shows the effect on prices. The effect on the price of groundnut(GP) is not shown in Table 18 because it was neutral. In all other cases the impact was positive. This implies that exchange reform caused the prices of all the commodities excluding groundnut to rise. However, the impact is not uniform. Rice (food crops) and cocoa (export crop) were influenced most significantly while the rise of prices of yams, cassava, millet, cotton, palm oil and palm kernel was very low. Therefore, rice and cocoa were the major beneficiaries of the reform.

Table 18: Effects of exchange rate on prices (%)

Year	Maize		Cassava		Millet		Palm Oil		Palm Kernel	
	A	B	A	B	A	B	A	B	A	B
1987	6.53	14.77	0.35	0.83	0.23	0.54	0.013	0.03	0.0015	0.003
1988	2.51	15.88	0.13	0.90	0.09	0.58	0.005	0.03	0.0005	0.004
1989	5.71	21.60	0.30	1.26	1.26	0.82	0.011	0.50	0.0120	0.090

Year	Yams		Rice		Cotton		Cocoa	
	A	B	A	B	A	B	A	B
1987	0.11	0.13	37.52	67.14	0.06	0.10	20.54	41.96
1988	0.04	0.15	16.24	70.01	0.02	0.18	8.39	44.50
1989	0.09	0.21	33.62	81.63	0.05	0.50	33.62	56.33

Source: Computed from simulation results.

It seems that exchange rate reform had more impacts on the prices of rice and cocoa than on their output (see Tables 18 and 14). This points to factors other than price as being responsible for the actual increase in the output of cocoa and rice. This conclusion is also true for the other commodities that were affected by exchange rate reform. The validity of the conclusion is apparent when Tables 1 and 2 are compared with Table 14.

These results, though not conclusive, provide a useful insight into the effect of exchange reform. In general, the results show evidence of a positive impact on prices, total nominal import, total nominal export and real domestic absorption of Nigerian food crops. The evidence on real output is inconclusive for aggregate agricultural output; the effect on tradeables is either marginal or neutral while the effect on food crops is mixed. Further investigations are necessary to expand the analysis to include fisheries, livestock and non-agriculture and to endogenize government policy variables. We suspect that the observed expansion in commodity output may be due to the fiscal austerity that complemented exchange rate reform. Fiscal austerity could be linked to the rise in urban unemployment, which in turn could be linked to the *reverse-migration,* i.e., urban-rural migration, of post 1986. If our suspicion is true, the growth in real output could simply be the consequence of a *more extensive* use of rural land rather than the result of either productivity gains or more efficient use of agricultural resources.

Further, the observed shift in consumption pattern in favour of Nigerian food may be due largely to a decline in income rather than the enhanced competitiveness of local relative to imported food. As Table 5 shows, the import bill rose after SAP. Once the high incidence of cross-border imports of wheat (either in processed or raw form) and rice is acknowledged, one can conclude that it is in fact those whose real income has declined who have been forced to adapt. A key aspect of this adaptation seems to be the consumption of foods not for their nutritional value but to avoid hunger. This type of adaptation or adjustment is incompatible with the policy realization of the attainment of FAO specifications on what a human being requires to live a healthy and, we should add, productive life.

VII. Conclusion

Our evaluation of adjustment policies does not instil confidence in the ability of those policies to attain the sectoral goals of the agricultural sector. The results indicate a persist excess demand for food. They also indicate only a nominal export response while import bills, which hitherto had declined, rose persistently. Consequently, the deficits in the agricultural trade balance shown in Table 7 worsened. Tables 1, 2, and 3 also show that neither the increase in commodity output nor the higher prices is sustainable.

The study suggests that the analysis of agricultural policy could be improved by:

- Modelling other agricultural non-crop sub-sectors.
- Specifying clearly the linkage between agriculture and industry. This would assist in decomposing domestic commodity absorption into final consumption and intermediate consumption.
- Endogenizing government policy variables.

The next stage of our research will focus on the manufacturing sector. Other sectors including government will be specified to provide a more complete model for agricultural policy analysis. An improvement in data would be of immense value in this regard.

While exact data are unavailable, it is important to note the expansion in unofficial and illegal cross-border trade. The wheat and rice ban in 1987 significantly encouraged this. This development points to a weakness in quantitative restriction as an instrument for altering domestic demand structures. As part of the expansion in cross- border trade, some processed and unprocessed food crops, e.g. gari, grains, etc., have become tradeables. The illegal export of these food crops in the search for foreign currency tends to worsen the output-consumption imbalance.

