CHAPTER SIX

EMPIRICAL ANALYSIS AND PRESENTATION OF ESTIMATED ECONOMETRIC MODELS

6.1 Introduction

In this chapter, the variables included in the estimated models for agriculture, manufacturing and mining and quarrying are described and analysed. The estimated results of the model for agriculture are presented first, followed with the models for the manufacturing and mining and quarrying respectively. The results are analysed and their implications discussed.

6.2 The model for the agricultural sector

The data (sources, derivation and univariate characteristics) utilised in both the long-run cointegration and short-run dynamics of the model is presented in appendix1. Appendix 2 represents the stochastic functions. On the other hand, appendix 3 presents the graphical illustration of the data series. Appendices 4 and 5 are the Augmented Dickey-Fuller tests for non-stationarity levels and first differences

Table 6.1 highlights data included in Model for agriculture. The data described in Table 6.1 assesses the policy impact of the public capital expenditure, labour, fertiliser, interest rates, the agricultural credit guarantee scheme and the dummy representing the structural adjustment programme (SAP) on agricultural production and development in Nigeria.

Table 6.1 Data incorporated in the estimated agricultural model

AGR	agricultural GDP at 1984 constant factor cost
AGCAP	public capital expenditure for the agricultural sector
FERT	fertiliser
RI	interest rates for the agricultural sector
AGLABOR	estimated labour engaged in agriculture
ACGS	agricultural credit guarantee scheme
DUM86SAP	impact of the structural adjustment programme on the agricultural sector (SAP launched in 1986)
LN	natural logarithms
Data coverage	1970-2005

6.2.1 Estimation results of the long-run cointegration equation

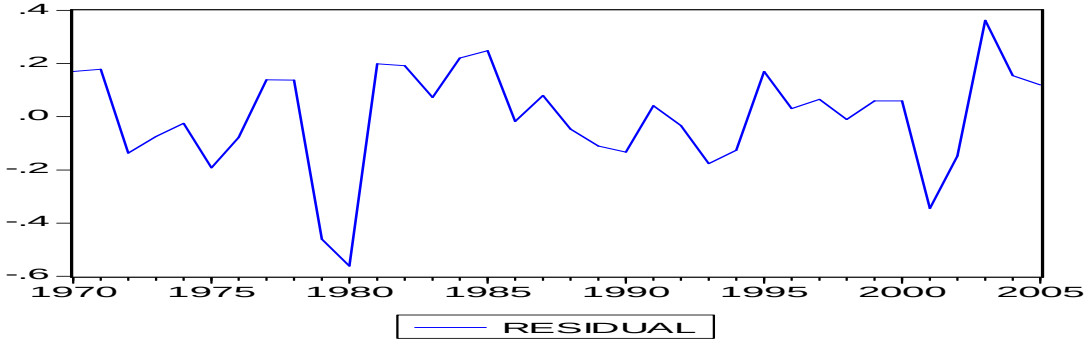
The first step of the Engle-Yoo (1991) three-step estimation technique was applied to test whether the set of variables specified in the empirical model is cointegrated. In essence, it shows whether the combination of variables incorporated in the estimation is consistent with the long-run equilibrium relationship. The cointegration results are reported in Table 6.2

Table 6.2 Estimated results of the Long-run cointegration equation

Dependent Variable: LNRAGR				
Method: Least Squares				
Sample: 1970 2005				
Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRAGCAP	0.144091	0.030233	4.766050	0.0000
LNRFERT	0.279778	0.062744	4.459029	0.0001
RI	-0.001385	0.002504	-0.552957	0.5844
LNRAGLABOR	0.511459	0.066712	7.666721	0.0000
DUM86SAP	0.297486	0.108455	2.742938	0.0102
LNRACGS	0.039825	0.016677	2.387982	0.0234
R-squared	0.961215	Mean dependent var		9.946248
Adjusted R-squared	0.954751	S.D. dependent var		0.987669
S.E. of regression	0.210096	Akaike info criterion		-0.131496
Sum squared resid	1.324206	Schwarz criterion		0.132424
Log likelihood	8.366926	Durbin-Watson stat		1.480066

The Engle-Granger test statistic of -5.601804 should be compared with the response surface for any number of regressors, excluding any constant and trend components, 1<n<6, can be calculated as $C(P)=\phi_{\infty}+\phi_1 T^{-1}+\phi_2 T^{-2}$, where $C(P)$ is the P percent critical value. The conclusion about this estimation is to reject the null hypothesis of a unit root in the residual. In essence, there is evidence of cointegration at the 10 percent, 5 percent and 1 percent. The diagram shown in Figure 6.1 also indicates that the residuals are stationary.

Figure 6.1 Residuals of real agricultural output (lnragr)



6.2.2 Estimation results of the error correction model (ECM)

After the long-run cointegration relationship has been determined, the second stage of the Engle-Yoo procedure entails the estimation of an error correction model (ECM), which captures the short-run dynamics of the adjustment process to the long-run equilibrium. It also incorporates the equilibrium error (lagged residual terms) estimated from the long-run equilibrium relationship. The estimated result of the ECM is reported in Table 6.3.

