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

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

*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

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

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# Contents

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

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.

**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.

**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

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,

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

**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

# 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.

- 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.

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).

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

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

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.

# 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.

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

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

46)

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

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

47)

$R^2 = 0.67$ 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

48)

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

$R^2 = 0.75$ F = 9.88

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

9)

$R^2 = 0.44$ F = 3.3

## *Block 2: Absorption*

0)

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

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

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

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

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

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

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

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

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

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

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

### *Block 4: Exports*

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

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

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

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

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

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

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

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

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

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

## 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.

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 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.

# 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).

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

## 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.

# 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

# 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 |

**Figure B3: Output of cocoa**

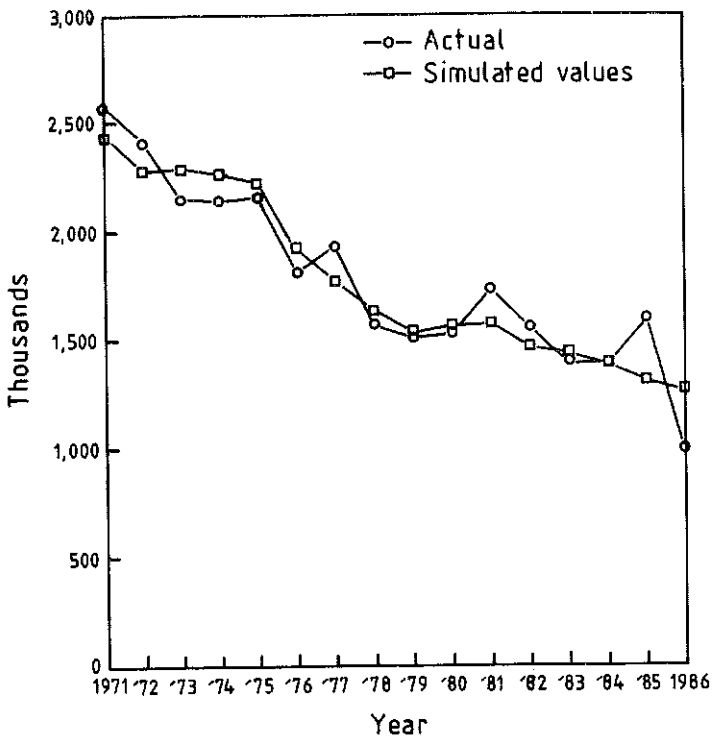



**Figure B4: Total imports**

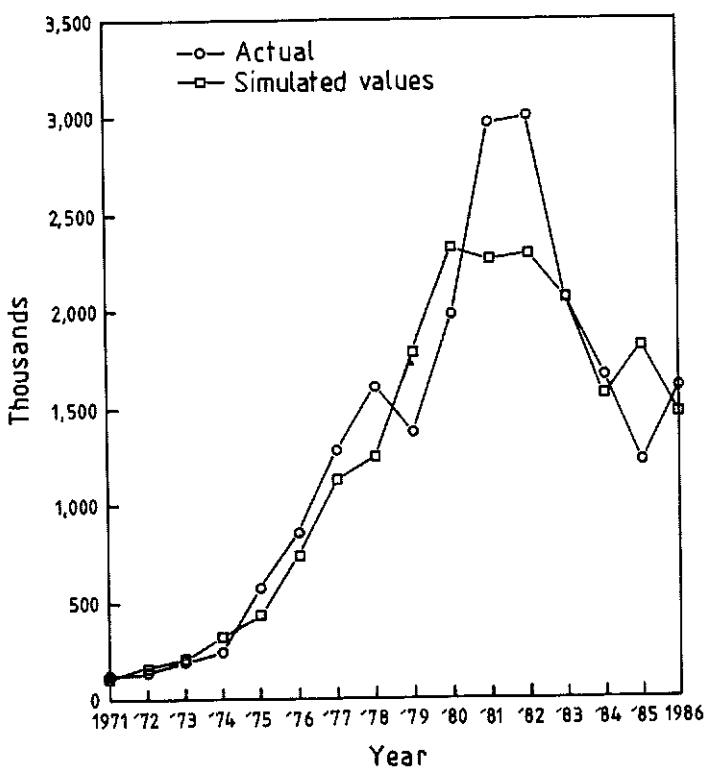


**Figure B7: Domestic price of cocoa**

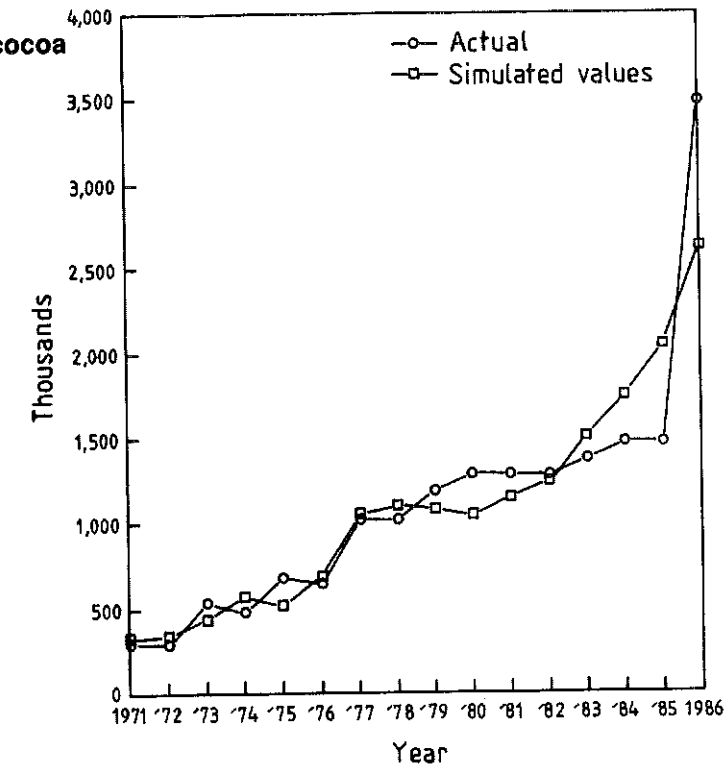
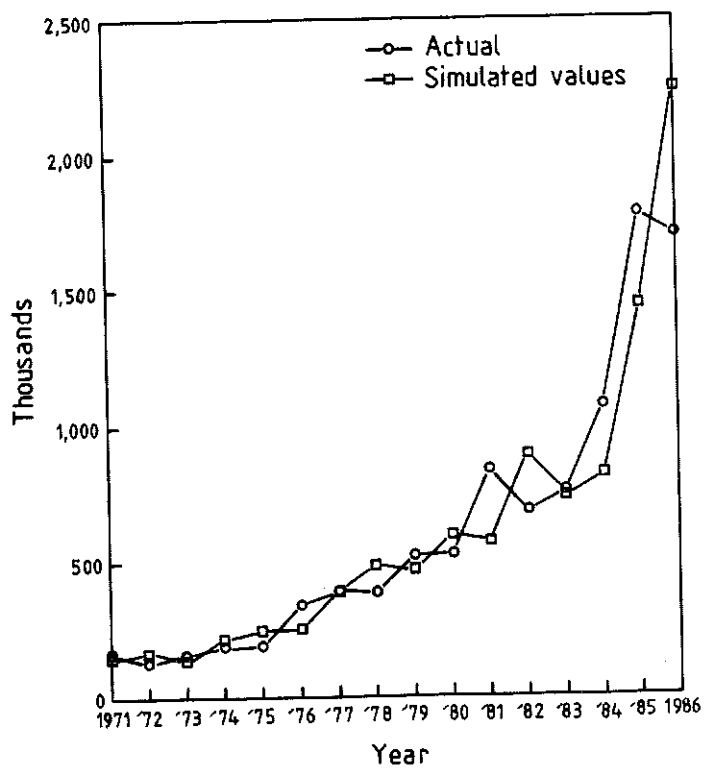



**Figure B8: Domestic price of maize**



| | |
|---|---|
| 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 |

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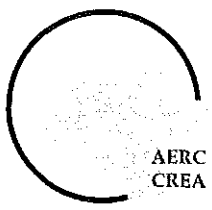


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