At face value this appears consistent with the adjustment aims of expanding non-oil exports. However, export revenue is not an end in itself but a means to an end. Besides, for both official and unofficial commodity exports, most of the revenue in foreign currency is not repatriated to Nigeria and does not contribute to improving the balance of payments. If the argument that commodity exports were used to repatriate resources from the economy is correct, then such export expansion without a concomitant expansion in foreign exchange inflow constitutes leakages rather than a stimulus to the domestic economy. This raises an important institutional issue.

Another institutional issue that must be explicit in agricultural policy analysis - which is also usually ignored - is the informal economy, where production, distribution and most food processing are operationalized. Neither pre-SAP nor SAP policies address

this sector. Both agricultural production and processing are traditionally organized. It is not clear how either processing or production can improve without fundamental changes in their structures, which are not tuned to free enterprise practices. Not only have these structures remained the same, but fiscal austerity has implied a decline in an already inefficient infrastructural income and marketing framework.

It would not only be simplistic but also misleading to assume that liberalization leads smoothly to efficiency. What it appears to lead to is an increase in commerce rather than production, which has less to do with efficiency than returns - which appear to correlate inversely to production and productivity. Even though these institutional issues are not easy to model, ignoring them leads to a misleading evaluation. For instance, as our estimations suggest, a dominant force influencing output is the cropping behaviour of farmers, which is a rational attempt not to maximize profit but to minimize the chance of poor harvest and hunger. This survival strategy is consistent with subsistence farming, and also with non-reliance on government and market forces.

Thus, for now, it can be inferred that it is not so much a shift from government to private sector activities but a reform in both the government's management of the economy and the structure of the private economy that would be instrumental in stimulating sustainable growth in commodity output. A reform in the institutional base of policy, real resource allocation and utilization, rather than a purely financial reform may be of more relevance to Nigeria. This assertion can be supported by the fact that Nigeria's institutional structures have been blamed by foreign investors and businesses as encouraging capital flight rather than capital inflow.

Besides these institutional problems, the macroeconometric policy model is weakened by structural change. For instance, pre-SAP behaviour could differ sharply from post-SAP behaviour. This limits the model's use for ex ante post-SAP policy evaluation or forecasting. However, as long as the dynamism of policy analysis is appreciated, a continuous process of re-specification, re-estimation and re-evaluation improves over time the reliability of this type of policy analysis.

Appendices

Appendix A: Summary statistics

Table A1: Summary statistics

VARIABLE	THEIL'S INEQUALITY	BIAS	VARIANCE	COVARIANCE
YQ	0.03	0.0007	0.0776	0.9271
MZQ	0.13	0.0029	0.0755	0.9215
CAQ	0.10	7.73E-05	0.0496	0.9502
RQ	0.17	0.0176	0.0149	0.9673
NLQ	0.10	0.0002	0.1838	0.8159
CTQ	0.12	0.0038	0.0968	0.8992
PQ	0.18	0.0042	0.0869	0.9087
GNQ	0.4	0.0001	0.0720	0.9278
CQ	0.07	8.96E-06	0.0746	0.9252
POQ	0.03	0.0002	0.0131	0.9867
YD	0.11	3.50E-05	0.3458	0.6542
MCD	0.10	0.0022	0.0177	0.9800
CAD	0.14	3.93E-05	0.1643	0.8356
F	0.13	4.02E-17	0.0499	0.9501
S	0.17	2.8E-14	0.0717	0.9283
AV	0.10	0.112	0.0016	0.9871
W	0.08	1.7E-12	0.0201	0.9799
RM	0.11	2.0E-10	0.0309	0.9691
TAM	0.15	3.9E-07	0.1450	0.8550
BT	0.18	0.0036	0.0999	0.8965
AX	0.10	0.0001	0.0452	0.9547
CX	0.23	0.0076	0.07216	0.9202
TAX	0.11	0.0007	0.1443	0.8550
FX	0.03	0.0002	0.2748	0.7164
RC	0.27	0.2189	0.0081	0.7730
CA	0.08	0.0012	0.0108	0.9880
CT	0.04	0.0068	0.0563	0.9369
YP	0.06	0.0033	0.0016	0.9951
MZ	0.12	0.0324	0.0007	0.9669
MC	0.14	0.0047	0.0335	0.9618
PK	0.16	0.0012	0.2882	0.7106
PO	0.10	7.4E-05	0.0409	0.9590