Table 6.3 Estimated result of the error correction model (ECM)

Dependent Variable: D(LNRAGR)				
Method: Least Squares				
Sample (adjusted): 1973 2005				
Included observations: 33 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUAL(-1)	-0.215507	0.111842	-1.926896	0.0635
D(LNRAGCAP)	0.070147	0.022746	3.083912	0.0044
D(LNRACGS(-2))	0.073439	0.011715	6.268808	0.0000
R-squared	0.694003	Mean dependent var		0.089344
Adjusted R-squared	0.673603	S.D. dependent var		0.180100
S.E. of regression	0.102893	Akaike info criterion		-1.623741
Sum squared resid	0.317611	Schwarz criterion		-1.487695
Log likelihood	29.79173	Durbin-Watson stat		1.638553

The interpretation of the coefficients of the ECM may not be necessary (see Du Toit, 1999a; Koekemoer, 1999; Du Toit & Moolman, 2004). The argument was based on the fact that most variables enter the model in differenced form, it becomes intricate to interpret the relationship plausibly. However, the coefficient of the lagged residuals is negative and significant. This

shows that the dynamics adjust towards the long-run equilibrium instead of moving away from the equilibrium path. Since all the variables in the ECM are stationary, the assumptions of classical regression analysis are fulfilled. In the ECM of the equation, the adjusted R^2 is 0.673603 or 67 per cent, which shows the estimation is dependable.

6.2.3 Diagnostic statistical testing

The model was subjected to rigorous diagnostic testing. It was noted that all the variables in the ECM are stationary; therefore, the assumptions of classical regression analysis are fulfilled. This implies that standard diagnostic tests can therefore be used to determine which variables should be included in the final specification of ECM (Harris, 1995:25; Du Toit 1999b:94). The diagnostic test results reported in Table 6.4 reveal that the function passes all the statistical diagnostic tests.

Table 6.4 Diagnostic tests on the real estimated agricultural model

Purpose of test	Test	d.f	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	JB(2)	4.8572	0.0886	Normal
Heteroscedasticity	ARCH LM	$nR^2(2)$	0.064982	0.798788	No heteroscedasticity
Heteroscedasticity	White	$nR^2(2)$	5.411518	0.492215	No heteroscedasticity
Serial correlation	Lung Box Q	Q(12)	6.4754	0.890	No serial correction
Misspecification	Ramsey Rest	LR(2)	0.992500	0.608809	No specification problem

6.2.4 Cointegration correction and adjusted coefficients

In this step, the originally estimated coefficients and t-statistics are adjusted by applying the Engle-Yoo technique, as depicted in Table 6.5.

Table 6.5 Engle-Yoo third step estimation for the agricultural model

Dependent Variable: ECM_AGR				
Method: Least Squares				
Sample (adjusted): 1973 2005				
Included observations: 33 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
0.215507*LNRAGCAP	-0.009386	0.063014	-0.148958	0.8827
0.215507*LNRFERT	0.026260	0.155365	0.169024	0.8670
0.215507*RI	-0.002820	0.004701	-0.599945	0.5534
0.215507*LNRAGLABOR	0.033403	0.181457	0.184081	0.8553
0.215507*LNRACGS	-0.043824	0.033346	-1.314223	0.1994
R-squared	0.270493	Mean dependent var		0.038448
Adjusted R-squared	0.166278	S.D. dependent var		0.091656
S.E. of regression	0.083690	Akaike info criterion		-1.984666
Sum squared resid	0.196113	Schwarz criterion		-1.757923
Log likelihood	37.74699	Durbin-Watson stat		2.595116

The estimation procedure and the new calculated coefficients are shown in Table 6.6.

Table 6.6 The calculation of the new coefficients for agricultural model

Variable	Coefficient	Std. Error	t-Statistic
LNRAGCAP	0.144091 - 0.009386=0.134705	0.063014	2.1377
LNRFERT	0.279778 + 0.026260=0.306038	0.155365	1.9698
RI	-0.001385 - 0.002820= -0.004205	0.004701	-0.8945
LNRAGLABOR	0.511459 + 0.033403=0.544862	0.181457	3.0027
LNRACGS	0.039825 - 0.043824= -0.003999	0.033346	-0.0119

