FORECASTING MODELS FOR NIGERIAN IMPORTS AND EXPORTS

Introduction:

The experience of the users of international trade statistics in collecting an up-to-date imports and exports figures for analysis and publications has not been interesting. In the main, the imports and exports data are used for the compilation of foreign trade indices, the monitoring of the country's international trade policy and research into the various facets of the economy to appreciate the impact of international trade. At present, there is a delay of more than 12 months in getting the Federal Office of Statistics (FOS) summary results of imports and exports, which poses problems for users in their analysis and policy recommendations.

In the light of all these, the need has arisen to make estimates pending when they would be made available by the FOS. This is what the paper hopes to accomplish. The paper should be seen as a technical one rather than a theoretical model building exercise. The attempt here at forecasting Nigerian imports and exports is made difficult due to relatively few and inconclusive research efforts that are available in this area.

Briefly, forecasting provides information on which estimates can be made and decision taken. Forecasting is an objective computation, that is quantitative, according to Brown (1962)[1] while trying to make a distinction between forecasting and prediction which he described as a subjective estimate requiring managerial judgement and qualitative "forecast". Forecasting the future requires the skills of an economist, statistician or an econometrician. The model to be used for forecasting should possess at least two properties, viz to be theoretically acceptable and to give a reasonably good fit when applied to historical data. Thus, the historical development of the variables concerned is first examined.

The paper is divided into three sections for easy exposition. Section 1 explains and discusses the model specification for forecasting while in section 2 the empirical results of the models and their implications are examined. Section 3 summarizes the findings of the paper. Explanations on data sources, definitions and other calculations are contained in the appendix.

1. FORECASTING MODEL SPECIFICATION

Import Model:

The theory of demand for imports suggests the basic explanatory variables would include income, the price of imports and the price of other consumable commodities. However, the data on these variables are unavailable and they cannot be forecast with a good deal of accuracy. It then becomes necessary to look for other explanatory variables that are more current.

In John E. Sundgren report[2] it was suggested that the relationship between FOS imports value and payments for imports through the Exchange Control Department of the Central Bank of Nigeria (CBN) be established through regression analysis. In fact, the scatter diagram in Figure 1 shows that there is a linear relationship between FOS value of imports and CBN payments using quarterly data and therefore the linear regression analysis is justified.

The forecasting model for value of imports may therefore be specified as follows:—

$$Mt = \&o + \&1\,Yt + \&2\,Yt-1 + Ut - \ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where

Mt = FOS value of imports during quarter t;

Yt = Payments for imports through the Exchange Control Department of CBN during quarter t;

Yt−1 = Payments for imports lagged one-period, that is quarter t−1;

Ut = error term during quarter t; and &s are the parameters to be estimated.

The import model briefly states that the value of imports this quarter is explained by the payments made to the Exchange Control Department of CBN this quarter and payments made in the previous quarter.

The conditions imposed on the independent variables under which an econometric model can be used as a forecasting device are that either (i) they must be known in advance of the dependent variable (ii) they must be forecast with a good deal of accuracy or (iii) they be in a lagged relationship with the dependent variable[3]. Since the independent variables are known in advance of the dependent variable in this case, then the use of an econometric model to forecast value of imports is in order.

It is to be mentioned that various models were tried with unsatisfactory forecasts. The present one gave the best fit and reasonable error margins, hence, its choice.

Export Model:

The value of exports is divided into oil and non-oil since the factors influencing oil exports are quite different from those of non-oil exports. This necessitates different forecasting models for oil and non-oil exports. It then follows that the forecast model for value of exports is derived as

$$Xt = Lt + Nt \text{———————} (2)$$

where Xt = value of all exports during quarter t;

Lt = value of oil exports during quarter t;

Nt = value of non-oil exports during quarter t.

Oil exports:

The value of oil exports is easily estimated by the product of oil exports in barrels and the official oil price in naira per barrel. Since the oil exports in barrels and official oil price statistics are current and immediate future levels known with a high degree of probability, this method is likely to do better. Thus, the value of oil exports is given as:

$$Lt = Ct\,Pt \text{———————} (3)$$

where Lt = as defined in equation (2);

Ct = export of crude oil in barrels during quarter t; and

Pt = official price of oil export during quarter t.

A model using the price of oil export, the income of countries importing Nigerian oil and an oil glut dummy as explanatory variables determining the value of oil exports could have been sepcified and estimated. This could have been in line with one of H. S. Houthakker's[1] conclusion on demand for petroleum products, that price and income changes have a highly significant effect on the demand for most petroleum products.

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[1] R. G. Brown, *Smoothing, Forecasting and Prediction of Discrete Time Series* (Prentice Hall, 1962).