Appendix B: Output, exports and domestic price

Figure B1: Output of yams

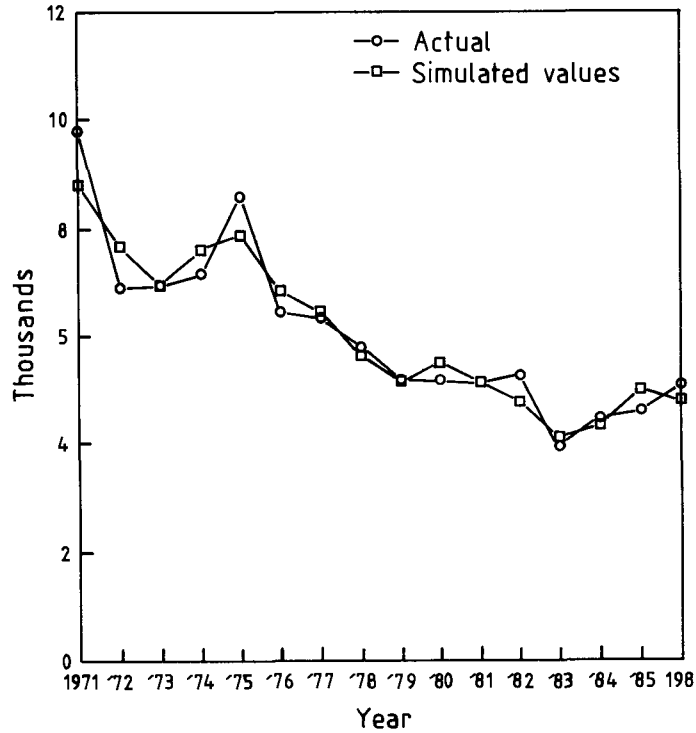


Figure B2: Output of cassava

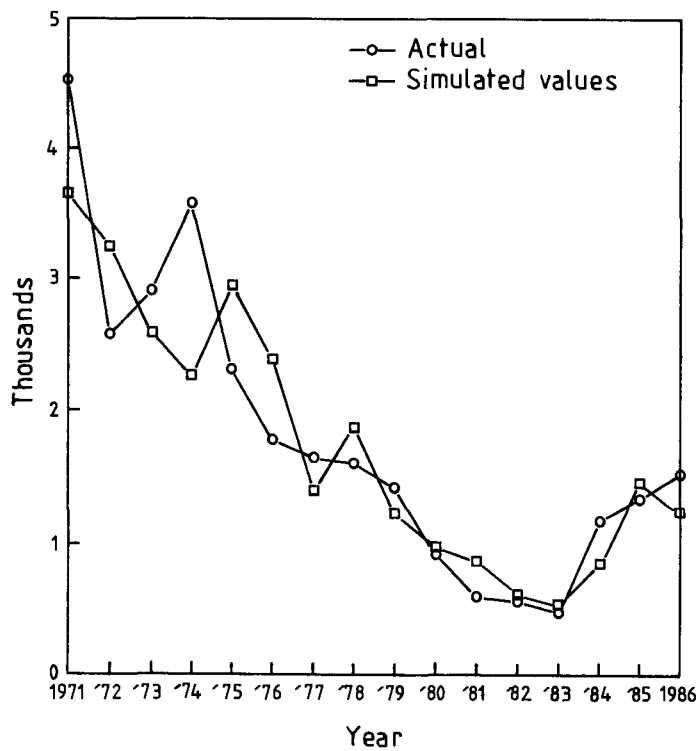