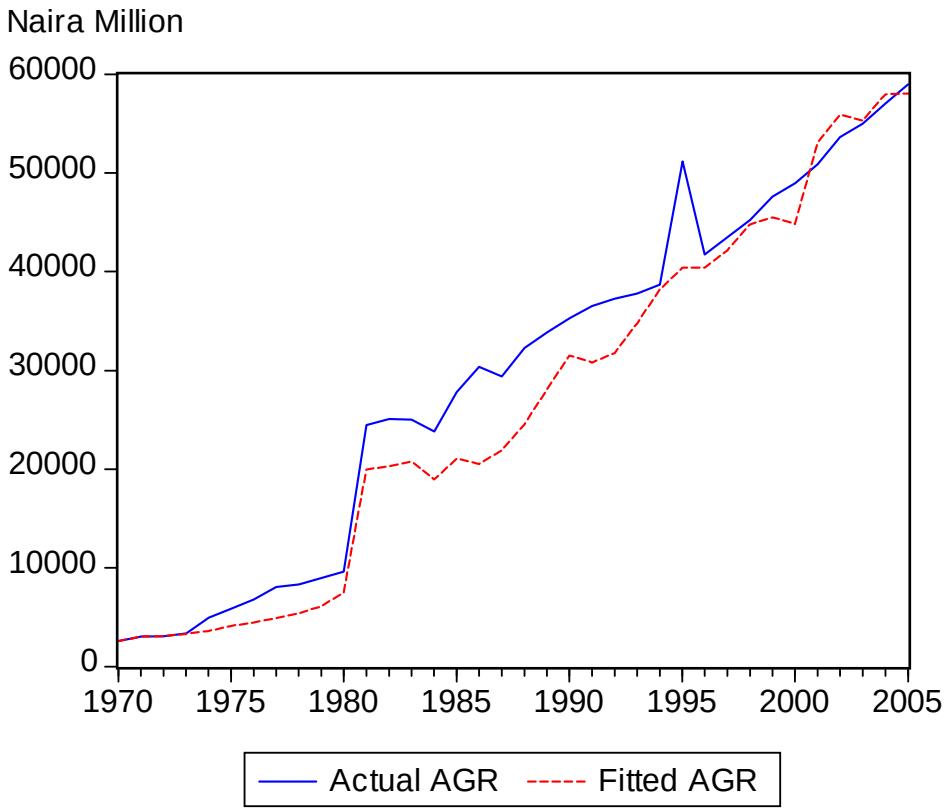
Table 6.7 represents the adjusted coefficient and adjusted t-statistic of the long- run cointegration estimation for the agriculture equation.

Table 6.7 The adjusted coefficients and t-statistics

Variable	Adjusted Coefficient	Adjusted t-Statistic
LNRAGCAP	0.134705	2.1377
LNRFERT	0.306038	1.9698
RI	-0.004205	-0.8945
LNRAGLABOR	0.544862	3.0027
LNRACGS	-0.003999	-0.0119
R-squared	0.961215	
Adjusted R-squared	0.954751	

A dynamic simulation of combined long and short-run characteristics of the model results in the overall fit is presented in Figure 6.2.

Figure 6.2 Actual and fitted values of agriculture model



The closeness of fit of the model depicted in Figure 6.2 shows that the model is stable and well specified. However, while the model moved progressively, it also showed some structural breaks and progression. For example, from the base year 1970, there was a smooth and rapid increase to 1980 when it stooped slightly before experiencing an upward movement until it got to the peak in 2005. The sudden low down and the immediate upward movement from the1980s could be explained as a time period when the agricultural sector was almost losing it contribution to the economy. However, as a result of the Green revolution launched in the 1982, and the subsequent policy strategies and intervention to the sector, the output has improved. The performance of the sector between 2000 and 2005 has shown a much better improvement due to government focused policy attention.

6. 2. 5 Analysis of the results of the estimated model for agriculture and their implications

The estimated multiple cointegration results shown in Table 6.2 of the long-run estimated coefficients reveal that the R^2 is 0.961215 or 96 per cent. This is an indication that 96 per cent of variations in agricultural production within the period under consideration are caused by public capital expenditure, labour, fertiliser, a robust interest rate regime, agricultural credit guarantee scheme, the policy measures and impact of the SAP on the sector. The adjusted R-squared is 0.954751 or 95 per cent. This high value shows that the model is dependable.

The coefficients show the expected signs as discussed in chapter five. The results show that a one per cent increases in public capital expenditure will cause 0.14 per cent increase in agricultural production. Furthermore, a one percent increase in labour supply to the agricultural sector will cause 0.51 per cent increase in the agricultural gross product. Similarly, a one per cent increase in fertiliser usage for crops production will cause 0.28 per cent increase in agricultural production. The results show that a one per cent increase in interest rate charged by the banks for loans granted to farmers have an insignificant -0.001385 per cent decline in agricultural production in Nigeria. Also, a one per cent increase in the agricultural credit guarantee scheme to the sector will cause the agricultural production to increase by 0.039 per cent. This results show that the credit scheme to the farmers have positive significant impact on agricultural production though the magnitude is not large.