[2] John E. Sundgren, International Monetary Fund Bureau of Statistics, Central Bank Bulletin Project (2nd Visit to Nigeria. Feb. 1979).

[3] Michael Firth, *Forecasting Models in Business and Management* (Edward Arnold Ltd., 1977).

However, income of these countries can only be known with a considerable lag especially income of developing countries importing Nigerian oil. Also, income of most of these countries is not available in quarterly series, but yearly. In the light of all these, the gross domestic product of the United States (US) is used as a proxy for the incomes of countries importing our oil. The United States is not only a major consumer of our crude oil, development in that country is a pointer to the state of the world economy. An oil glut dummy as an explanatory variable is considered necessary because even though recession in the world economy which the gross domestic product of the United States typified can cause oil glut, other principal causes of oil glut are not captured by it. These include exploitation of new discoveries, destockpiling and increased production by existing producers of crude oil. The method tested[2] is therefore given as

$$Lt = ao + a_1 Pt + a_2 G_t + a_3 D_t + Ut \quad \text{.................. (4)}$$

where Lt = as defined in equation (2);
Pt = as defined in equation (3);
Gt = the gross domestic product of the United States in quarter t;
Dt = the oil glut dummy in quarter t (Dt=0 when there is no oil glut and Dt=1, otherwise);
Ut = error term in quarter t; and
as = the parameters being estimated.

Non-Oil Exports[3]

Time series models are used here to forecast the value of non-oil exports in Nigeria because of their peculiarities. The value of non-oil exports in Nigeria is influenced by many other factors which are qualitative like weather and changes in government policies. The Nigerian non-oil exports are mainly primary agricultural products namely, cocoa, rubber, cotton, groundnuts, palm produce and rubber. The value of non-oil exports has been changing irregularly, not necessarily because of any change in the income of countries importing Nigerian products or the price of exports, but because of the qualitative factors mentioned above. Weather affects the production of agricultural products and since our ability to forecast weather condition has been inadequate, introducing appropriate dummy variable is made difficult. Government policy on export of non-oil commodities has not been consistent as ban can be placed or lifted on the exportation of certain non-oil items from time to time. The growth in industries which cannot be adequately taken care of by a dummy variable has meant more consumption of our primary agricultural products locally leaving little or nothing for export of some non-oil commodities. These and other reasons have made it difficult to develop an econometric model for forecasting the value of non-oil exports. Time series forecasting methods are however, suited to short-term forecasts required here.

This is not to over-rule the shortcomings of time series forecast for the value of non-oil exports is not horizontal, neither is there a fairly constant trend when graphed with time. Therefore, time series models may likely produce poor results. The graph of the actual value of non-oil exports (Figure 2) against time shows that the data fluctuates with time such that the trend or seasonal pattern is difficult to discern. This leads to the trial of many time series methods with a view to selecting the one with the best forecasting accuracy of the value of non-oil exports.

The first model tested is the four-period moving average since the data is on quarterly basis. Notationally, this is computed as

$$N_{t+1} = \frac{At + At-1 + A_{t-2} + A_{t-3}}{4} \quad \text{...........(5)}$$

where
N_{t+1}=forecast for the next quarter, t+1,$A_{t,\ t-1,\ t-2,\ t-3}$=the actual value of non-oil exports at quarters t, t−1, t−2 and t−3. The quarterly forecast given by this four-period moving average is presented in column 3 of Table 1.

The four-period moving average has the disadvantage of assigning equal weights to each of the observations and ignores any observations prior to quarter t−3.

Thought is then given to a weighted moving average technique. The decimal weightings of this method are as used in equation (6) below:

$$N_{t+1 = 0.4}A_{t + 0.3}A_{t-1 + 0.2}A_{t-2 + 0.1}A_{t-3} \quad \text{...........(6)}$$

where the variables are as earlier defined.

The forecast resulting from this method is presented in column 4 of Table 1.

Exponential smoothing, another weighting technique, assigns weights that decrease exponentially with time to past data. The exponential smoothing forecasting model is thus:

$$N_{t+1} = ßA_t + ß\,(1-ß)\,A_{t-1} + ß\,(1-ß)^2\,A_{t-2+\dots} + ß\,(1-ß)_n A_{t-n} \quad \text{...........(7)}$$

where ß = a value which lies between 0 and 1 and other variables are as previously defined.