Figure B3: Output of cocoa

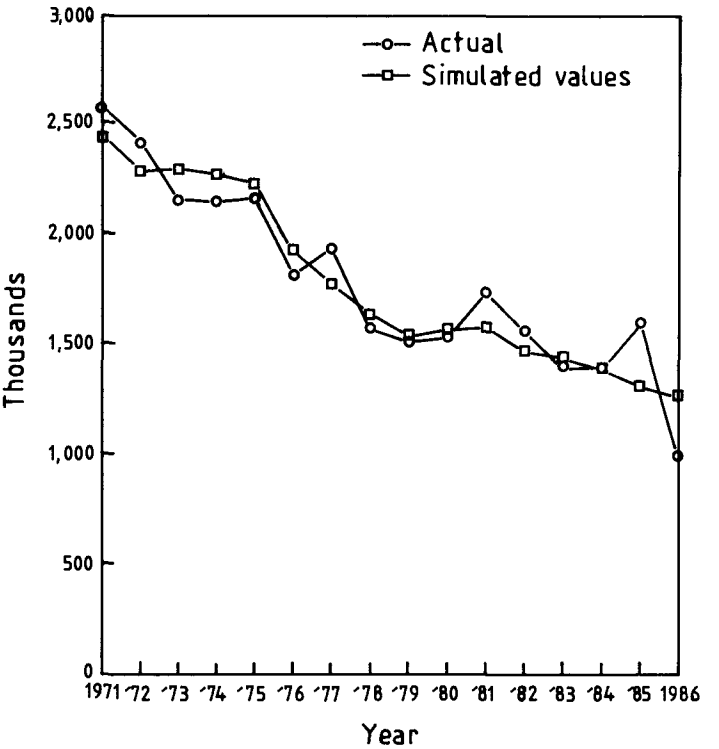


Figure B4: Total imports

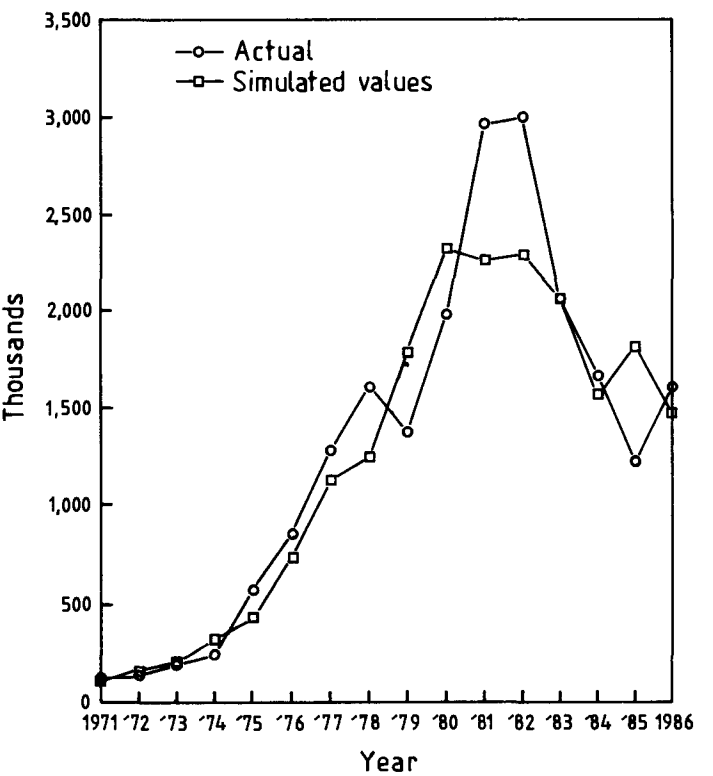


Figure B5: Total exports

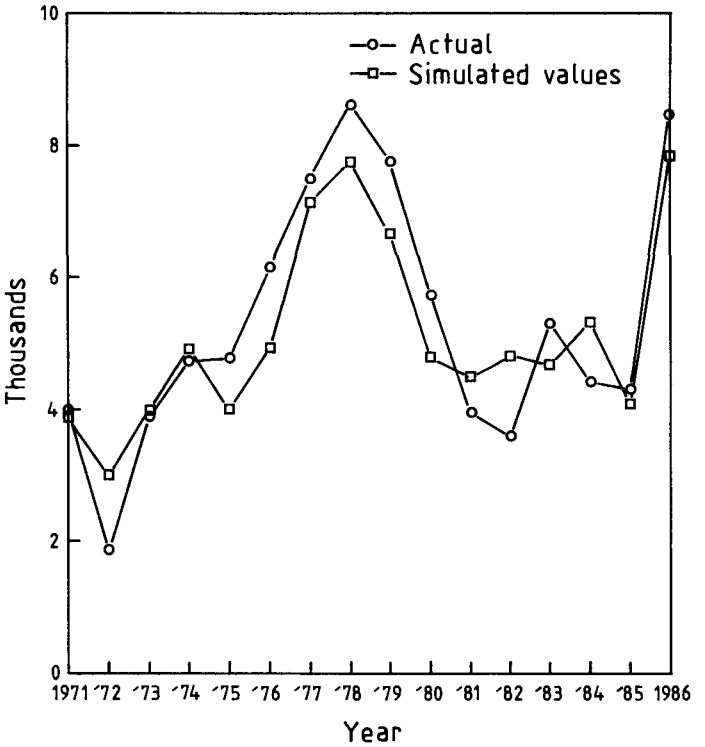


