

AN OPERATIONAL ECONOMETRIC MODEL OF THE  
NIGERIAN ECONOMY

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## I. INTRODUCTION

Earlier attempts to build an econometric model for the Nigerian economy include the models by Nicholas Carter (1963); Olayide (1968); Ojo (1973); UNCTAD Staff (1973); Uwujaren (1977) and Ghosh and Kozi (1978). What is perhaps unique about the econometric model being presented in this paper, is that it emerges from an on-going research programme aimed at building and maintaining operational models of the Nigerian economy of which an econometric approach is considered a major option. Virtually all of the earlier models listed above have been one-shot attempts with little or no consideration given to updating needs, for continuous application purposes. They were either merely estimated, and in some cases solved once, for some specific analytical purpose and abandoned thereafter.

The model being discussed in the present paper is the CEAR MAC IV model which differs in scope and set objectives from earlier models including earlier models developed at CEAR by the present authors<sup>1</sup>. Unlike earlier models of the Nigerian economy its data base and sources were selected on the basis of accessibility and reliability for continuous updating purposes. The data base takes cognizance of the most recent National Income Accounting scheme just adopted by the Federal Office of Statistics Lagos<sup>2</sup>. The model is designed to allow

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<sup>1</sup> This is the fourth model in CEAR series. Earlier versions, MAC I, MAC II have been discarded for their lack of adequate scope for operationalisation.

<sup>2</sup> See: Nigerian Gross Domestic Product and Allied Macro Aggregates 1973/74 - 1981. Vol. 1. No. 1. 1982, Federal Office of Statistics Lagos, Nigeria.

for testing and refining on a continuous basis for the purposes of making regular short term forecasts, policy analysis and projections.

## II. SOME MAJOR MODEL FEATURES.

The Nigerian economy is at the moment dominated by its oil sector. However the model structure tries to anticipate a declining oil sector in its level of disaggregation. The economy is viewed for modeling purpose as consisting of two major sectors, the supply or production sector, and the external or foreign trade sector. A consideration of other sectors in addition to these two key sectors, leads to a subdivision of the economy into eight major analytical blocks or sectors as shown in the block diagram in fig.1. These sectors are Supply, Consumption, Capital formation, Population and Employment, Wages and Prices, Financial, Taxes and Transfers (Government) and the External sector. In the model specification, the Supply sector is further disaggregated into twelve subsectors giving a total of nineteen sectors. There are a total of 137 equations of which 76 are stochastic. Most of these are either in simple linear or linear in log forms. Usual considerations were given to theory, and perhaps overridingly to data requirements which imposed major constraints on the degree of sophistication that could be pursued along the lines dictated by theory. The model is dynamic in structure given the extensive use of one period lags and some first difference specifications. Again the specifications were limited to one

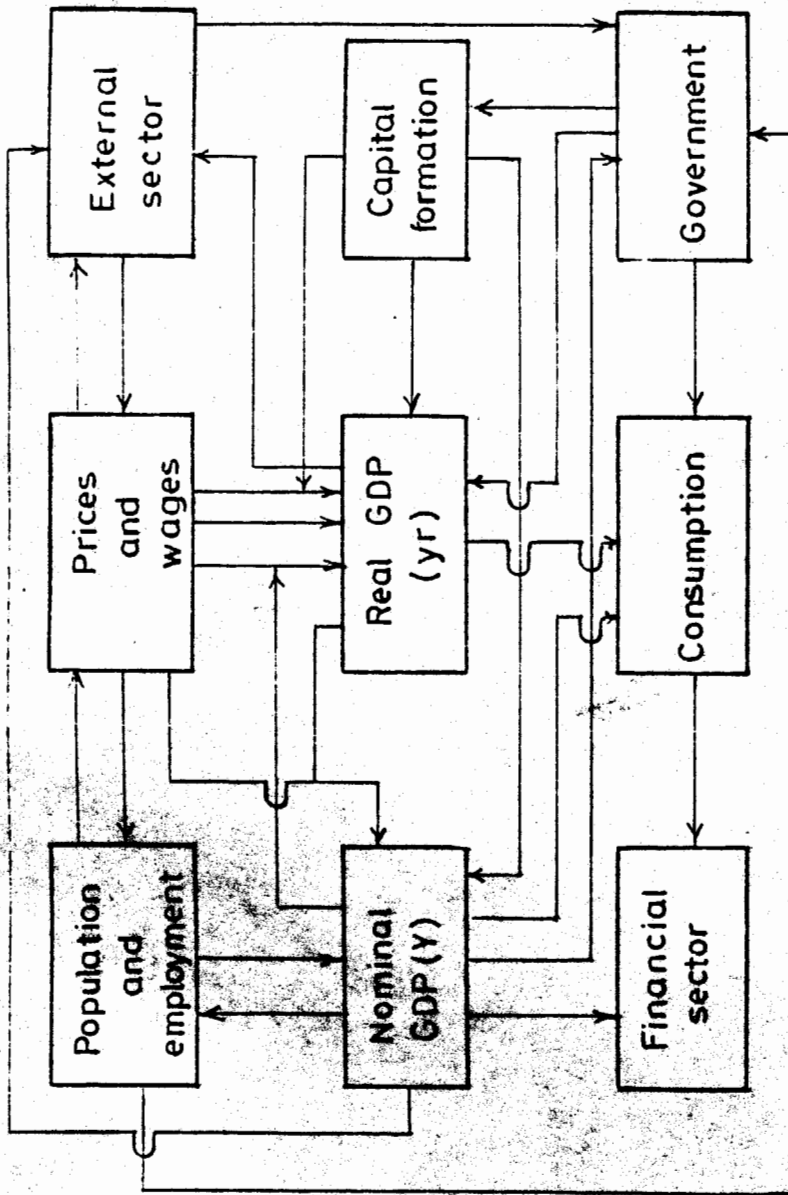


Fig.1: Sectoral block diagram of the gear-mac IV model

period lags due to data constraint even where a more complex distributed lag structure would have been more appropriate.

### III.

#### THE MODEL STRUCTURE

Supply sector: This sector is subdivided into twelve sub sectors which are, Agriculture, Fishing, Livestock, Mining, Manufacturing, Utilities, Building and Construction, Distribution, Transport, Communications, Government and other Services sector. The limitations imposed by data requirements ruled out standard neo-classical or Leontief type production function specifications in explaining the level of output. Rather an indirect approach was adopted in which we assumed that physical output is generally a function of own price, other prices and relevant activity variables. For valuation and aggregation purposes, real value added is made a function of physical output and other input variables such as capital, labour or appropriate proxies where the data for these are available. These assumptions lead to the two following general specifications:

$$Q_t = f(X_{it}) \quad (2.1.)$$

$$VAR_t = f(Q_t, Y_{it}) \quad (2.2.)$$

where  $Q$  and  $VAR$  are physical output and real value added respectively and the  $X$ 's are unit prices, relative prices and relevant activity variables, and the  $Y$ 's are input variables such as investment and labour inputs in sectors where data for these factor inputs are available.

Output in most of the sectors is heterogenous. To circumvent the resulting aggregation problem resort is made to using quantity index numbers. From (2.2.) current, value added is obtained for each sector by using the nonstochastic relation

$$VA_t = PV_t * VAR_t \quad (2.3.)$$

where  $PV_t$  is the relevant GDP deflator for the sector, that is,  $VA_t / VAR_t$ . Elsewhere in the model  $PV_t$  is endogenised and hence nominal valued added  $VA_t$  is fully determined from within the model.

The aggregation problems encountered in deriving the outputs varied from one sector to another. The explicit specifications with apriori parametric restrictions, are presented below starting with the agricultural sector.

#### 2.2.1 Agricultural Sector:

This is the most heterogenous sector in terms of output. As a result it is disaggregated into three sub-sectors as follows: These are the production of food crops, non-food crops, and cocoa. Cocoa production is singled out because it is currently the most important export crop even though its production is declining. We also disaggregate the food component into cereals and tuber outputs in conformity with the geographical distribution of food production.