Equation (7) can be re-written as

$$N_{t+2} = ßA_t + (1-ß)\,[ßA_{t-1} + ß\,(1-ß)\,A_{t-2} + \dots + ß(1-ß)^{n-1}A_{t-n}] \quad \text{...........(8)}$$

But from (7)

$$N_t = ßA_{t-1} + ß(1-ß)\,A_{t-2} + \dots + ß(1-ß)^{n-1}A_{t-n} \quad \text{...........(9)}$$

where N_t is the forecast for the present quarter, t.
Substituting N_t for the squared bracket in (7) gives

$$N_{t+1} ßA_t + (1-ß)\,N_t \quad \text{...........(10)}$$

Rearranging (10) gives

$$N_{t+1} = N_t + ß(A_t - N_t) \quad \text{...........(11)}$$

The method simply says that the forecast for the next quarter is the sum of forecast for the present quarter and the product of ß and the error in the present quarter forecast. The value of ß=0.2, 0.5, 0.8 are used to produce the forecast in columns 5, 6, 7 of Table 1 respectively.

The method of classical decomposition which involves a break-down of the pattern into a number of factors is tested here. The trend factor, the seasonal factor, the cyclical factor and the irregular factor are to be identified in applying this method. The classical decomposition model is thus presented as

$$N_t = T_t X\, S_t X\, C_t X\, I_t \quad \text{...........(12)}$$

where
T_t=trend factor during quarter t;
S_t=Seasonal factor during quarter t;
C_t=cyclical factor during quarter t; and
I_t=irregular factor during quarter t.
Some people use the additive form of

$$N_t = T_t + S_t + C_t + I_t \quad \text{...........(13)}$$

[1] H. S. Houthakker, *The World Price of Oil: A Medium-Term Analysis* (American Enterprise Institute for Public Policy Research, Washington D.C., 1976).

[2] Various combinations of the models were made and tested including the use of growth rate of the U.S. gross domestic product, lagging the U.S. gross domestic product and log-linear specification but the one reported here produced the best statistically significant result.

[3] Most of the models discussed here for forecasting the value of non-oil exports are found in Michael Firth, op.cit.

The seasonal index (S) for each quarter is calculated as

$$S = \frac{A_t}{\text{Moving average centred on } A_t} \quad \ldots\ldots\ldots\ldots(14)$$

This is to say that the four-period moving averages are first calculated before the seasonal index are computed. The average seasonal index is obtained for each quarter since several years data are involved. The simple linear regression equation for the four period moving average against time is used to compute the trend factor. The equation is

$$T = bo + b_1 Q \ldots\ldots\ldots\ldots(15)$$

whereT=moving average of A_t;

Q=time period (1 to 28); and

bs=are parameters to be estimated.

The trend factor arising from the estimation of equation (15) is

$$\hat{T} = 75.5463 + 3.1675Q \ldots\ldots\ldots\ldots(16)$$

The cyclical factor is difficult to identify and measure because of the forces such as government economic policy which is not precise and consistent in Nigeria. Also, the irregular factor cannot be forecast because of its randomness. Therefore the forecast model using the classical decomposition method is

$$N_t = \text{trend factor X seasonal index} \ldots\ldots\ldots\ldots(17)$$

This combines the results of equations (14) and (15).

The forecast resulting from this is presented in column 8 of Table 1.

Mention is also made of Sundgren (1979[1]) that recommended forecasting value of non-oil exports by simply carrying forward into current quarters the data entered for the corresponding quarters of the preceding year.This, according to him, is due to the minor importance of non-oil export values. The forecast arising from this approach is as presented in column 9 of Table 1.

2. Empirical Results and Implications:

Following the different models proposed in Section 1, the empirical results are presented here. Effort is also made to bring out the implications of the results.

Import Model Estimation:

The result of the estimation of the import model discussed is given below:—

$$\hat{M}_t = -13.5917 + \underset{(5.3022)}{0.8466Y_t} + \underset{(1.8209)^2}{0.293\, Y_{t-1}} \quad \ldots\ldots\ldots\ldots(18)$$

$\bar{R}^2 = 0.894$; D.W. $=1.623$; $F^* = 126.888$

The co-efficients of payments and lagged payments have the correct positive sign and are significantly different from zero at the 5 per cent level. The F*, F-statistic calculated at 2,29 degrees of freedom, shows that the regression is significant at 5 per cent level. The significance of the intercept is not tested because it is not important to this analysis, being a demand function. The adjusted co-efficient of determination ($\bar{R}^2$) shows that 89.4 per cent of variation in value of imports is explained by payments and one period lagged payments in every quarter. This no doubt is a high proportion due to the explantory variables.