However, dum86sap shows a positive impact on the agricultural production in Nigeria. The results show that the introduction of the structural adjustment programmes (SAP) causes the agricultural production to increase to about 0.30 per cent. The sharp increase in agricultural production between 1986 and 1990 reflected a favourable response of agricultural production to the SAP measures (Central Bank of Nigeria, 2000:38). The adjusted coefficients and t-statistic in Table 6.7 show that coefficients of fertiliser and labour increased to 0.31 percent and 0.54 per cent respectively. But the coefficient of pubic capital expenditure decreased slightly to 0.13 per cent, while the adjusted coefficient for interest rate increased to -0.0042, the agricultural credit guarantee scheme dropped to -0.0039 per cent. However, the adjusted t-statistic of all the variables shows a slight decrease while the interest rates coefficient remains insignificant.

The coefficients are subjected to diagnostic statistical tests, and the results confirm that there are no serious problems with autocorrelation and that serial correlations are absent. The adjusted t-statistics also indicate that all the variables are statistically significant. The stability test reveals that the variables included in the model are not mis-specified but are stable.

6. 3 The model for manufacturing

The purpose of the model for manufacturing is two-fold. Firstly the to assess impact of the domestic investment climate with respect to the availability of labour in Nigeria; and secondly, the role of FDI in the Nigerian economy vis-a-vis the impact of these variables on the manufacturing gross output within the period under consideration. The variables shown in Table 6.8 are included in the manufacturing model.

Table 6.8 Data incorporated in the estimated manufacturing model

MANUF	manufacturing value-added GDP
MANLABOR	estimated labour engaged in industry/manufacturing
FDIM	foreign direct investment into the manufacturing sector
EXCH	Naira/dollar exchange rate
MANCAP	public capital expenditure for the manufacturing sector
INFRAST	public expenditure for communication and transportation
EXPORT	Exports of non-oil goods
DUM86SAP	impact of the structural adjustment programme on the manufacturing sector (SAP launched in 1986)
LN	natural logarithms
Data coverage	1970-2005

6.3.1 Estimation results for long-run cointegration equation

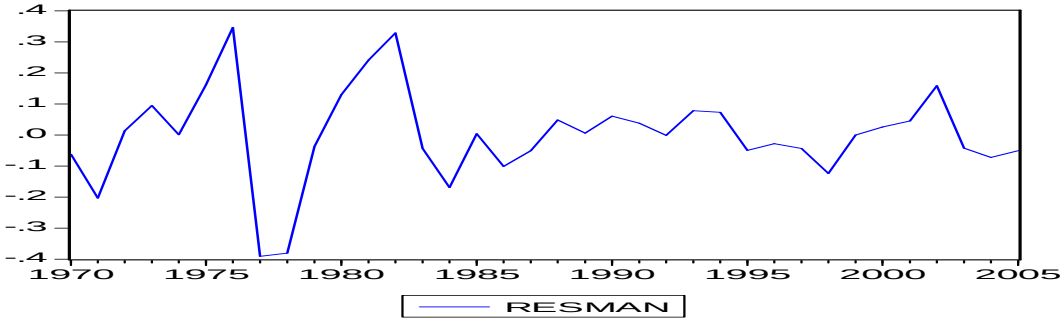
The first step of the Engle-Yoo (1991) three-step estimation technique was applied to test whether the set of variables specified in the empirical manufacturing model is cointegrated. The estimated result shows whether the combination of variables incorporated in the model is consistent with the long-run equilibrium relationship. The cointegration results are reported in Table 6.9.

Table 6.9 Estimated result of the long-run cointegration equation

Dependent Variable: LNRMANUF				
Method: Least Squares				
Sample: 1970 2005				
Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRMANLABOR	0.348549	0.153239	2.274552	0.0300
LNRFDIM	0.195541	0.063924	3.058955	0.0046
LNREXCH	-0.082614	0.041861	-1.973549	0.0574
DUM86SAP	0.123274	0.069546	1.772549	0.0861
C	16.26863	1.867324	8.712271	0.0000
R-squared	0.855435	Mean dependent var		22.74094
Adjusted R-squared	0.836782	S.D. dependent var		0.398403
S.E. of regression	0.160956	Akaike info criterion		-0.687129
Sum squared resid	0.803109	Schwarz criterion		-0.467195
Log likelihood	17.36832	F-statistic		45.85929
Durbin-Watson stat	1.453011	Prob(F-statistic)		0.000000

The Engle-Granger test statistic of -5.541749 should be compared with the response surface for any number of regressors, excluding any constant and trend components, 1<n<6, can be calculated as $C(P)=\phi_{\infty}+\phi_1 T^{-1}+\phi_2 T^{-2}$, where $C(P)$ is the P percent critical value. The conclusion about this estimation is to reject the null hypothesis of a unit root in the residual. In essence, there is evidence of cointegration at the 10 percent, 5 percent and 1 percent. The diagram shown in Figure 6.3 also indicates that the residuals are stationary.

Figure 6.3 Residuals: real manufacturing value-added (lnrmanuf)



6.3.2 Estimation results of the error correction model (ECM)

After the long-run cointegration relationship has been determined, the second stage of the Engle-Yoo procedure, the ECM is applied. The estimated results of the ECM are reported in Table 6.10.