Output of the agricultural sector is therefore assumed to consist of output of tubers (QTU) output of Cereals (QCR) output of nonfood, (QNF) and output of cocoa (QCO). Output

of each subsector is derived as a unit weighted average of quantity relatives as follows:

$$IQ_{jt} = \sum_1^n (Q_{jit}/Q_{jio})$$

where  $j$  = tubers, cereals, non-food and cocoa, and  $i$  = 1, 2, ... n items in each sector 'j' and year '0' is 1960 chosen as the base year.

Hence,

$$IQTU_t = \sum_1^2 (QTY_{it}/QTY_{io})$$

$i$  = yams, cassava.

$$IQCR_t = \sum_1^4 (QCR_{it}/QCR_{io})$$

$i$  = millets, guineacorn, maize, and rice

$$IQNF_t = \sum_1^5 (QNF_{it}/QNF_{io})$$

$i$  = groundnuts, palm oil, palm kernel cotton and beniseed.

$$IQCO_t = (QCO_t/QCO_0)$$

where  $QTY_{it}$ ,  $QCR_{it}$ ,  $QNF_{it}$  are the physical outputs of the  $i^{th}$  item produced at period  $t$ . Marketing Board purchases in tons have been used in the case of Cocoa.

Although a price weighted quantity index should be preferred in indexing tubers, cereals and non-food, we do not have reliable price information. The equations in the Agricultural sector were originally specified as:

$$IQCR_t = \alpha_0 + \alpha_1 \frac{(CPIF)}{(CPI)}_t \quad (2.4)$$

$$IQCU_t = \alpha_0 + \alpha_1 \frac{(CPIF)}{(CPI)}_t + \alpha_2 t \quad (2.5)$$

$$IQNF_t = \alpha_0 + \alpha_1 \frac{(PAG)}{(P)}_{t-1} + (1-\lambda) IQNF_{t-1} \quad (2.6)$$

$$IQCO_t = \alpha_0 + \alpha_1 \frac{(IXPC)}{(IXP)}_t + (1-\lambda) IQCO_{t-1} \quad (2.7)$$

$$IQAAGR = \alpha_0 + \alpha_1 IQCR_t + \alpha_2 IQTU_t + \alpha_3 IQNF_t + \alpha_4 IQCO_t \quad (2.8)$$

where  $0 < \lambda < 1$ ,  $\alpha_1 > 0$  in (2.4) - (2.7), CPI is the overall consumer price index, CPIF is the food component of the consumer price index, PAG is the GDP deflator for agriculture, P, the overall GDP deflator, IXPC is the index of export price cocoa IXP is overall export price index and IQAAGR is the index of real value added in agriculture. The dynamic simulation performance of these specifications based on standard supply assumption of quantity supplied being a function of real price was rather poor and this may not be unconnected with the scanty and unreliable data on the price variables. In all cases auto regressive specification or merely fitting the endogenous variable on time trend performed better (Eqs. A.1. - A.4 in the Appendix). In these and in similar other instances in the rest of the model, these simpler specifications were utilised, as stop gap measures pending the availability of more reliable price data, and data on relevant activity variables.



### 2.2.2. Fishing

The specifications of the equations in this subsector were as follows:

$$IQFS_t = \alpha_0 + \alpha_1 \frac{(PF_t)}{(PL_t)} + (1-\lambda) IQFS_{t-1} \quad (2.9)$$

$$IVAFSR_t = \alpha_0 + \alpha_1 IQFS_t \quad (2.10)$$

$$VARSR_t = VAFSR_{t_0} * IVAFR, \text{ and} \quad (2.11)$$

$$VAFS_t = PFS_t * VAFSR_t \quad (2.12)$$

where  $0 < \lambda < 1$ .  $PF_t / PL_t$  is the relative unit price of fish to that of meat and  $IVAFSR_t$  is the index of real value added in Fishing. In (2.10) we expected that  $\alpha_1 > 0$ .

In (2.12) the sign of  $\alpha_1$  would depend on whether fish and meat are substitutes in which case a rise in the relative price would make  $\alpha_1 < 0$  or if complements we would expect  $\alpha_1 > 0$  when the relative price rises. Our estimate of  $\alpha_1$  conformed with the second option as shown by the following estimate of (2.9):

$$\hat{IQFS}_t = -0.1592 + 0.2811 \frac{(PF_t)}{(PL_t)} + 0.5535 IQFS_{t-1} \quad (2.9a)$$

$$(-1.4895) \quad 4.0226) \quad (4.4707)$$

$$R^2 = 0.74 \quad DW = 1.34.$$

where  $t$  ratios are in parentheses.

### 2.2.3. Livestock

Like the agricultural sector the output of the livestock sector is heterogenous. As a result a weighted index of output,  $IQLIV_t$  was constructed and the equations for this sector were specified as follows:

$$IQLIV_t = \alpha_0 + \alpha_1 \frac{(PF_t)}{(PB_t)} + \alpha_2 I STLIV_{t-1} \quad (2.13)$$

$$IVALSTR_t = \alpha_0 + \alpha_1 IQLIV_t \quad (2.14)$$

$$VALSTR_t = VALSTR_{t_0} * IVALSTR_t \quad (2.15)$$

$$VALST = PL_t * VALSTR_t \quad (2.16)$$

where •

$$IQLIV_t = 0.5 \frac{(C_t)}{(C_{t_0})} + 0.25 \frac{(S_t)}{(S_{t_0})} + 0.15 \frac{(G_t)}{(G_{t_0})} + 0.10 \frac{(P_t)}{(P_{t_0})}$$

which is a weighted index of output of Cattle ( $C_t$ ), Sheep ( $S_t$ ), Goats ( $G_t$ ) and Pigs ( $P_t$ ) the weights being average numbers of cattle, sheep, goats and pigs slaughtered in the sample period 1964 - 1979 expressed as percentages.  $PI$  is the implicit GDP deflator for Livestock,  $I STLIV$  is the index of the stock of livestock while  $IVALSTR$  is an index of real value added in livestock and other variables are as previously defined. One would expect  $\alpha_1$  and  $\alpha_2$  in (2.13) to be positive.

#### 2.2.4. Mining

This is disaggregated into two subsectors petroleum and other mining. Output of Tin was used as a proxy for the output of other minings. The specifications used in the petroleum sector were as follows:

$$IQPET_t = \alpha_0 + \alpha_1 \frac{(UPP)}{(PPET)}_t + \alpha_2 DUM_t \quad (2.17)$$

$$IVAPR_t = \alpha_0 + \alpha_1 IQPET_t \quad (2.18)$$

$$VAPR_t = VAPR_{t_0} * IVAPR_t$$

$$VAP_t = PPET_t * VAPR_t$$

where  $\alpha_1 > 0$ ,  $\alpha_2 < 0$ ,

IQPET is index of output of crude petroleum in barrels, UPP is unit price of petroleum, PPET is implicit GDP deflator petroleum DUM is dummy variable which is 1 for each of the civil war years 1966 - 1970 and 0 for other years. IVAPR is index of value added by petroleum and PPET is the GDP deflator in the petroleum sub-sector.

In the estimated version of equation 2.17 reported below, correct signs were obtained for  $\alpha_1$  and  $\alpha_2$ , when nominal price was substituted for the real price variable. The low DW statistic of 0.37 was indicative of missing supply variables for which we could not find any suitable proxy.

$$\Delta IQPET_t = 35.1543 + 11.2199 UPP_t - 21.0362 DUM_t \quad (2.17a)$$

(1.9852)      (1.1959)      (-0.9065)

$$\bar{R}^2 = 0.43 \quad DW = 0.37$$

The specifications for the other mining sub-sector are:

$$IQTIN_t = \alpha_0 + \alpha_1 IWP_t \quad (2.19)$$

$$IVAOMR_t = \alpha_0 + \alpha_1 IQTIN_t \quad (2.20)$$

$$VAOMR_t = VAOMR_{t_0} * IVAOMR_t$$

$$VAOM = POM * VAOMR_t$$

where  $\alpha_1 > 0$ , IQTIN is the index of output of Tin, IVAOMR is the index of real value added in Tin, IWP is the index of world price of tin.