Oil Export Estimation:

The Equation (3) oil export model is a definitional method which requires no estimation. The value of oil exports is thus estimated using the equation.

$$L_t = C_t\, P_t \ldots\ldots\ldots\ldots(19)$$

The result of equation (4) is

$$L_t = \underset{(2.24)}{-410} + \underset{(8.37)}{142\, P_t} + \underset{(2.56)}{0.443\, C_t} \underset{(-3.04)^2}{-243D_t} \ldots\ldots\ldots\ldots(20)$$

$\bar{R}^2 = 0.957$

D.W. $= 1.11$

$F^* = 232.09$

The parameters have the correct signs and are significantly different from zero at 1 per cent level except the intercept which is only significant at 5 per cent level. The F* shows that the regression is significant at 1 per cent level. The $\bar{R}^2$ shows that 95.7 per cent of variation in the value of oil exports is explained by price, US gross domestic product and oil glut dummy which is very high. Autocorrelation exists as D.W. statistics show, but it is expected since this is a time-series analysis. In spite of the highly significant regression result and its good forecasting accuracy as its Theil's inequality co-efficient statistics, U = 0.044, this model is not preferred to the first one. The reason being that its ex-post forecasts are far from being realistic as they differ widely from the actual figures.

Non-Oil Export Model Estimation:

The results of the various non-oil exports models discussed are presented in Table 1. The question then is which of the seven methods is preferred as a forecasting model for value of non-oil exports? The squared error for each of the method is computed and their mean squared error calculated. The model with the least mean squared error (MSE) is regarded to have the best forecasting results. The classical decomposition method has the smallest MSE of 1070.2 (Table 1) and is therefore better considered as forecasting model for the value of non-oil exports.

The Sundgren[1] rule of thumb forecasting method for non-oil exports value is found to give one of the poorest forecasting value with the MSE of 1789.6 (Table 1). This is to confirm that the value of non-oil exports is not seasonal as Sundgren method would want us to believe but that it changes irregularly.

The graph of the actual value of non-oil exports with time is produced with the forecasts arising from the moving average, exponential smoothing with ß = 0.2 and the classical decomposition methods (Fig. 2). It is evidenced from figure 2 that the graph arising from the forecast of classical decomposition approximates the graph of the actual values better than the graphs of the forecasts of other methods.

Testing Forecast Accuracy:

With the choice of these forecasting models, a useful measure of their forecasting accuracy is the Theil's inequality co-efficient[3] statistics U. This statistics is given as:

$$U = \frac{\sqrt{\frac{1}{n}\sum_{i=1}^{n}(Fi - Ai)^2}}{\sqrt{\frac{1}{n}\sum_{i=1}^{n}Fi^2} + \sqrt{\frac{1}{n}\sum_{i=1}^{n}Ai^2}}$$

where Fi are the forecasts for each quarter;

Ai are the actual values for each quarter, and

n is the number of quarters being compared.

The value of U ranges from 0 to 1 (undefined for Fi = 0 and Ai = 0). If U is 0, the forecast is perfect, otherwise a value of 1 implies the forecasts are all incorrect. The nearer the value of U is to O

[1] John E. Sundgren, op. cit.

[2] Figures in parentheses are t ratios.

[3] The calculation of U for the different models is carried out in Appendix II.

the more accurate the forecasting. With the U = 0.0492, 0,0388 and 0.1269 for the import, oil export and non-oil export models respectively, their forecasting ability are considered fairly accurate.

Summary and Conclusions:

The forecasting models estimated and recommended for forecasting the values of the different components for which they are specified are as follows:—

(i) $\hat{M}_t = -13.5917 + 0.8466\,Y_t + 0.2930\,Y_{t-1}$
for value of imports;

(ii) $\hat{L} = C_t P_t$
for value of oil exports; and

(iii) $\hat{N}_t$ = Trend factor X Seasonal Index
for value of non-oil exports.

The art of forecasting the value of imports and exports is at present in a state of flux. The methods adopted here still leave room for improvement as these methods are constantly being revised. The difficulty of choosing a specific methodological approach for forecasting these variables arises partly because the technique employed depends on the nature of the variables to be forecast and the fact that forecasters are not agreed on which method to use for a particular situation.

The models proposed for forecasting imports and exports are used to generate ex-post (out-of-sample) forecast from first quarter of 1981 to the second quarter of 1983 (Appendix III). It will be useful to mention here that the non-oil export model needs revision for its use for further forecasting beyond 1981, as it is a short run model. The imports model also need to be revised when the actual data are known which could be used to generate new parameters determining the value of imports. Besides, a number of variables including dummy variables were not introduced in the paper, as they should, for want of computer services at the time the paper was prepared.

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[1] John E. Sundgren, op. cit.

[2] The calculation of U for the different models is carried out in Appendix II.