Table 6.10 Estimated result of the error correction model (ECM)

Dependent Variable: DLNRMANUF				
Method: Least Squares				
Sample (adjusted): 1973 2005				
Included observations: 33 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESMAN(-1)	-0.786186	0.151841	-5.177696	0.0000
DLNRFDIM(-2)	0.296068	0.089988	3.290063	0.0029
DLNRMANCAP	-0.035805	0.012899	-2.775780	0.0101
DLNRMANLABOR(-1)	0.292775	0.160440	1.824824	0.0795
DLNRINFRAST	0.059601	0.031835	1.872181	0.0725
DLNREXPORT	-0.237181	0.119638	-1.982481	0.0581
DLNREXPORT(-1)	-0.384988	0.148737	-2.588387	0.0156
R-squared	0.680490	Mean dependent var		0.034814
Adjusted R-squared	0.606757	S.D. dependent var		0.179230
S.E. of regression	0.112394	Akaike info criterion		-1.347790
Sum squared resid	0.328440	Schwarz criterion		-1.030349
Log likelihood	29.23853	Durbin-Watson stat		1.708094

The need to build a strong short-run dynamics that will facilitate a long-run equilibrium situation leads to the inclusion of three important variables. These variables are public capital expenditure for the manufacturing sector DLNRMANCAP, infrastructure DLNRINFRAST and non-oil exports goods D(LNREXPORT). The public capital expenditure variable plays crucial role in the manufacturing sector, it shows the government's support and contribution to industrialisation in Nigeria through supervisory, training to improve managerial and entrepreneurial skills, research and development to the sector. Infrastructure is one of the key factors needed in any country that encourages manufacturing enterprises. For this reason the variable is included in the ECM. The non-oil exports from the manufacturing sector earn foreign exchange for the enterprises and to the economy. This variable plays important role in the functioning of the sector. For this reason, it is included in the ECM to foster the long-run dynamics of the equilibrium mechanism.

The interpretation of the coefficients of the ECM may not be necessary (see Du Toit, 1999; Koekemoer, 1999; Du Toit & Moolman, 2004). The argument was based on the fact that most variables enter the model in differenced form, it becomes intricate to interpret the relationship plausibly. However, the coefficient of the lagged residuals is negative and significant. This shows that the dynamics adjust into the long-run equilibrium instead of moving away from the

equilibrium path. Since all the variables in the ECM are stationary, the assumptions of classical regression analysis are fulfilled. In the ECM of the equation, the adjusted R^2 is 0.606757 or 61 per cent, which shows the estimation is dependable.

6.3.3 Diagnostic statistical testing

The manufacturing value-added function was subjected to rigorous diagnostic testing. Once again it must be noted that, since all the variables in ECM are stationary, the assumptions of classical regression analysis are filled. Standard diagnostic tests can therefore be used to determine which variables should be included in the final specification of the ECM (Harris, 1995:25; Du Toit, 1999:94). The diagnostic test results reported in Table 6.11 indicate that the function passes all the statistical diagnostic tests.

Table 6. 11 Diagnostic tests on the real estimated manufacturing model

Purpose of test	Test	d.f	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	JB(2)	1.078167	0.583283	Normal
Heteroscedasticity	ARCH LM	$nR^2(2)$	3.816047	0.148373	No heteroscedasticity
Heteroscedasticity	White	$nR^2(2)$	16.72262	0.271261	No heteroscedasticity
Serial correlation	Breusch-Godfrey	$nR^2(2)$	3.695195	0.157615	No serial correction
Serial correlation	Lung Box Q	Q(12)	14.625	0.263	No serial correction
Misspecification	Ramsey Rest	LR(2)	3.840542	0.146567	No problem of misspecification

6.3.4 Cointegration correction and adjusted coefficients

Table 6.12 gives the summary the Engle-Yoo third-step estimation results.

Table 6.12 Engle-Yoo third step estimation for the manufacturing model

Dependent Variable: ECMAN				
Method: Least Squares				
Sample (adjusted): 1973 2005				
Included observations: 33 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
0.786186*LNRMANLABOR	0.039271	0.027856	1.409813	0.1689
0.786186*LNRFDIM	-0.075619	0.053617	-1.410357	0.1687
0.786186*LNREXCH	0.042925	0.034930	1.228883	0.2287
R-squared	0.065383	Mean dependent var		-0.004696
Adjusted R-squared	0.003075	S.D. dependent var		0.101198
S.E. of regression	0.101042	Akaike info criterion		-1.660050
Sum squared resid	0.306285	Schwarz criterion		-1.524004
Log likelihood	30.39083	Durbin-Watson stat		1.902675

The calculation of the new coefficients and t-statistics is shown in the Table 6.13.