### 2.2.5 Manufacturing

It was possible to specify standard production functions in respect of the manufacturing sector because of the availability of data on factor inputs. To this end, value added in manufacturing industries was disaggregated into three components as follows:

Value added in food manufacturing industries (VAMF), Consumer goods industries (VAMC), and other manufacturing industries (VAMO).

A form of the Cobb-Douglas Production function assuming disembodied technical progress was specified for each of these three subsectors as follows:

$$\ln VAMF_t = \alpha_0 + \alpha_1 \ln \sum_{\tau=0}^{t-1} NKEF_{\tau} + \alpha_2 \ln EMDF_t + \alpha_3 t \quad (2.21)$$

$$\ln VAMC_t = \alpha_0 + \alpha_1 \ln \sum_{\tau=0}^{t-1} NKEC_{\tau} + \alpha_2 \ln EMDC_t + \alpha_3 t \quad (2.22)$$

$$\ln VAMO_t = \alpha_0 + \alpha_1 \ln \sum_{\tau=0}^{t-1} NKEO_{\tau} + \alpha_2 \ln EMDO_t + \alpha_3 t \quad (2.23)$$

In estimation the use of the cumulative capital stock variables  $\sum_{\tau=0}^{t-1} NKEF_{\tau}$ ,  $\sum_{\tau=0}^{t-1} NKEC_{\tau}$  and  $\sum_{\tau=0}^{t-1} NKEO_{\tau}$  gave wrong signs, thus

capital expenditure variables NKEF, NKEC and NKEO which gave the right signs were used instead as proxies, where NKEF, NKEC, and NKEO are as defined in the appendix. In each subsector,  $\alpha_1 + \alpha_2$  measures returns to scale also  $0 < \alpha_1$ ,  $\alpha_2 < 1$ . Total real value added in manufacturing was obtained from (2.21) to (2.23) as:

$$VAMR_t = \alpha_0 + \alpha_1 VAMF_t + \alpha_2 VAMC_t + \alpha_3 VAMO_t \text{ where}$$

$VAMF_t = \exp. [\ln VAMF_t]$ , with similar expressions being derived for  $VAMC_t$  and  $VAMO_t$ .

## 2.0 Other Supply Sector Specifications.

In this category, sector outputs are not as quantifiable as in the categories discussed above. Consequently only the real value added equations were specified for each of these six sectors. There was no need to use indices of real value added and hence there are only two equations, one stochastic the other non-stochastic for each of these sectors. In the stochastic equations autoregressive specification was employed because we assumed that the level of real value added in the previous period in most of these essentially service sectors was adequate in explaining current period value added. Also wherever the relevant data was available, real investment, as represented by the relevant capital formation variable was employed, as a second major explanatory variable in each case. The resulting specifications were as follows for each of the six sectors.

### 2.3.1 Utilities

$$VAUR_t = \alpha_0 + \alpha_1 IEG_t + (1-\lambda) VAUR_{t-1} \quad (2.3.1)$$

$$VAU_t = PU_t \cdot VAUR_t \quad (2.3.2)$$

### 2.3.2. Building and construction

$$VABCR_t = \alpha_0 + \alpha_1 (SKBC/PBC) \quad (2.3.3.)$$

$$VABC_t = PBC_t \cdot VABCR \quad (2.3.4)$$

### 2.3.3. Distribution

$$VADR_t = \alpha_0 + \alpha_1 VAMR_t \quad (2.3.5)$$

$$VAD_t = PD_t \cdot VADR_t \quad (2.3.6)$$

2.3.4. Transport and Communications

$$VATCR_t = \alpha_0 + \alpha_1 RKTR_t + (1-\lambda) VATCR_{t-1} \quad (2.3.7)$$

2.3.5. Government Services

$$VAGSR_t = \alpha_0 + \alpha_1 TGKER_t + (1-\lambda) VAGSR_{t-1} \quad (2.3.8)$$

$$VAGS = PGS_t VAGSR_t \quad (2.3.10)$$

2.3.6. Other Services

$$VAOSR_t = \alpha_0 + \alpha_1 IGCR_t \quad (2.3.11)$$

$$VAOS_t = POS_t \cdot VAOSR_t \quad (2.3.12)$$

where  $0 < \lambda < 1$ ,  $\alpha_1 > 0$ ,  $\alpha_2 > 0$ . The second equation in each sector states that nominal value added in each sector is as before a product of the corresponding GDP deflator and real value added in that sector. The sector described as utilities consists mainly of water and electricity supplies. In the absence of any reliable data on the capital input into this sector we decided to use the index of electricity generated ( $IEG_t$ ) as a plausible activity variable. The estimates of (2.3.1) were unreliable and when an auto-regressive specification was tried the adjustment coefficient was not well behaved since  $(1-\lambda) > 1$  i.e.  $\lambda < 0$ . Thus (2.3.1) was re-estimated with first differences as follows:

$$VAUR_t - VAUR_{t-1} = \alpha_0 + \alpha_1 t \quad (2.3.1 a)$$

giving

$$\widehat{VAUR}_t - \widehat{VAUR}_{t-1} = 1.9386 + 0.0069 t$$

(1.0948) (0.0477)

$$\bar{R}^2 = 0.06 \quad DW \quad 1.93$$

Real value added in Utilities was then obtained as

$$\widehat{VAUR}_t = \widehat{VAUR}_{t-1} + 1.9386 + 0.0069 t$$

with a correlation coefficient of 0.97 between  $VAUR_t$  and  $\hat{VAUR}_t$ . The potentially explosive nature of this trend equation, which arises from the fact that (2.3.1a) integrates into a growing quadratic function in  $t$ , which may result in an **undesirable** dynamic feature in the long run. A more stable form will need to be substituted when improved data allows for a better specification.

In the distribution sector, real value added in manufacturing was the only explanatory variable used in (2.3.5) when the inclusion of capital formation in transport and communication (KTCR) yielded unreliable estimates. The failure of KTCR may be due to data problems because we were not able to isolate capital formation in transport from capital formation in communications. We have used value added in manufacturing because a substantial percentage of the wares handled by this sector are locally manufactured goods. Also increased manufacturing activity would imply a rise in the urban population with the consequent rise in the demand for the services of the distribution sector.

In equation (2.3.11) the exogenous variable, real value added in other services (VAOSR) was obtained as a residual component of the GDP. Easily identifiable activities in this sector are banking, insurance, hotel and catering services, and private professional practices. Most of these services are provided by the private sector. It is assumed that government consumption expenditure will serve as a reasonable explanatory variable, because the bulk of such current expenditure goes to

items such as personal emoluments, allowances and professional fees.

Total GDP which is later considered for simulation purposes, as an aggregation of the value added in the foregoing 12 sectors is given by

$$Y = VAAG + VAFS + VALST + VAP + VAOM + VAM + VAM + VAU \\ + VABC + VAD + VATC + VAGS + VAOS.$$

### 3. Other Sectors

In addition to the supply sectors discussed above, seven additional sectors considered were Consumption.; Investment; Population and Employment; Prices and Wages; Financial; Government; and the External Sector.

#### 3.1. Consumption Sector

Total consumption is disaggregated into two components, that is, Private Consumption Expenditure (PCE) and Government Consumption (GC). I

In this model, we assumed along conventional lines that current private consumption plans are based on current disposable income and previous period level of consumption expenditure. Such a previous level may refer to consumption spending in the immediately preceding period, or peak consumption spending among a set of previous period's consumption expenditure.