Figure B6: Domestic price of rice

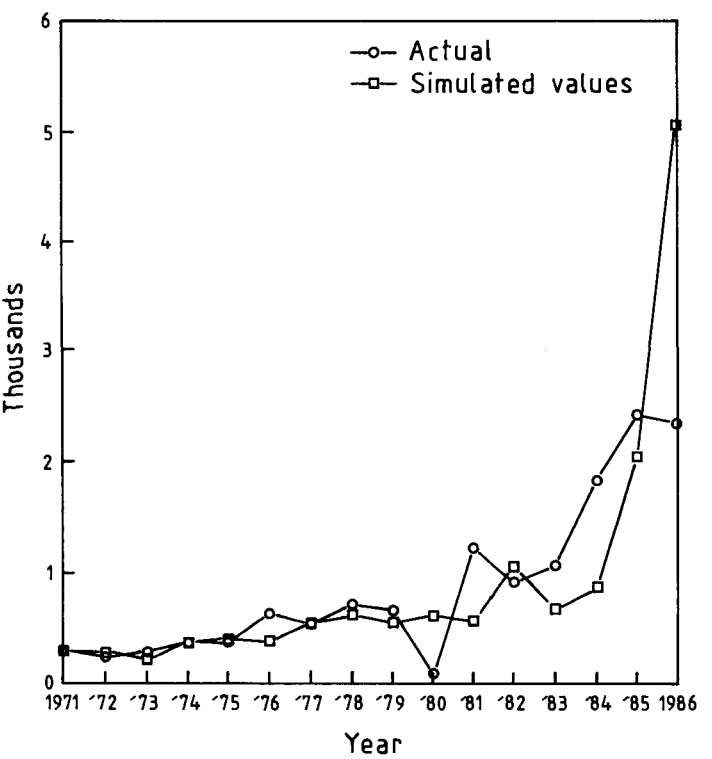


Figure B7: Domestic price of cocoa

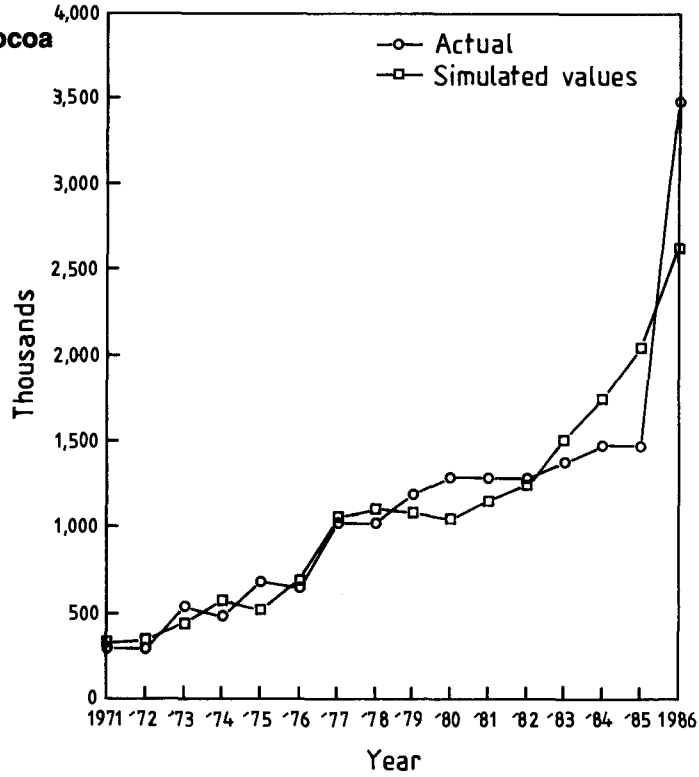
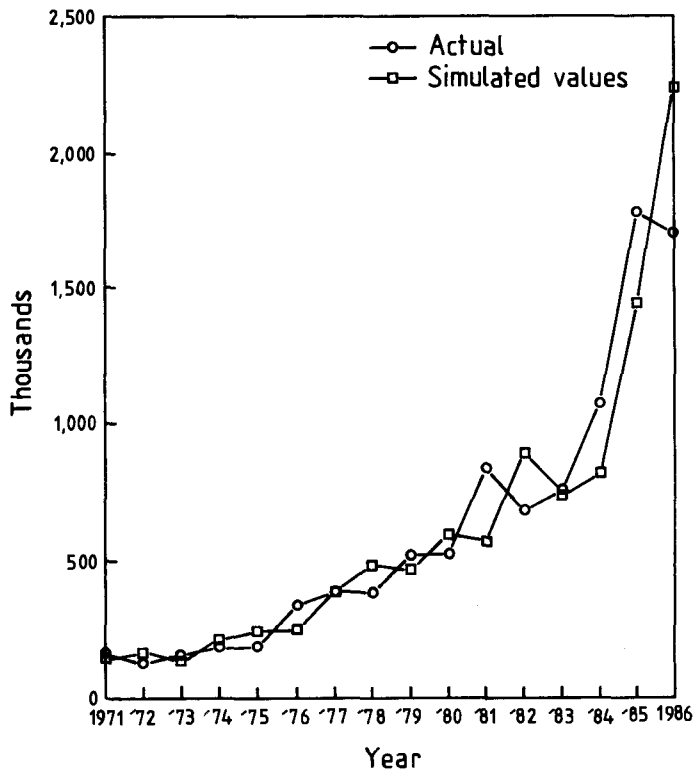