Table 6.13 The calculation of the new coefficients for manufacturing model

Variable	Coefficient	Std. Error	t-Statistic
LNRMANLABOR	0.348549 + 0.039271= 0.38782	0.027856	13.922315
LNRFDIM	0.195541 - 0.075619= 0.119922	0.053617	2.2366414
LNREXCH	-0.082614 + 0.042925= -0.039689	0.034930	-1.1362439
DUM86SAP	0.123274	0.069546	1.772549
C	16.26863	1.867324	8.712271

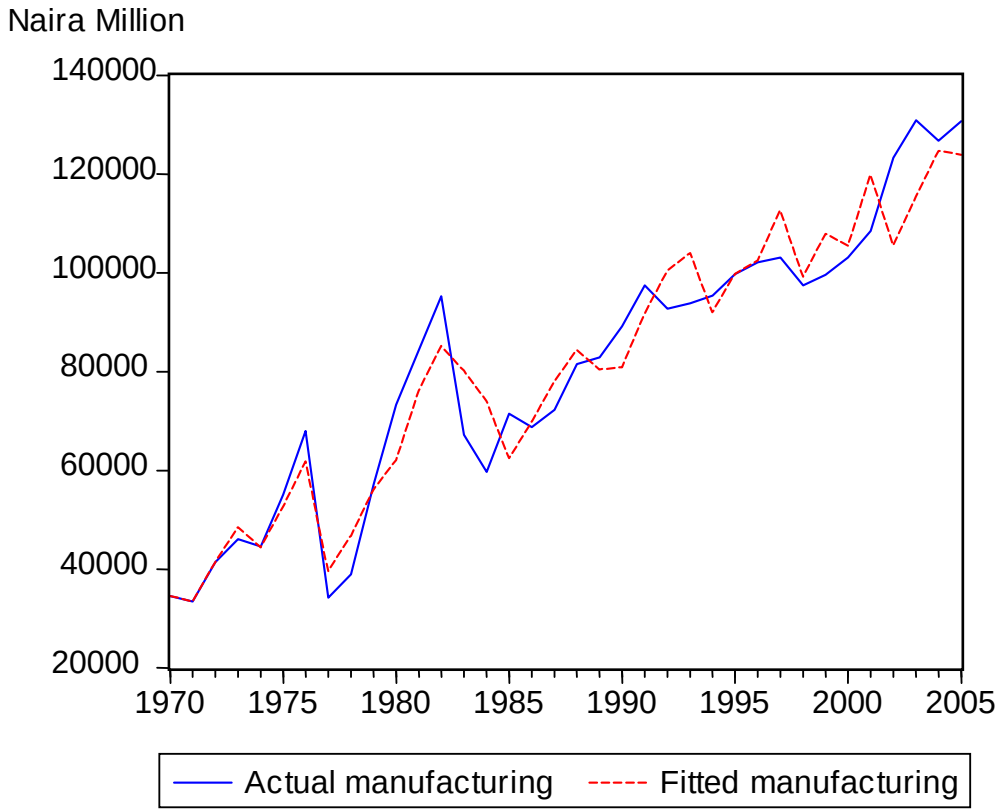
The adjusted coefficients and t-statistics are reported in the Table 6.14.

Table 6.14 The adjusted coefficients and t-statistics

Variable	Coefficient	t-Statistic
LNRMANLABOR	0.38782	13.922315
LNRFDIM	0.119922	2.2366414
LNREXCH	-0.039689	-1.1362439
DUM86SAP	0.123274	1.772549
C	16.26863	8.712271
R-squared	0.855435	
Adjusted R-squared	0.836782	

Based on the new adjusted coefficient, the model for dynamic stimulation of the actual and fitted manufacturing equation was solved. The result is graphically presented in figure 6.4.

Figure 6.4 Actual and fitted manufacturing model



The solved model shows that the actual and fitted results are very close. The trend shows an erratic upward movement from the base year 1970 through to 2005. This explains the growth pattern of the Nigeria's manufacturing GDP within the period under consideration. Ogwuma (1996:69-70) states that the growth momentum of the manufacturing sector is not being sustained due to a poor technology base, poor performance of infrastructural facilities, low production volume and variety, and lack of new foreign capital (FDI). Thus, it is vital that the manufacturing sector in Nigeria increases its productivity, maintains a rapid growth pattern and contributes to the economic development of the country. This could happen with fresh local and foreign capital injection (FDI) and the adoption of new manufacturing technologies in the sector (Ogwuma, 1996:72).

6. 3. 5 Analysis of the results of the estimated manufacturing model and their implications

The estimated cointegration results shown in Table 6.9 reveal that the R^2 is 0.855435 or 86%. The variation in the manufacturing output can be explained by labour (LNRMANLABOR), foreign direct investment (LNRFDIM) into the sector and the policy impact of the SAP (DUM86SAP) during the period of 1970-2005 in Nigeria. The adjusted R-squared exhibits a high value of about 0.836782 or 84%, which shows that the model is dependable. The signs of the coefficients are consistent with the expectations, with the exception of the exchange rates.