The resulting specifications were as follows,

$$PCE_t = \alpha_0 + \alpha_1 YDN_t + \alpha_2 PCE_{t-1} \quad (3.1)$$

where  $0 < \alpha_2 < 1$ , PCE, and YDN are private consumption expenditure, and disposable incomes respectively. It can be shown that, in the absence of serial correlation, multicollinearity



and limitations of sample size more lags can be introduced into (3.1) to give

$$PCE_t = \alpha_0 + \alpha_1 YDN_t + \alpha_2 YDN_{t-1} + \alpha_3 YDN_{t-2} + \dots \quad (3.2)$$

If it is assumed that the parameters (3.2) decline according to a geometric series this expression can be rewritten as:

$$PCE_t = \alpha_0 + \alpha_1 YDN_t + \alpha_1 \lambda YDN_{t-1} + \alpha_1 \lambda^2 YDN_{t-2} + \dots \quad (3.3)$$

where  $0 < \lambda < 1$ .

Using Koyck (1954) it can be readily shown by writing out  $\lambda PCE_{t-1}$  in full employing (3.3) that

$$PCE_t = \lambda PCE_{t-1} = \alpha_0 (1-\lambda) + \alpha_1 YDN_t$$

and hence that

$$PCE_t = \alpha_0 (1-\lambda) + \alpha_1 YDN_t + \lambda PCE_{t-1} \quad (3.4)$$

which is equivalent to (3.1), and shows that given some restrictions, current private consumption expenditure can be estimated as a function of current disposable income, and the private consumption expenditure of the immediately preceding period.

Since our model is to be used for forecasting purposes, we are interested in both the short and longer term effects of a change in the level of disposable income on private consumption expenditure. The short-term effect is measured by the marginal propensity to consume (MPC) defined as:

$$\frac{\partial PCE_t}{\partial YDN_t} = \alpha_1 \quad (3.5)$$

In the longrun, consumption is stable hence

$$PCE_t = PCE_{t-1} = PCE_{t-2} = \dots \quad \text{and} \quad (3.4)$$

can be restated as:

$$PCE_t = \alpha_0 + \alpha_1 YDN_t + \alpha_2 PCE_t$$

or

$$PCE_t = \frac{\alpha_0}{1-\alpha_2} + \frac{\alpha_1}{1-\alpha_2} YDN_t \quad (3.6)$$

and hence the long run MPC is defined from (3.6) as

$$\frac{\partial PCE_t}{\partial YDN_t} = \frac{\alpha_1}{1-\alpha_2} \quad (3.7)$$

In addition to (3.1) government consumption function is specified as:

$$GC_t = \alpha_0 + \alpha_1 Y_t + \alpha_2 TGR_t \quad (3.8)$$

where  $0 < \alpha_1, \alpha_2 < 1$ ,  $Y$  and  $TGR$  are total GDP and total government revenue respectively. Contrary to a priori expectation the exclusion of  $TGR$  from (3.8) yielded a more reliable estimate of  $GC$  and consequently, the two equations estimated for this sector were

$$\hat{PCE}_t = -2196.23 + 0.6345 YDN_t + 0.3924 PCE_{t-1} \quad (3.1a)$$

(-4.4666) (5.9161) (3.6168)

$$\bar{R}^2 = 0.97 \quad DW = 2.68$$

$$\hat{GC}_t = -183.205 + 0.1207 Y_t \quad (3.8a)$$

(-1.8702) (15.9068)

$$\bar{R}^2 = 0.93 \quad DW = 1.49$$

From (3.1a) the shortrun MPC is 0.6345 while in the long run and according to (3.7) it is obtained as:

$$\frac{\hat{\alpha}_1}{\hat{1-\alpha_2}} = 1.04$$

### 3.2. Investment.

This is considered in three categories namely; Gross fixed capital formation (GFCF); Government capital Expenditure (TGKE) Foreign investment. Gross fixed capital formation is disaggregated into four components. These are gross fixed capital formation in Building and construction (KBC), Transport (KTR), Agriculture, (KAG), and in Machinery and Equipment (KMEQ). Corresponding to each of these four sub-sectors the capital expenditure of government is also disaggregated into government capital expenditure in, Building and Construction (GKBC), Transport (GKET), Agriculture (GKEA), and Machinery and Equipment (GKOT). Labelling the four components of each of the two categories of investment as  $K_i$  and  $GK_i$  respectively, we therefore have  $i$  = building and construction, Transport, Agriculture and Machinery and Equipment. The following two equations were specified for each of the four sectors:

$$K_{it} = \alpha_0 + \alpha_1 GK_{it} \quad (3.9)$$

$$GK_{it} = \alpha_0 + \alpha_1 TGR_t + (1-\lambda) GK_{it-1} \quad (3.10)$$

where  $0 < \lambda < 1$ ,  $0 < \alpha_1 < 1$ , and  $TGR$  is total government revenue. In the first specification it is assumed that capital formation in subsector (i) depends on government's capital expenditure in that sector. The second specification states that government's capital expenditure in a sector depends on total government revenue and the previous period's government capital expenditure in that sector.

Two equations were estimated in respect of the foreign investment component. These are,

$$NFIY_t = \alpha_0 + (1-\lambda) NFIY_{t-1} \quad (3.11)$$

$$\text{and } NFIV_t = \alpha_0 + \alpha_1 STGKE_t + (1-\lambda) NFIV_{t-1} \quad (3.12)$$

where  $0 < \lambda < 1$ ,  $0 < \alpha_1 < 1$ ,  $NFIY$  is net foreign investment income,  $NFIV_t$  is net foreign investment, and  $STGKE$  is the stock of total government capital expenditure, hence

$$TGKE_t = \sum_{i=1}^T GK_{it} \quad \text{and}$$

$$STGKE_t = \sum_{t=1}^T TGKE_t \quad \text{where } T \geq t$$

As will be shown below in the government sector, total government revenue depends predominantly on revenue from the petroleum sector, gross fixed capital formation therefore depends (although indirectly) on oil revenue.

The following two identities aggregate the endogenous variables explained in this sector:

$$GCFC_t = KBC_t + KTR_t + KAG_t + KMEQ_t \quad (3.13)$$

and,

$$TGKE_t = GKBC_t + GKET_t + GKEA_t + GKOT_t \quad (3.14)$$

### 3.3 Population and Employment:

Total population (POP) is disaggregated into Urban (UPOP) and Rural (RPOP) populations. Data on employment is available only for manufacturing establishments. Employment demand in manufacturing (EDM) is disaggregated into three components EMDF, EMDC, and EMDO for food, consumer goods and other manufacturing industries respectively as previously explained. The following five equations were specified in respect of this sector

$$LPOP_t = \alpha_0 + \alpha_1 t \quad (3.15)$$

$$UPOP_t = \alpha_0 + \alpha_1 VAM_t + \alpha_2 VAOS_t \quad (3.16)$$

$$\ln EMDF_t = \alpha_0 + \alpha_1 \ln RWM + \alpha_2 \ln VAMF_t \quad (3.17a)$$

$$\ln EMDC_t = \alpha_0 + \alpha_1 \ln RWM + \alpha_2 \ln VAMC_t \quad (3.17b)$$

$$\ln EMDO_t = \alpha_0 + \alpha_1 \ln RWM + \alpha_2 \ln VAMO_t \quad (3.17c)$$

where,  $RWM$  is real average wage in manufacturing defined as

$$RWM = WM / EDM.P \quad (3.18)$$

$WM$  is wage bill in manufacturing,  $P$  is the overall GDP deflator and total employment in manufacturing is defined as:

$$EDM = EMDF + EMDC + EMDO \quad (3.19)$$

In equation (3.16), value added in manufacturing ( $VAM$ ) and value added in other services ( $VAOS$ ) are variables relating to urban centred activities and are therefore expected to explain the population drift to the cities. Surprisingly these variables both separately and jointly failed to yield reliable estimates of  $\alpha_1$  and  $\alpha_2$  and consequently  $UPOP$  was estimated simply as a function of total population. As would be expected  $\hat{\alpha}_1$  is negative in (3.17) - while  $\hat{\alpha}_2$  is positive. Rural Population ( $RPOP$ ) is obtained as a residual as follows:

$$RPOP_t = POP_t - UPOP_t \quad (3.20)$$

### 3.4. Prices and Wages

An attempt is made to explain the implicit GDP deflator obtained for each of the 12 Supply sectors. Including the overall GDP deflator, 12 price equations are specified using in each case a relevant price variable and in most cases a lagged endogenous variable. The following are the 13 price equations.