Figure B8: Domestic price of maize



Appendix C

Table C1: List of variables

YQ	Output of yams
MZQ	Output of maize
CAQ	Output of cassava
RQ	Output of rice
MLQ	Output of millet
GNQ	Output of groundnut
CTQ	Output of cotton
CQ	Output of cocoa
POQ	Output of palm oil
PQ	Output of palm kernel
YD	Domestic absorption yams
CAD	Domestic absorption of cassava
RD	Domestic absorption rice
MLD	Domestic absorption millet
MZD	Domestic absorption maize
GND	Domestic absorption groundnut
PD	Domestic absorption palm kernel
POD	Domestic absorption palm oil
CTD	Domestic absorption cotton
AV	Animal and vegetable oil imports
BT	Beverages and tobacco imports
F	Food and live animals imports
S	Sugar imports
SF	Stock fish imports
RM	Rice imports
W	Wheat imports
FL	Flour imports
TAM	Total imports
CX	Cocoa exports
FX	Food and live animals exports
AX	Animal and vegetable oil exports
RX	Rubber exports
PX	Palm kernel exports
RC	Domestic price of rice
CA	Domestic price of cassava
GP	Domestic price of groundnuts
CT	Domestic price of cotton
YP	Domestic price of yams
MZ	Domestic price of maize

ML	Domestic price of millet
PK	Domestic price of palm kernel
PO	Domestic price of palm oil
CO	Domestic price of cocoa
RF	Average national rainfall
TEA	Total expenditure on agriculture
LA	Total credit to agriculture
SS	Expenditure on social services
RFK	Average Kano state rainfall
RFB	Average Bendel state rainfall
YN	National income
ERN	Naira/dollar nominal exchange rate
CPTP	Weighted index of consumer price index of six of Nigeria's major trading partners
SGR	Domestic output of sugar
DD1	Dummy for civilian regime
DD4	Dummy for Obasanjo/Shagari regimes
TM	Average import tax rate
CPN	Consumer price index
TX	Average export tax rate
CW	World price of cocoa

References

Alonge, D. O. 1991. "Meat and Poultry Processing Industries in Nigeria" *Processing in Nigeria,* Policy Analysis Department, Federal Ministry of Industries, PAD/FMI, Ibadan.

Bevan, D. P, Collier, and J. W. Gunning. 1988. "Poverty Equity and Growth in Nigeria and Indonesia", mimeo, World Bank.

_____.1992a. "Nigeria Policy Response to Shocks, 1970-90", mimeo Oxford, London.

_____.1992b. "Nigerian Economic Policy and performance: 1981-92", mimeo, Oxford, London.

Binswanger, H. 1989. "The Policy Response of Agriculture", *The World Bank Supplement to Research Observer.*

Bond, M. E. 1983. "Agricultural Response to Prices in Sub Saharan African Countries", *IMF staff papers.*

Braverman, A. 1989. Comment on "The Policy Response of Agriculture" by Binswanger, in *The World Bank Supplement to Research Observer.*

Cavallo, D. and Mundlak, Y. 1982. "Agriculture and Economic Growth in an Open Economy: The Case of Argentina", International Food Policy Research Institute, *Research Report No. 36,* Washington.