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APPENDIX I

DATA SOURCES

1. Central Bank of Nigeria, Economic and Financial Review, various publications – provide data for value of imports and exports (oil and non-oil), quarterly data extracted covered the period, 1st quarter of 1973 to the 4th quarter of 1980.
2. Central Bank of Nigeria, Balance of Payments Office of the Research Department – supply data on quarterly basis of payments made to the Exchange Control Department for importation of commodities.
3. Central Bank of Nigeria, Petroleum Studies Office of the Research Department – Give monthly price of Nigerian crude oil in dollars. These monthly figures are converted to quarterly data after conversion of dollars to naira using the exchange rate applicable at the time the figures were reported.

Appendix II
Calculation of Theil's Inequality Statistics (U)

Import Model			Oil Export Model			Non-oil Export Model		
M^2	$\hat{M}^2$	$(\hat{M}\text{-}M)^2$	L^2	$\hat{L}^2$	$(\hat{L}\text{-}L)^2$	N^2	$\hat{N}^2$	$(\hat{N}\text{-}N)^2$
78,008.5	101,888.6	1,592.0	102,400.0	149,150.4	4,382.4	12,254.5	7,174.1	676.0
98,219.6	312,034.0	60,123.0	138,830.8	142,657.3	26.0	10,774.4	5745.6	784.0
95,234.0	496,884.0	157,053.7	187,056.3	191,231.3	23.0	14,328.1	9,006.0	615.0
108,900.0	186,710.4	10,424.4	590,438.6	661,945.0	2,043.0	12,100.0	5,505.6	1,281.6
155,236.0	100,425.6	5,944.4	1,683,765.8	2,303,009.7	60,565.2	8,892.5	9,682.6	16.8
212,705.4	140,475.0	7,465.0	1,960,280.0	3,149,915.0	140,400.1	11,257.2	7,673.8	342.3
305,148.8	177,241.0	17,266.0	1,945,746.0	2,434,536.1	27,357.2	6,872.4	11,902.8	686.4
384,648.0	411,907.2	466.6	1,618,238.4	1,978,804.9	18,117.2	5,490.8	7,089.6	102.0
818,120.3	947,507.6	4,747.2	1,153,476.0	1,318,822.6	5,535.4	4,542.8	12,566.4	1,998.1
1,046,529.0	1,015,660.8	231.0	889,060.4	943,423.7	806.6	4,998.5	9,860.5	818.0
1,378,276.0	975,551.3	34,707.7	1,404,225.0	1,278,030.3	2,970.3	10,180.8	15,178.2	497.3
1,406,596.0	1,052,265.6	25,664.0	2,038,327.9	1,801,500.8	7,310.3	1,584.0	9,139.4	3,113.6
1,406,596.0	1,041,012.1	27,456.5	1,993,179.2	1,966,725.8	88.4	7,157.2	15,775.4	1,681.0
1,505,774.4	1,402,803.4	1,823.3	2,169,434.4	2,190,400.0	50.4	9,350.9	12,321.0	204.5
2,346,104.9	2,073,024.0	8,445.6	2,482,200.3	2,222,186.5	7,191.0	18,198.0	18,878.8	6.3
2,471,184.0	2,466,470.3	2.3	3,013,696.0	3,026,904.0	14.4	21,638.4	11,278.4	1,672.8
3,222,025.0	3,316,041.0	676.0	3,171,961.0	3,343,046.6	2,246.8	24,180.3	19,404.5	262.4
6,313,801.0	3,169,112.0	14,592.6	3,594,436.8	3,475,614.5	998.6	12,746.4	15,079.8	98.0
3,332,450.3	3,572,856.0	4,186.1	3,150,625.0	2,975,970.0	2,490.0	26,896.0	22,952.3	156.3
5,047,211.6	3,773,694.8	92,416.0	2,652,012.3	2,739,025.0	702.3	29,618.4	13,665.6	3,047.0
4,151,406.3	5,097,209.3	48,488.0	1,131,032.3	1,452,266.0	20,050.6	31,898.0	23,409.0	655.4
4,338,889.0	4,232,071.8	665.6	1,639,424.2	1,843,620.8	5,990.8	15,977.0	18,090.3	65.6
3,135,732.6	3,875,386.0	39,124.8	2,335,089.6	1,342,817.4	136,382.5	43,388.9	27,456.5	1,814.8
3,570,588.2	4,034,072.3	14,137.2	3,280,807.7	3,156,307.6	1,204.1	8,911.4	16,281.8	1,102.2
1,193,556.3	1,598,201.6	29,480.9	3,885,235.2	3,650,010.3	3,672.4	57,792.2	27,755.6	5,446
2,141,539.6	1,516,346.0	53,824.0	6,112,761.8	6,993,380.3	29,618.4	21,844.8	21,374.4	2.6
2,944,312.8	3,245,762.6	7,344.5	6,306,627.7	7,622,016.6	62,250.3	17,822.3	32,328.0	2,143.7
3,721,812.6	3,698,313.6	37.2	7,570,202.0	8,739,709.7	41,984.0	9,082.1	19,099.2	1,840.4
5,293,680.6	4,647,042.5	21,054.0	12,057,561.8	11,378,478.2	9,840.6	37,869.2	32,472.0	207.4
5,439,156.8	5,908,788.6	9,722.0	13,197,962.4	12,707,086.1	4,651.2	16,978.1	24,964.0	767.3
6,417,608.9	6,093,492.3	4,199.0	12,547,889.3	10,794,510.3	65,946.2	—	—	—
—	—	—	8,984,406.8	10,206,747.0	38,966.8	—	—	—
74,081,049.5	70,680,251.3	701,768.6	114,988,391.0	118,259,849.8	703,876.5	514,625.6	483,111.2	32,105.2