$$PAG_t = \alpha_0 + \alpha_1 P_t + (1-\lambda) PAG_{t-1} \quad (3.21)$$

$$PMAN_t = \alpha_0 + \alpha_1 IMP_t + (1-\lambda) PMAN_{t-1} \quad (3.22)$$

$$PBC_t = \alpha_0 + \alpha_1 IUPMC_t + \alpha_2 IMP_t \quad (3.23)$$

$$PFS_t = \alpha_0 + \alpha_1 PB_t + \alpha_2 PF_t + (1-\lambda) PFS_{t-1} \quad (3.24)$$

$$PPET_t = \alpha_0 + \alpha_1 UPP_t \quad (3.25)$$

$$PU_t = \alpha_0 + (1-\lambda) PU_{t-1} \quad (3.26)$$

$$PL_t = \alpha_0 + \alpha_2 PFS_t \quad (3.27)$$

$$PD_t = \alpha_0 + \alpha_1 PTC_t \quad (3.28)$$

$$POS_t = \alpha_0 + \alpha_1 PU_t \quad (3.29)$$

$$PTC_t = \alpha_0 + \alpha_1 POP_t \quad (3.30)$$

$$RGS_t = \alpha_0 + \alpha_1 POP_t + \alpha_2 t \quad (3.31)$$

$$POM_t = \alpha_0 + \alpha_1 IWPT_t \quad (3.32)$$

$$P_t = \alpha_0 + \alpha_1 CPI_t + \alpha_2 IMP_t \quad (3.33)$$

where  $0 < \lambda < 1$ ,  $\alpha_1 > 0$ ,  $\alpha_2 > 0$ . The endogenous and explanatory variables are as listed in the appendix. The only wage equation specified in the model was in respect of the manufacturing sector where average wage in manufacturing is specified as:

$$AWM_t = \alpha_0 + \alpha_2 PMAN_t + (1-\lambda) AWM_{t-1} \quad (3.34)$$

where  $0 < \lambda < 1$  and  $\alpha_2 > 0$ .

The simulation performance of  $AWM_t$  due to tenous data led us to the exogenising this variable temporarily, as was also the case with the consumer price index (CPI).

All the other equations in this sector had good fit, and all the parameters had the expected signs and were highly significant in most cases.

### 3.5. Financial Sector

Total demand for money is disaggregated into demand deposit (DD) and currency held by non-bankings public (CHP). In our earlier models, the interest rates for lending and saving were treated as exogenous since they could not be significantly explained, however, the economy is becoming increasingly monetised such that these rates can no longer be validly exogenized. We have therefore used the following three specifications in explaining the savings rate  $rS$ , the lending rate  $rL$  and the rate of return on manufacturing investment  $RM$

$$rS_t = \alpha_0 + \alpha_1 rFSB_t \quad (3.35)$$

$$rL_t = \alpha_0 + \alpha_1 rS_t \quad (3.36)$$

$$RM_t = \alpha_0 + \alpha_1 VAM_t \quad (3.37)$$

where in each case  $\alpha_1 > 0$  and  $rFSB$  is Federal Savings Bank Rate of interest. The Demand for money equation was specified as follows:

$$DD_t = \alpha_0 + \alpha_1 rL_t + \alpha_2 Y_t + (1-\lambda) DD_{t-1} \quad (3.38)$$

where  $0 < \lambda < 1$ ,  $\alpha_1 < 0$ ,  $\alpha_2 > 0$

We are yet to be able to specify an acceptable supply of money equation which we believe is endogenously determined in most developing economies. In the interim we make a highly simplifying assumption of equating Money Supply (MS) with money demand MD. This is the rationale behind the specification in (3.39) which is more appropriately an approximation of supply rather than the demand for cash equation if  $\alpha_1 < 0$ . However the estimation showed  $k_1 > 0$ . This equation is tentatively left as:

$$(CHP - CHP_{t-1}) = \alpha_0 + \alpha_1 PHGS_t \quad (3.39)$$

where  $\alpha_1 > 0$ . PHGS is public holding of government securities and is in turn explained by the following equation

$$PHGS_t = \alpha_0 + \alpha_1 GDEF_t + (1-\lambda) PHGS_{t-1} \quad (3.40)$$

where  $0 < \lambda < 1$ ,  $\alpha_1 > 0$ , GDEF is government deficit.

The poor simulation performance of this specification led to an alternative specification of the form

$$(PHGS - PHGS_{-1}) = \alpha_0 + \alpha_1 T \quad (3.40a)$$

Both the demand deposits (DD) as estimated in (3.38) and currency held by non banking public (CHP) as estimated by (3.3a) sum up to total money demand defined as

$$MD_t = DD_t + CHP_t \quad (3.41)$$

As already explained it is further assumed that

$$MS_t = MD_t \quad (3.41)$$

where MS is total money supply.

### 3.6 Government Sector

Here emphasis is on the sources of government revenue. Other aspects of government activities such as current and capital expenditures, and government services have been dealt with under their appropriate sectors. Total government revenue (TGR) is disaggregated in four components. These are Import Tax Revenue (ITS); Export Tax Revenue (XTR); Direct Government Revenue (DGR) and; Other Tax Revenue (OTXR). These four components are explained in the following equations:



$$MTR_t = \alpha_0 + \alpha_1 MV_t + (1-\lambda) MTR_{t-1} \quad (3.43)$$

$$XTR_t = \alpha_0 + \alpha_1 TXP_t + (1-\lambda) XTR_{t-1} \quad (3.44)$$

$$DGR_t = \alpha_0 + \alpha_1 VAP_t + (1-\lambda) DGR_{t-1} \quad (3.45)$$

$$OTXR_t = \alpha_0 + \alpha_1 Y_t \quad (3.4f)$$

where  $0 < \lambda < 1$ , and  $\alpha_1 > 0$  in all the four specifications.  $MV_t$  is total value of imports,  $TXP_t$  is total exports which is dominated by petroleum,  $VAP_t$  is value added in petroleum sector.

Equations (3.44) and (3.45) emphasize the complete dependence of government revenue on earnings from petroleum. Finally in this sector government transfer payment (GTRP) is explained by:

$$GTRP_t = \alpha_0 + \alpha_1 UPOP_t + \alpha_2 GDEF_t \quad (3.47)$$

The importance of output of petroleum as a determinant of direct government revenue is brought out in equation (3.45)

whose estimate is given by:

$$\hat{DGR}_t = -29.8495 + 0.5039 VAP_t + 0.2624 DGR_{t-1} \quad (3.45a)$$

(-0.8775) (22.0244) (7.1036)

$$R^2 = 0.99 \quad DW = 2.11$$

Total government revenue,  $TGR_t$  is explained in the identity:

$$TGR_t = MTR_t + XTR_t + DGR_t + OTXR_t \quad (3.48)$$

### 3.7. External Sector

This sector consists of the import and export sub-sectors. Imports are disaggregated according to U.N. one-digit SITC commodity classifications. The following four categories of imports are considered:

Import of Food Beverages and Tobacco (MFBT); Import of Crude Materials (MCM); Import of Manufactured Goods (MMG) and

Import of Machinery and Transport Equipment (MMTE). these four categories of imports defined in value terms are explained as follows:

$$MFBT_t = \alpha_0 + \alpha_1 IMP_t + \alpha_2 VAAG_t \quad (3.49)$$

$$MCM_t = \alpha_0 + \alpha_1 (IMP_t / P_t) + (1-\lambda) MCM_{t-1} \quad (3.50)$$

$$MMG_t = \alpha_0 + \alpha_1 SFR_t + (1-\lambda) MMG_{t-1} \quad (3.51)$$

$$MMTE_t = \alpha_0 + \alpha_1 (IMP_t / P_t) + (1-\lambda) MMTE_{t-1} \quad (3.52)$$

where  $0 < \lambda < 1$ ,  $IMP_t / P_t$  is real import price index manufactures, SFR, is the stock of foreign reserve which is in turn explained by:

$$SFR_t = \alpha_0 + \alpha_1 CAB_t + (1-\lambda) SFR_{t-1} \quad (3.53)$$

where  $0 < \lambda < 1$  and CAB, is current Account Balance. In Nigeria import of manufactured goods has always depended on the level of foreign reserve as shown in equation (3.51). The current restrictions on import of manufactured goods are direct results of the low level of foreign reserves.