The results show that a one per cent increase in labour supply to the manufacturing sector will cause the value-added GDP to increase by 0.35 per cent. Furthermore, a one per cent increase in foreign direct investment into the manufacturing sector of Nigeria will cause the value-added GDP to increase by 0.20 per cent. Also, a one per cent increase in Naira/dollar exchange rate will cause the value-added GDP of the manufacturing sector to decline by -0.08 per cent. Similarly, dum86sap which tests the policy impact of the structural adjustment programme on the manufacturing sector shows a favourable impact. It indicates a 0.12 per cent increase in the value-added manufacturing output.

The adjusted coefficients in Table 6.14 show that labour slightly increased to 0.38782 and foreign direct investment decreased marginally to 0.119922. The Naira/dollar exchange rates also decreased to -0.039689. However, the adjusted t-statistic for labour increases significantly to 13.922 while FDI and Naira/dollar exchange rates decreased slightly to 2.237 and -1.136 respectively.

The coefficients are further subjected to diagnostic testing. The results show that the variables do not suffer from problems of autocorrelation and serial-correlation. The adjusted t-statistics are all statistically significant. Most importantly, the stability test indicates that the model is not misspecified and stable.

6. 4 Model for the mining and quarrying sector

The primary goal of this mining and quarrying cointegration estimation model is to assess the impact of public policy and the implications of mobilising financial resources towards stimulating investment and growth in the solid minerals resources sector for the general

enhancement of the productive capacity of the country. Growth in the mining sector should help to create employment, expanding the revenue sources of Nigeria and, the multiplier effect enhancing development and poverty-reduction in the country. Table 6.15 shows the data included in the long-run cointegration estimation of the mining and quarrying model.

Table 6.15 Data incorporated in the estimation of the mining and quarrying model

MINQUA	mining and quarrying value-added GDP
MINCAP	public capital expenditure for the mining and quarrying sector
LABORMINE	labour in mining and quarrying (as proxy for industry labour)
SOCOMS	public expenditure for social and community services
EXPORT	export of non-oil commodities
DUM86SAP	impact of the structural adjustment programme on the mining and quarrying sector (SAP launched in 1986)
DUM80s	the impact of government policies and programmes on the mining and quarrying sector.
LN	natural logarithms
Data coverage	1970-2005

6.4.1 Estimation results of long-run cointegration equation

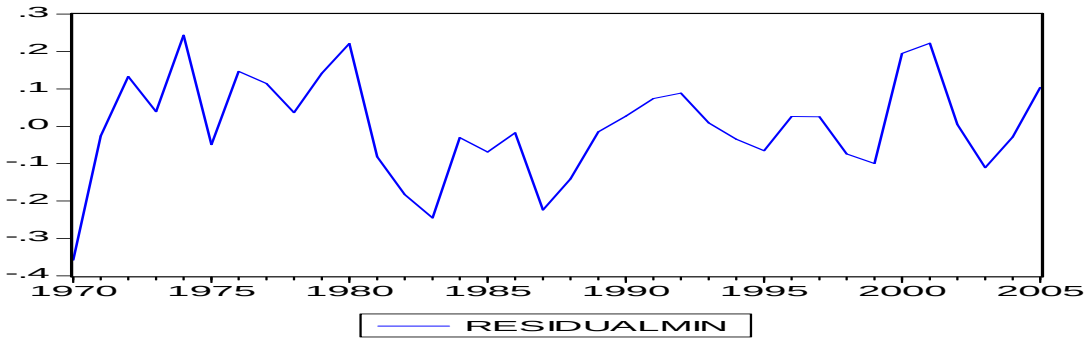
The first Engle-Yoo (1991) cointegration estimation of the real mining and quarrying (lnrminqua) is carried out to determine if the variables included in the model have long-run cointegration relationship for testing the long-run equilibrium relationship. The cointegration results are reported in Table 6.16.

Table 6.16 Estimated resulted of the long-run cointegration equation

Dependent Variable: LNRMINQUA				
Method: Least Squares				
Sample: 1970 2005				
Included observations: 36				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNRMINCAP	0.049981	0.013501	3.702039	0.0008
LNRLABORMINE	0.345660	0.070412	4.909082	0.0000
DUM86SAP	-0.321980	0.076973	-4.183024	0.0002
DUM80S	-0.242170	0.075437	-3.210220	0.0031
C	19.27908	0.948670	20.32222	0.0000
R-squared	0.734754	Mean dependent var		24.25895
Adjusted R-squared	0.700529	S.D. dependent var		0.262059
S.E. of regression	0.143409	Akaike info criterion		-0.917981
Sum squared resid	0.637553	Schwarz criterion		-0.698048
Log likelihood	21.52366	F-statistic		21.46815
Durbin-Watson stat	1.191332	Prob(F-statistic)		0.000000

The first methodological step of the Engle-Yoo technique was adapted to test whether or not the set of variables specified in the empirical model is cointegrated, in other words, whether this particular combination of variables is consistent with the long-run equilibrium relationship.