$$U_m = \frac{\sqrt{\frac{1}{n}\ \Sigma\,(\hat{M}-M)^2}}{\sqrt{\frac{1}{n}\ \Sigma\,\hat{M}^2} + \sqrt{\frac{1}{n}\ \Sigma\,M^2}} = \frac{150.4583}{1509.9696 + 1545.8691} = \underline{0.04924}$$

$$U_L = \frac{\sqrt{\frac{1}{n}\ \Sigma\,(\hat{L}-L)^2}}{\sqrt{\frac{1}{n}\ \Sigma\,\hat{L}^2} + \sqrt{\frac{1}{n}\ \Sigma\,L^2}} = \frac{148.311}{1895.6232 + 1922.3996} = \underline{0.03884}$$

$$U_N = \frac{\sqrt{\frac{1}{n}\ \Sigma\,(\hat{N}-N)^2}}{\sqrt{\frac{1}{n}\ \Sigma\,\hat{N}^2} + \sqrt{\frac{1}{n}\ \Sigma\,N^2}} = \frac{32.7135}{130.9740 + 126.9004} = \underline{0.1269}$$

APPENDIX III
EX-POST (OUT-OF-SAMPLE) FORECAST
(₦'Million)

PERIOD		Actual Imports (M)	Estimated Imports ($\hat{M}$)	Actual Oil Exports (L)	Estimated Oil Exports ($\hat{L}$)	Actual Non-Oil Exports (N)	Estimated Non-Oil Exports ($\hat{N}$)
1981	1st Quarter		2,718.4		3,392.3		193.9
	2nd Quarter		3,287.6		2,666.4		148.9
	3rd Quarter		3,524.7		1,509.3		193.9
	4th Quarter		3,448.9		2,797.9		169.7
Year	1981	12,919.6[1]	12,979.6	10,687.1[1]	10,364.9	323.3[1]	706.4
1982	1st Quarter		3,523.6		2,204.3		208.1
	2nd Quarter		2,643.1		2,164.1		159.5
	3rd Quarter		1,402.8		2,036.3		207.5
	4th Quarter		2,278.4		2,344.8		181.4
Year	1982	10,096.1[1]	9,847.9	8,929.6[1]	8,749.5	266.8[1]	756.5
1983	1st Quarter		2,313.5		1,060.6		222.2
	2nd Quarter		1,710.9		2,181.0		170.2

[1] Federal Office of Statistics (FOS) provisional figures.

Note: Quarterly imports and exports figures are not yet available from FOS since 1981 and therefore only their annual figures are reported here.

Table 1

NON-OIL FORECASTING MODELS
(₦ million)