Nigeria's major export commodity is petroleum. The prominence of this commodity has shown up in several sectors of this model such as in the consumption, investment and government sectors. In addition to crude, petroleum, Nigeria also exports cocoa, oils and oil seeds, columbite, tin and other minor commodities such as timber and animal products. Here for modeling purposes we have singled out the following major export commodities for emphasis:

export of crude petroleum (XP), export of cocoa beans (XCB),

export of tin (XTIN), considering all others under other exports (XO).

These four variables are explained as follows:

$$XP_t = \alpha_0 + \alpha_1 QPET_t + \alpha_2 UPP_t \quad (3.54)$$

$$XCB_t = \alpha_0 + \alpha_1 QCOV_t + (1-\lambda) XCB_{t-1} + \alpha_3 IXPC_t \quad (3.55)$$

$$XTIN_t = \alpha_0 + \alpha_1 IQTIN_t + \alpha_2 IWPT_t \quad (3.56)$$

$$XO_t = \alpha_0 + (1-\lambda) XO_{t-1} \quad (3.57)$$

where  $0 < \lambda < 1$ , and IXPC is index of export price cocoa. Other variables are as previously defined. This sector is, as should be expected highly linked with the supply sector where QPET, QCOV and IQTIN are endogenous variables. The remaining items in the external sector is not import of services MNS which for want of an explanatory variable is simply put on time trend. An additional endogenous variable is imports value (MV) which is an aggregate of four important categories of import each of which has been explained. This is defined as

$$MV_t = MFB_t + MC_t + MMG_t + MMTE_t \quad (3.58)$$

Also the identity for total exports is given by

$$TXP_t = XP_t + XCB_t + XTIN_t + XO_t \quad (3.59)$$

#### IV MODEL'S DYNAMIC SIMULATION PERFORMANCE

The 76 stochastic equations in CEAR MAC IV model were estimated using OLS method over a sixteen year period 1964 - 1979. In order to evaluate the dynamic performance of the model, a dynamic historical simulation was carried out over the estimation period. The results from the ex-post dynamic simulation are presented and discussed in this concluding section. In our evaluation we seek to ascertain, (i) how well the simulated values for the endogenous variables track the historical data series, (ii) secondly we seek to evaluate the models predictive performance, and thirdly and finally to find out how well the model reproduces turning points in the time path of endogenous variables.

The relevant simulation Statistics for evaluation purposes are contained in table I in the Appendix. First we consider the Theil's Inequality which provides a measure of the ability of the model to forecast well, or how well the simulated values are able to track actual data series. The computed Theil's inequality coefficients for 103 of the endogenous variables in the model are listed under column I of table I in the appendix. For good predictive performance, it is desirable that this coefficient be as close to zero as much as possible. As shown in the table only seven or 7 per cent of these 103 endogenous variables have  $TI > 0.30$  and none of these are considered to be key variables in the model. Virtually in all the cases the TI are considerably low, indicating that the predictive performance of the model may be very good since

virtually all the key variables track the historical data very well. This is further illustrated in the graphs in the appendix showing the actual and simulated values for a few endogenous variables. The restriction of the graphs to just a few illustrative ones was due to space constraint. Similar graphs for all the other endogenous variables show that virtually all the simulated values of the endogenous variables track the actual series very well.

Column's 2-4 of table I (appendix) shows a decomposition of the inequality into Bias proportion, variance and covariance proportions respectively. The Bias proportion of the error which measures the extent to which the average simulated values deviate from actual series is shown in column 2 of table 1. Again it is desirable that this proportion be low and close to zero for good dynamic performance of the model. As the table shows only in 10 cases out of 103 variables is this coefficient higher than 0.3 and again this 10 percent does not include any of the key variables in the model.

Finally in column 3 of table I we have the variance proportion of the error which is indicative of the model's ability to replicate the degree of variability in the actual data series with respect to each endogenous variable. Also for good performance it is desirable that this index be as small as possible and close to zero. In this regard the performance of the model is not as good as may be desired for a forecasting model, as about 40 per cent of the endogenous variables have a coefficient higher than 0.30. The conclusion

may therefore be drawn that even though most of the endogenous variables track historical data fairly well, the model may be weak in capturing turning points or sharp variations in the values of the endogenous variables. Future work to further refine the model would have to focus on improving on this aspect of the dynamic performance of the model.

**APPENDIX**

APPENDIX  
 CEAR MAC IV MODEL  
 LIST OF VARIABLES

CODE	NAME	1980 FIGURE
BOP	Balance of Payments on Current account ₦ Mill	+ 392.10
CAB	Current Account Balance ₦ Mill	+ 2492.97
CHP	Currency Held by Non-banking Public ₦ Mill	3185.9
*CPI	Consumer Price Index All items	4.04
DD	Demand Deposits ₦ mill.	6040.9
DGR	Direct Government Revenue ₦ Mill	4602.07
DINV	Changes in Inventory ₦ mill	40370.38
DS	Demand for Savings ₦ mill	3003.60
*DWM 6670	Dummy Variable for the War Years 1966 - 70	0
EDM	Employment Demand Manufacturing '000 persons	280.91
EMDC	Employment Demand Manufacturing consumer goods '000 Persons	123.421
EMDF	Employment Demand Manufacturing Food '000 persons	52.771
EMDO	Employment Demand Manufacturing Others '000 persons	116.750
GC	Government Consumption ₦ mill	4034.35
GCPC	Total Gross fixed Capital formation ₦ mill	10975.97
GKEA	Capital Expenditure Agric. Government ₦ mill.	116.550
GKEC	Capital Expenditure Construction Government ₦ mill.	846.366
GKET	Capital Expenditure Transport Government ₦ mill.	1577.300
GNP	Gross National Product ₦ mill.	43126.37
GTRP	Government Transfer Payment Debt. Servicing ₦ mill.	835.6
IGCR	Real Government Consumption Index	1.4128
IKTR	Capital Formation in Transport Index	3.66
*IMP	Import Price Manufactures Index	1.297
IQAG	Output of Agric. Index	0.47
IQCO	Output of Cocoa Index	0.493



IQCR	Output of Cereals Index	0.517
IQFS	Output of Fish Index	0.442
IQLIV	Output of Livestock Volume Index	0.842
IQNF	Output of Non-food Crops Index	0.36
IQPET	Output of Petroleum (Barrels) Index	127.43
*IQTIN	Output of Tin Volume Index	0.42
IQTU	Output of Tubers Index	0.189
*IUPMC	Unit Import Price Cement Index	1.587
IVAAGR	Real Value Added Agric. Index	1.417
IVAFR	Real Value Added Fishing Index	1.293
IVALR	Real Value Added Livestock Index	3.221
IVAM	Value Added Manufacturing Index	15.238
IVAMC	Value Added Consumer Goods Manufacturing Index	28.72
IVAMF	Value Added Food Manufacturing Index	10.38
IVAMNR	Real Value Added Manufacturing Index	14.939
IVAMO	Value Added Other Manufacturing Index	9.54
IVAMR	Real Value Added Other Mining Index	20.486
IVAPR	Real Value Added Petroleum Index	168.719
*IWPT	World Price Tin (Index)	2.425
KAG	Capital Formation Agriculture ₦ mill	135.79
KBC	Capital Formation Building and Construction ₦ mill	7342.3
KMEQ	Capital Formation Machinery and Equipment ₦ mill.	2085.66
KOT	Other Capital Formation ₦ mill	2351.3
KTR	Capital Formation Transport ₦ mill	1412.18
NCM	Import of Crude Materials ₦ mill	135.200
MD	Money Demand ₦ mill	9226.80
MFBT	Import of Food Beverages and Tobacco ₦ mill	1158.300
MMG	Import of Manufactured Goods ₦ mill	2076.500