Chhibber, A. 1988. "Raising Agricultural output: Price and Non-price Factors", *Finance and Development,* June.

Garba, A. G. 1989. "The Performance of ECOWAS Agriculture Under IMF/World Bank Sponsored Economic Recovery Programmes: The Case of Nigeria and Ghana", Paper presented at the 5th Biennial Conference of WAEA, Lome, November, 1989.

Gardner, B. 1981. "Constraints on the Modelling of Agriculture", in Federal Reserve Bank of Kansas State FRBKS - (1981), *Modelling Agriculture for Policy Analysis in the 1980s,* Kansas.

Idusogre, E. O. 1971. "Nutritional Requirements for the Nigerian Population", *African Journal of Medical Science* 3(1).

Igene, J. O. 1991a. "The Challenges of the Industrial Processing of Indigenous Foods in Nigeria", *The Nigerian Food Processing Sub-sector,* Federal Ministry of Industries, Ibadan.

Igene, J. O.1991b. "Research and Development for Indigenous Meat Products in Nigeria", Food Processing in Nigeria, Policy Analysis Department, Federal Ministry of Industries, Ibadan.

Johnson, S. R.1981. "Alternative Design For Policy Models of The Agricultural Sector", FRBKS 1981, *Modelling Agriculture for Policy Analysis in the 1980's,* Kansas.

Khan, M. and Roberto, Z. 1983. "The Macroeconomic Effects of Changes in barriers to Trade and Capital flows: A simulation Analysis". *IMF Staff Papers*.

Kwanashie, M. Ajilima, I. and Garba, A. "1991, 'The Nigeria Economy: The Responseof Agriculture to Adjustment Policies", Final Report, AERC, Nairobi, Kenya.

Lopez, R. and Thomas, V. 1988. *Imports and Growth in Africa,* The World Bank, Working Paper Series, No. 20.

Muoka, A.1991. "Government Policies and the Food Industry in Nigeria", *Food Processing in Nigeria,* Policy Analysis Department, Federal Ministry of Industries, Ibadan.

Nerlove, M. 1979. "The Dynamic of Supply: Retrospect and Prospects" *American Journal of Agricultural Economics.*

NISER, 1988. "The NISER Econometric Model of the Nigerian Economy - Version 87", NISER, Ibadan.

Nowrishirvani, V. F. 1971. "A modified adaptive expectation model" *American Journal of Agricultural Economics.* Vol. 53.

Odubela, M. O. 1991. "Dairy Processing", *Food Processing in Nigeria,* Policy Analysis Department, Federal Ministry of Industries, Ibadan.

Ojameruaye, E. O.1991. "An Application of the Purchasing Power Parity Theory to the Determination of the Realistic Exchange Rate of the Nigerian Currency", *Nigerian Financial Review,* Vol. 3, No. 4.

Olayemi, J. K. Titilola, S. O. Igben, M. 1986. *Nigerian Food Balance Sheet 1985 - 1995,* NISER, Ibadan.

Olayide, S. O. 1969. "Some Estimates of Supply and Demand Elasticity for SelectedCommodities in Nigeria's Foreign Trade", *The Journal of Business and Social Studies,* Vol. 1, No. 1.

_____.1972. "Some Estimates of Supply Elasticities for Nigeria's Cash crops", *Journal of Agricultural Economics,* Vol. 23, No. 3.

Olayide, S. O. 1982. *Food and Nutrition Crisis in Nigeria,* Ibadan: University of Ibadan Press.

Olayide, S. O. and Olatunbosun, Dupe. 1970. "An Econometric Analysis of Nigeria's Export Demand", *Indian Journal of Agricultural Economics,* No. 25.

Olayide, S. O. and Olayemi J. K. 1978. "Economic Aspects of Agriculture and Nutrition;A Nigerian Case Study", *Food and Nutrition Bulletin,* UNU, Tokyo 1(1).

Olofin, S.1985. *Modelling Nigeria's Economic Development,* Ibadan University Press, Ibadan.