1		2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Period		Actual Non-Oil Export	4-Period Moving Average	Weighted Moving Average	Exponential Smoothing			Classical Decom-position	Corres-ponding Quarter of Last Year	Squared Error						
					ß=0.2	ß=0.5	ß=0.8			Col. 3	Col. 4	Col. 5	Col. 6	Col. 7	Col. 8	Col. 9
1973	1	74.0	—	—	—	—	—	—	—	—	—	—	—	—	—	—
	2	95.5	—	—	74.0	74.0	74.0	—	—	—	—	462.3	462.3	462.3	—	—
	4	103.8	—	—	84.8	97.8	106.8	75.8	—	—	—	1,049.8	670.8	380.3	676.0	—
1974	1	119.7	96.0	101.2	88.6	100.8	104.4	94.9	74.4	561.7	342.8	361.0	36.0	9.0	784.0	—
	2	110.0	107.4	110.7	94.8	110.3	116.6	74.2	95.5	6.8	0.5	967.2	357.2	234.1	615.0	2,088.5
	3	94.3	111.1	111.6	97.8	110.1	111.3	98.4	110.7	282.2	306.3	231.0	0.1	43.6	1,281.6	210.3
	4	106.1	107.0	105.0	97.1	102.2	97.7	87.6	103.8	0.8	1.2	12.3	249.6	289.0	16.8	269.3
1975	1	82.5	107.5	104.5	98.9	104.2	104.8	109.1	119.7	405.2	475.2	81.0	15.6	70.6	342.3	5.3
	2	74.1	98.3	94.7	95.7	93.5	87.2	84.2	110.0	585.6	432.6	256.0	453.7	462.3	686.4	1,354.2
	3	67.4	89.4	85.1	91.4	83.0	76.7	112.1	94.3	484.0	313.3	466.6	376.4	171.6	102.0	1,288.8
	4	70.7	82.6	76.4	86.6	75.6	69.3	99.3	106.1	141.6	32.5	576.0	269.0	86.5	1,998.1	723.6
1976	1	100.9	73.8	71.6	83.4	73.1	70.4	123.2	82.9	734.4	858.5	252.8	24.0	2.0	818.0	1,274.5
	2	39.8	78.3	82.5	86.5	87.0	94.8	95.6	74.1	1,482.3	1,823.3	306.8	772.8	930.3	497.3	324.0
	3	84.6	69.7	67.0	77.2	63.4	50.8	125.6	67.4	222.0	309.8	2,180.9	227.8	3,025.0	3,113.6	1,176.5
	4	96.7	74.0	73.0	70.7	74.0	77.8	111.0	70.7	515.3	561.7	54.8	449.4	1,142.4	1,681.0	295.8
1977	1	134.9	80.5	82.2	82.3	79.3	92.9	137.4	100.9	2,959.4	2,777.3	324.0	515.3	357.2	204.5	676.0
	2	147.1	89.0	103.9	92.8	107.1	126.5	106.2	39.8	3,375.6	1,866.2	2,766.8	3,091.4	1,764.0	6.3	1,156.0
	3	155.5	115.8	127.1	103.7	127.1	143.0	139.3	84.6	1,576.1	806.1	2,948.5	1,600.0	424.4	1,672.8	11,513.2
	4	112.0	133.6	143.0	114.2	141.3	153.0	122.8	96.7	428.5	906.0	2,683.2	806.6	156.3	262.4	5,026.8
1978	1	164.0	137.6	134.8	113.9	127.1	120.9	151.5	134.9	697.0	718.2	1.7	806.6	1,608.0	98.0	262.4
	2	172.1	144.9	145.3	123.9	145.6	155.4	116.9	147.1	739.8	718.2	2,510.0	1,361.6	1,857.6	156.3	846.6
	3	178.6	151.1	156.2	133.5	158.9	169.2	153.0	155.5	756.3	501.3	2,323.2	702.3	278.9	3,047.0	625.0
	4	126.4	156.9	167.2	142.5	168.8	176.7	134.5	112.9	930.3	1,664.6	2,034.0	388.1	88.4	655.4	533.6
1979	1	208.3	160.3	155.0	139.3	147.6	136.5	165.7	164.0	2,304.0	2,840.9	259.2	1,797.8	2,530.1	65.6	182.3
	2	94.4	171.4	174.2	153.1	178.0	193.9	127.6	172.1	5,729.0	6,368.0	4,761.0	3,684.5	5,155.2	1,814.8	1,962.5
	3	240.4	151.9	143.4	141.4	136.2	114.3	166.6	178.6	7,832.3	9,409.0	3,445.7	6,989.0	9,900.3	1,102.2	6,037.3
	4	147.8	167.4	178.8	161.2	18.3	215.2	146.2	126.4	384.2	961.0	9,801.0	10,857.6	15,901.2	5,446.4	3,819.2
1980	1	133.5	172.7	171.0	158.5	168.1	161.3	179.8	208.3	1,536.6	1,406.3	179.6	1,640.3	4,542.8	2.6	458.0
	2	95.3	154.0	155.3	153.5	150.8	139.1	138.2	94.4	3,445.7	3,600.0	625.0	1,197.2	772.8	2143.7	5,595.0
	3	194.6	154.3	131.8	141.9	123.1	104.1	180.2	240.4	1,624.1	3,942.8	3,387.2	3,080.3	1,918.4	1,840.4	0.8
	4	130.3	142.8	211.0	152.4	158.9	176.5	158.0	147.8	156.3	6,512.5	2,777.3	5,112.3	8,190.3	207.4	2,097.6
			138.4	142.9	148.0	144.6	139.5					488.4	818.0	2,134.4	767.3	306.3
								Total Squared Error		40,097.1	49,686.1	48,574.3	50,811.2	64,889.3	32,105.2	50,109.6
								Mean Squared Error (MSE)		1,432.0	1,774.5	1,566.9	1,639.1	2,093.2	1,070.2	1,789.6