MMTE	Import of Machinery and Transport Equipment ₦ mill	4548.600
MNS	Net Import Services ₦ mill	1287.1
*MO	Other Imports ₦ mill	1181.75
MS	Money Supply ₦ mill	9226.80
MTS	Import Tax Revenue ₦ mill	998.85
MV	Total Goods Import Value ₦ mill	9658.100
NFIV	Net Foreign Investment (credit - Debit) ₦ mill	774.6
NFIY	Net Foreign Investment Income ₦ mill	142.6
NKEC	Net Capital Expenditure Consumer Goods Manufacturing ₦ mill	210.900
NKEF	Net Capital Expenditure Food Manufacturing Industries ₦ mill	137.461
NKEM	Net Capital Expenditure Manufacturing ₦ mill	544.185
NKEO	Net Capital Expenditure Other Manufacturing Industries ₦ mill	164.019
OTXR	Other Tax Revenue ₦ mill	53.30
P	Overall GDP Deflator	2.89
DAG	Implicit G.D.P. Deflator Agric.	3.16
*PB	Price of Beef ₦/kg	0.44
PBC	Implicit G.D.P. Deflator Building and Construction	2.055
PCE	Private Consumption Expenditure ₦ mill	8218.0
PD	Implicit G.D.P. Deflator Distribution.	2.97
*PF	Price of Fish ₦/kg	9.287
PFS	Implicit G.D.P. Deflator Fishing	3.52
PGS	Implicit G.D.P. Deflator Government Services	1.66
PHGS	Public Holding of Government Securities ₦ mill	17246.8
*PIDV	Private Direct Overseas Investment ₦ mill.	155.9
PL	Implicit G.D.P. Deflator Livestock	3.45
PMAN	Implicit G.D.P. Deflator Manufacturing	1.345
POM	Implicit G.D.P. Deflator Other Mining	2.25
POP	Population Total Mill. Persons	85.191

CODE	Name	1980 FIGURES
VOS	Implicit G.D.P. Deflator other services	0.300
PPET	Implicit G.D.P. Deflator Petroleum	3.34
PTC	Implicit G.D.P. Deflator Transport and Communication	1.77
FU	Implicit G.D.P. Deflator Utilities	1.57
QCOV	Output of Cocoa Value ₦ mill	143.63
QPET	Output of Petroleum Volume (. in Million Barrels)	753.46
*RFSB	Federal Savings Bank Rate of Interest	6.00
RKTR	Real Capital Formation Transport ₦ mill	754.45
RL	Interest Rate Lending	10.3 %
RM	Rate of Return on Manufacturing Investment	0.9418
RKPL	Relative Price of Capital and Labour Index	1.05
RPOP	Rural Population in Mill. Persons	61.02
RS	Interest Rate Savings	6.0%
SFR	Hard of Foreign Reserve ₦ mill	1473.10
SKBC	Stock of Capital Formation Building and Construction ₦ mill	5025.1
STGKE	Stock of Total Government Capital Expenditure ₦ mill	28006.406
*T	Time Trend	21
TCE	Total Consumption Expenditure ₦ mill	11562
TGKE	Total Government Capital Expenditure ₦ mill	5068.450
TGR	Total Government Revenue ₦ mill	8808.133
TKP	Total Export ₦ mill	14050.1
U POP	Urban Populations Million Persons	24.17
*UPP	Unit Export Price Petroleum, ₦ Per Barrel	18.537
UAAG	Value Added Agric ₦ mill	3977.92
VAAGR	Value Added Agric. [constant 1973 Prices ₦ mill)	2614.18
VABC	Value Added Building and Construction ₦ mill	2419.15

CODE	NAME	1980 FIGURES
VABCR	Value Added Building and Construction. (constant 1973 Prices)	1515.62
VAD	Value Added Distribution N mill	9617.20
VADR	Value Added Distribution (constant 1973 Prices N Prices N mill)	3237.68
VAFS	Value Added Fishing N mill	2006.68
VAFSR	Value Added Fishing Constant 1973 Prices Nmill	569.46
VAGS	Value Added Government Services N mill	1,938.22
VAGSR	Value Added Government Services constant 1973 Prices N mill	1168.77
VALST	Value Added Livestock N mill	1553.76
VALSTR	Value Added livestock Constant 1973 Prices N millq	449.73
VAM	Value Added Manufacturing N mill	2073.2
VAMR	Value Added Manufacturing constant 1973 Prices N mill	1123.27
VAMC	Value Added Consumer goods Manufacturing Nmill	292.865
VAMF	Value Added Manufacturing Food N mill.	346.40
VAMO	Value Added Manufacturing Others Nmill	378.34
VAOM	Value Added Other Mining N mill	669.850
VAOMR	Value Added Other Mining Constant 1973 Prices N mill	391.679
VAOS	Value Added Other Services N mill	2498.68
VAOSR	Value Added other Services Constant 1973 Prices N mill	1692.97
VAP	Value Added Petroleum Current N mill.	10734.26
VAPR	Value Added Petroleum Constant 1973 Prices Nmill	1855.89
VATC	Value Added Transport and Communications N mill	1762.57
VATCR	Value Added Transport and Communications Constant 1973 Prices N mill	643.92
VAU	Value Added Utilities N mill	187.08

CODE	NAME	1980 FIGURES
VAUR	Value Added Utilities Constant 1973 Prices N mill	81.23
VM	Wage Bill Manufacturing N mill	120.54
XCB	Export of Cocoa Beans Value N mill	311.8
XO	Other Exports N mill	212.90
XP	Total Export of Petroleum N mill	13,524.0
XTIN	Export of Tin N mill	1.4
XTR	Export Tax Revenue N mill	3.32
Y	Gross Domestic Product N mill	28,133.99
YDN	Disposable Income N mill	26,377.82
YD	Gross Domestic Product at constant 1973 Prices N mill	14,149.79
YRC	Real Gross Domestic Product at Market Prices.	14,168.142

LIST OF ESTIMATED EQUATIONS**SUPPLY****A. AGRICULTURE**

$$1. \text{ IQCR} = 0.998158 - 0.0237293T$$

$$(28.8383) \quad (-8.21263)$$

$$\bar{R}^2 = 0.7776 \quad DW = 1.3056 \quad SER = 0.0745099$$

$$2. \text{ IQTU} = 0.93321 - 0.0404962 T$$

$$(34.4090) \quad (-17.8868)$$

$$\bar{R}^2 = 0.9467 \quad DW = 0.6075 \quad SER = 0.0583839$$

$$3. \text{ IQNF} = 0.0810959 + 0.803771 \text{ IQNF}_{-1}$$

$$(0.790576) \quad (5.46639)$$

$$\bar{R}^2 = 0.6160 \quad DW = 2.5972 \quad SER = 0.191337$$

$$4. \text{ IQCO} = 1.25416 - 0.01130087 T$$

$$(10.5457) \quad (-1.1383)$$

$$\bar{R}^2 = 0.0153 \quad DW = 1.6643 \quad SER = 0.256013$$

$$5. \frac{\text{IVAAGR}}{\text{IQAG}} = 1.24919 + 0.105776 T$$

$$(8.98168) \quad (9.11052)$$

$$\bar{R}^2 = 0.8112 \quad DW = 1.5157 \quad SER = 0.299401$$

$$6. \text{ IQFS} = -0.159159 + 0.281068 (\text{PFS/PL}) + 0.553479 \text{ IQFS}_{-1}$$