Oni, S. A. 1960a. "Productions Response in Nigerian Agriculture: A Case Study of Palm Produce, 1949 - 1966", *Nigerian Journal of Economic and Social Research* (NJESS), Vol. 11.

_____.1969b. "Econometric Analysis of Supply Response among Nigerian Cotton Farmers", *Bulletins of Rural Economics and Sociology,* Vol. 4, No. 2.

Oni, S. A. 1970. "The Demand for Nigerian Cocoa: A Statistical Analysis of Regional Markets and Projection", *NJESS,* VOL. 12, No. 1.

Owosekun, A. A. 1976. "Agricultural Supply Response: A Case Study of the supply of Groundnuts to the Marketing Board of Northern States of Nigeria", *East African*

Journal of Rural Development, Vol. 9.

_____.1977. "Peasant Farmers Supply Response: A case study of the supply of cotton to the Marketing Board of the Northern States of Nigeria", *Journal Rural and Economics Development,* Vol. 11, No. 2.

_____.1980. *Prospects for Nigeria's Major Export Commodities in the Expanded EEC,* NISER, Ibadan.

Oyejide. A. T. 1990. *Supply Response in the Context of Structural Adjustment in Sub-Saharan Africa,* Initiative Publishers, Nairobi.

_____.1991. "Trade Shocks, Oil Boom and the Nigerian Economy 1973-83", mimeo, Department of Economics, University of Ibadan.

Orcutt, Guy. 1950. "Measurement of Price Elasticities in International Trade", *Review of Economics and Statistics.* Vol. 32, No. 2.

Penson, J. B.1981. "Capturing Linkages between Agriculture and the Domestic Economy" FRBKS, 1981, *Modelling Agriculture for Policy Analysis in the 1980s,* Kansas.

Phillips, D. O. and G. O. I. Abalu. 1987. "Price Expectation Formation and Revision in the Nerlovian Framework with Application to Nigerian Farmers", *Journal of Agricultural Economics,* Vol. 38, No. 7.

Rausser, G. C. and Just R. C. 1981. "Principles of Policy Modelling in Agriculture", FRBKS, 1981, *Modelling Agriculture for Policy Analysis in the 1980's,* Kansas.

Schuch, E.1981. "Foreign Linkages" FRBKS, 1981, *Modelling Agriculture for PolicyAnalysis in the 1980s,* Kansas.

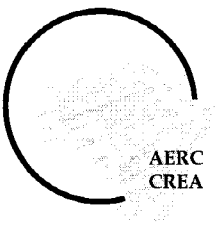
Stanley, F. 1986. "Issues in Medium-Term Macroeconomic Adjustment", *Research Observer,* Vol. 1, No. 2.

The Hunger Project. 1980. *African Farmer,* No. 3.

World Bank. 1990. *Policy Research Bulletins,* Vol. 1, No. 3.

United Nations. 1990. *Africa's Commodity Problems: Towards a Solution,* New York.

United Nations. 1980. *Africa Recovery,* Vol. 4, No. 2.



P.O. BOX 62882
NAIROBI, KENYA

TELEPHONE (254-2) 228057
225234 215898 212359
332438 225087

TELEX 22480

FAX (254-2) 219308

E-MAIL aerc@elci.gn.apc.org
or aerc@form-net.com

The principal objective of the African Economic Research Consortium (AERC), established in August 1988, is to strengthen local capacity for conducting independent, rigorous inquiry into problems pertinent to the management of economies in Sub-Saharan Africa.

In response to special needs of the region, AERC has adopted a flexible approach to improve the technical skills of local researchers, allow for regional determination of research priorities, strengthen national institutions concerned with economic policy research, and facilitate closer ties between researchers and policy makers.

Since its establishment, AERC has been supported by private foundations, bilateral aid agencies and international organizations.

SPECIAL PAPERS contain the findings of commissioned studies in furtherance of AERC's programmes for research, training and capacity building.

RESEARCH PAPERS contain the edited and externally reviewed results of research financed by the AERC.

It is AERC's policy that authors of Special and Research Papers are free to use material contained therein in other publications. Views expressed in the Special and Research Papers are those of the authors alone and should not be attributed to the AERC's sponsoring Members, Advisory Committee, or Secretariat.

Further information concerning the AERC and additional copies of Special and Research Papers can be obtained by writing to: African Economic Research Consortium, P.O. Box 62882, Nairobi, Kenya.

ISBN 9966-900-99-3