Fig. 1: Value of Imports (M_t) against Payments (Y_t)

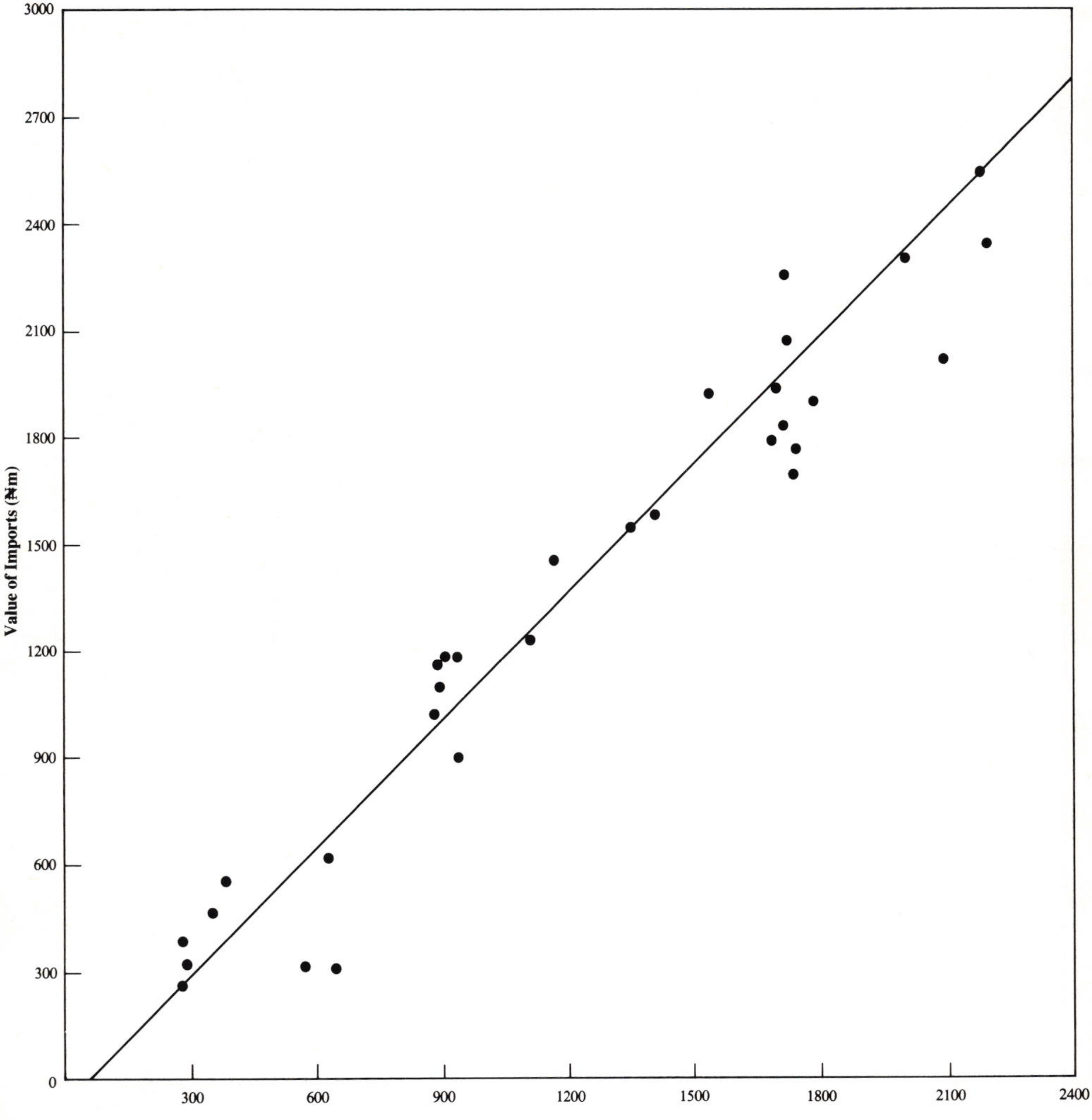

Fig. 2: Graphs of the Actual and Forecast of Non-Oil Exports Value