$$(-1.48955) \quad (4.02262) \quad (4.4707)$$

$$\bar{R}^2 = 0.7428 \quad DW = 1.3443 \quad SER = 0.241698$$

$$7. \frac{\text{IVAFR}}{\text{IQFS}} = 1.31301 + 0.682124 \text{ RVFS}_{-1}$$

$$(1.68672) \quad (4.09472)$$

$$\bar{R}^2 = 0.4669 \quad DW = 2.4282 \quad SER = 2.23936$$

$$8. \text{ IQLIV} = 1.01289 - 0.00660902 T$$

$$(8.33788) \quad (-0.651710)$$

$$\bar{R}^2 = 0.0312 \quad DW = 1.3698 \quad SER = 0.261513$$

**D. UTILITIES BUILDING AND CONSTRUCTION**

$$1. \quad (VAUR-VAUR_{-1}) = 1.93858 + 0.00686827 T \\ (1.09485) \quad (0.0476659)$$

$$\bar{R}^2 = 0.0586 \quad DW = 1.9267 \quad SER = 3.44015$$

$$2. \quad VABCR = 151.201 + 0.327481 (SKBC/PBC) \\ (0.714125) \quad (3.07638)$$

$$\bar{R}^2 = 0.3081 \quad DW = 0.3401 \quad SER = 421.403$$

**E. SERVICES**

$$1. \quad VADR = 1168.33 + 1.77689 VAMR \\ (16.6363) \quad (14.0687)$$

$$\bar{R} = 0.9120 \quad DW = 0.9876 \quad SER = 182.040$$

$$2. \quad VATCR = 59.2513 + 0.0982717 RKTR + 0.793790 VATCR_{-1} \\ (1.86393) \quad (1.57445) \quad (6.12487)$$

$$\bar{R}^2 = 0.9258 \quad DW = 1.0876 \quad SER = 28.6331$$

$$3. \quad VAGSR = 75.0054 + 0.974462 VAGSR_{-1} \\ (1.15445) \quad (10.3241)$$

$$\bar{R}^2 = 0.8545 \quad DW = 2.6112 \quad SER = 186.708$$

$$4. \quad VAOSR = 393.930 + 196.695 IGGR. \\ (3.41011) \quad (5.04604)$$

$$\bar{R}^2 = 0.5628 \quad DW = 1.2058 \quad SER = 263.749$$

**F. CONSUMPTION**

$$1. \quad PCE = -2196.23 + 0.634543 YDN + 0.392401 PCE \\ (-4.4666) \quad (5.91606) \quad (3.61683)$$

$$\bar{R}^2 = 0.9681 \quad DW = 2.6762 \quad SER = 457.052$$

$$2. \quad 2. \quad GC = -183.205 + 0.120706 Y$$

$$(-1.67019) \quad (15.9068)$$

$$\bar{R}^2 = 0.9299 \quad DW = 1.4887 \quad SER = 339.959$$

G. CAPITAL FORMATION

$$1. \quad KMBQ = -76.0972 + 0.419994 KOT_{-1} + 1.71385 PIDV_{-1}$$

$$(-0.866464) \quad (6.32557) \quad (2.83640)$$

$$\bar{R}^2 = 0.9030 \quad DW = 2.4402 \quad SER = 183.663$$

$$2. \quad NKEP = -125.289 + 175.738 RM + 0.683571 NKEP_{-1}$$

$$(-2.15078) \quad (2.27390) \quad (3.62227)$$

$$\bar{R}^2 = 0.7476 \quad DW = 2.5870 \quad SER = 17.5480$$

$$3. \quad NKEC = -353.982 + 502.736 RM + 0.266687 NKEC_{-1}$$

$$(-2.78145) \quad (2.98474) \quad (1.17780)$$

$$\bar{R}^2 = 0.5821 \quad DW = 2.0623 \quad SER = 38.9484$$

$$4. \quad NKEO = -87.6682 + 123.496 RM + 0.905759 NKEO_{-1}$$

$$(-1.97966) \quad (2.04874) \quad (7.13766)$$

$$\bar{R}^2 = 0.9045 \quad DW = 2.6084 \quad SER = 12.5090$$

$$5. \quad KBC = -68.0469 + 0.158589 GKEC + 37.5624 T$$

$$(-1.11316) \quad (1.46878) \quad (6.42373)$$

$$\bar{R}^2 = 0.8327 \quad DW = 0.8679 \quad SER = 108.493$$

$$6. \quad KTR = -189.790 + 0.434905 GKET + 38.1673 T$$

$$(-1.33762) \quad (3.16043) \quad (2.61247)$$

$$\bar{R}^2 = 0.7694 \quad DW = 1.0056 \quad SER = 237.945$$

$$7. \quad KAG = 28.8143 + 0.164187 GKEA + 0.439104 KAG_{-1}$$

$$(2.83958) \quad (2.05389) \quad (2.16690)$$

$$\bar{R}^2 = 0.6037 \quad DW = 1.9146 \quad SER = 14.4574$$

$$8. \quad GKEC = -47.8858 + 0.104139 TGR + 0.334672 GKEC_{-1}$$

$$(-0.985067) \quad (4.00196) \quad (1.75241)$$

$$\bar{R}^2 = 0.7961 \quad DW = 1.8973 \quad SER = 158.639$$



$$9. \text{ GKET} = - 32.3437 + 0.135929 \text{ TGR} + 0.573649 \text{ GKET}_{-1}$$

$$(4.632799) \quad (3.61541) \quad (4.07566)$$

$$\bar{R}^2 = 0.9370 \quad DW = 1.2531 \quad SER = 162.493$$

$$10. \text{ GKEA} = 5.25343 + 0.0203972 \text{ TGR} + 0.189941 \text{ GKEA}_{-1}$$

$$(0.561825) \quad (2.96907) \quad (0.735065)$$

$$\bar{R}^2 = 0.7570 \quad DW = 1.9209 \quad SER = 31.0687$$

$$11. \text{ KOT} = 140.326 + 0.964330 \text{ KOT}_{-1}$$

$$(1.15473) \quad (9.30082)$$

$$\bar{R}^2 = 0.8260 \quad DW = 2.0669 \quad SER = 431.586$$

$$12. \text{ NFIV} = 44.4014 + 0.788087 \text{ NFIV}_{-1}$$

$$(1.36680) \quad (5.73803)$$

$$\bar{R}^2 = 0.6394 \quad DW = 1.0547 \quad SER = 97.9361$$

$$13. \text{ NFIV} = 54.3343 + 0.00145563 \text{ STGKE}_{-1} + 0.613369 \text{ NFIV}_{-1}$$

$$(2.07882) \quad (0.527525) \quad (3.32313)$$

$$\bar{R}^2 = 0.3928 \quad DW = 2.1548 \quad SER = 51.9638$$

#### H. POPULATION AND EMPLOYMENT

$$1. \text{ In POP} = 3.90952 + 0.0256876 \text{ T}$$

$$(914.538) \quad (73.8397)$$

$$\bar{R}^2 = 0.9967 \quad DW = 1.1880 \quad SER = 0.00830559$$

$$2. \text{ UPOP} = - 13.5261 + 0.433760 \text{ POP}$$

$$(-20.1894) \quad (43.6810)$$

$$\bar{R}^2 = 0.9906 \quad DW = 0.4557 \quad SER = 0.404545$$

$$3. \text{ IN EMDC} = - 7.14684 - 0.01262C2 \text{ In RPKL}$$

$$(-12.8835) \quad (-0.128493)$$

$$+ 0.409493 \text{ In VAMC}$$

$$(12.0119)$$

$$\bar{R}^2 = 0.8883 \quad DW = 1.8911 \quad SER = 0.162262$$