Figure 6.5 Plot of the stationary residuals of the series (residualmin)



The Engle-Granger test statistic of -4.733806 should be compared with the response surface for any number of regressors, excluding any constant and trend components, 1<n<6, can be calculated as $C(P)=\phi_{\infty}+\phi_1 T^{-1}+\phi_2 T^{-2}$, where $C(P)$ is the P percent critical value. The conclusion about this estimation is to reject the null hypothesis of a unit root in the residual. In essence, there is evidence of cointegration at the 10 percent, 5 percent and 1 percent. The diagram shown in Figure 6.9 also indicates that the residuals are stationary.

6.4.2 Estimation results of the error correction model (ECM)

After the first long-run cointegration relationship has been dealt with, the second stage of the Engle-Yoo procedure the ECM, is applied, as usual. The estimated results of the ECM are reported in Table 6.17.

Table 6.17 Estimated results of the error correction model (ECM)

Dependent Variable: D(LNRMINQUA)				
Method: Least Squares				
Sample (adjusted): 1971 2005				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
RESIDUALMIN(-1)	-0.317421	0.104364	-3.041468	0.0047
D(LNRSOCOMS)	0.039819	0.017024	2.338972	0.0257
D(LNREXPORT)	0.572139	0.085375	6.701463	0.0000
R-squared	0.707268	Mean dependent var		0.039194
Adjusted R-squared	0.688972	S.D. dependent var		0.142436
S.E. of regression	0.079437	Akaike info criterion		-2.145897
Sum squared resid	0.201926	Schwarz criterion		-2.012581
Log likelihood	40.55319	Durbin-Watson stat		1.925130

Interpreting the coefficients of the ECM may not be necessary (see Du Toit, 1999; Koekemoer, 1999; Du Toit & Moolman, 2004); since most variables enter the model in differenced form, it becomes intricate to interpret the relationship plausibly. However, the coefficient of the lagged residuals is negative and significant. This shows that the dynamics adjust into the long-run equilibrium instead of moving away from the equilibrium path. Since all the variables in the ECM are stationary, the assumptions of classical regression analysis are fulfilled. In the ECM of the equation, the adjusted R^2 is 0.688972 or 69 per cent, which shows the estimation is dependable.

6.4.3 Diagnostic statistical testing

The results of the ECM cointegration estimation for the mining and quarrying model are now subjected to statistical diagnostic tests. Since all the variables in the ECM are stationary, the assumptions of classical regression analysis are satisfied. Standard diagnostic tests can therefore be used to determine which variables should be included in the final specification of the ECM (see Harris, 1995:25; Du Toit, 1999:94). The diagnostic test results reported in Table 6.18 indicate that the model passes all the statistical diagnostic tests.

Table 6. 18 Diagnostic tests on the real estimated mining and quarrying model

Purpose of test	Test	d.f	Test statistic	Probability	Conclusion
Normality	Jarque-Bera	JB(2)	0.887111	0.641751	Normal
Heteroscedasticity	ARCH LM	$nR^2(2)$	8.802333	0.012263	No heteroscedasticity
Heteroscedasticity	White	$nR^2(2)$	3.588072	0.732218	No heteroscedasticity
Serial correlation	Breusch-Godfrey	$nR^2(2)$	0.705390	0.702792	No serial correction
Serial correlation	Lung Box Q	Q(12)	3.5942	0.990	No serial correction
Misspecification	Ramsey Rest	LR(2)	1.317511	0.517495	No specification problem

6.4.4 Cointegration correction and adjusted coefficients

Table 6.19 summarises the results of the third Engle-Yoo step estimation and the adjusted coefficients respectively.

Table 6.19 Engle-Yoo third step estimation for the mining and quarrying model

Dependent Variable: ECM				
Method: Least Squares				
Sample (adjusted): 1971 2005				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
0.317421*LNRMINCAP	-0.016978	0.014063	-1.207287	0.2359
0.317421*LNRLABORMINE	0.008625	0.006764	1.275161	0.2112
R-squared	0.041742	Mean dependent var		0.005818
Adjusted R-squared	0.012704	S.D. dependent var		0.076839
S.E. of regression	0.076349	Akaike info criterion		-2.251562
Sum squared resid	0.192362	Schwarz criterion		-2.162685
Log likelihood	41.40233	Durbin-Watson stat		1.963805

Table 6.20 shows the calculation of the new coefficients and t-statistics.

Table 6.20 The calculation of the new coefficients for mining and quarrying model

Variable	Coefficient	Std. Error	t-Statistic
LNRMINCAP	0.049981 - 0.016978= 0.033003	0.014063	2.346797
LNRLABORMINE	0.345660 + 0.008625=0.354285	0.006764	52.37803
DUM86SAP	-0.321980	0.076973	-4.183024
DUM80S	-0.242170	0.075437	-3.210220
C	19.27908		20.32222
R-squared	0.734754		
Adjusted R-squared	0.700529		

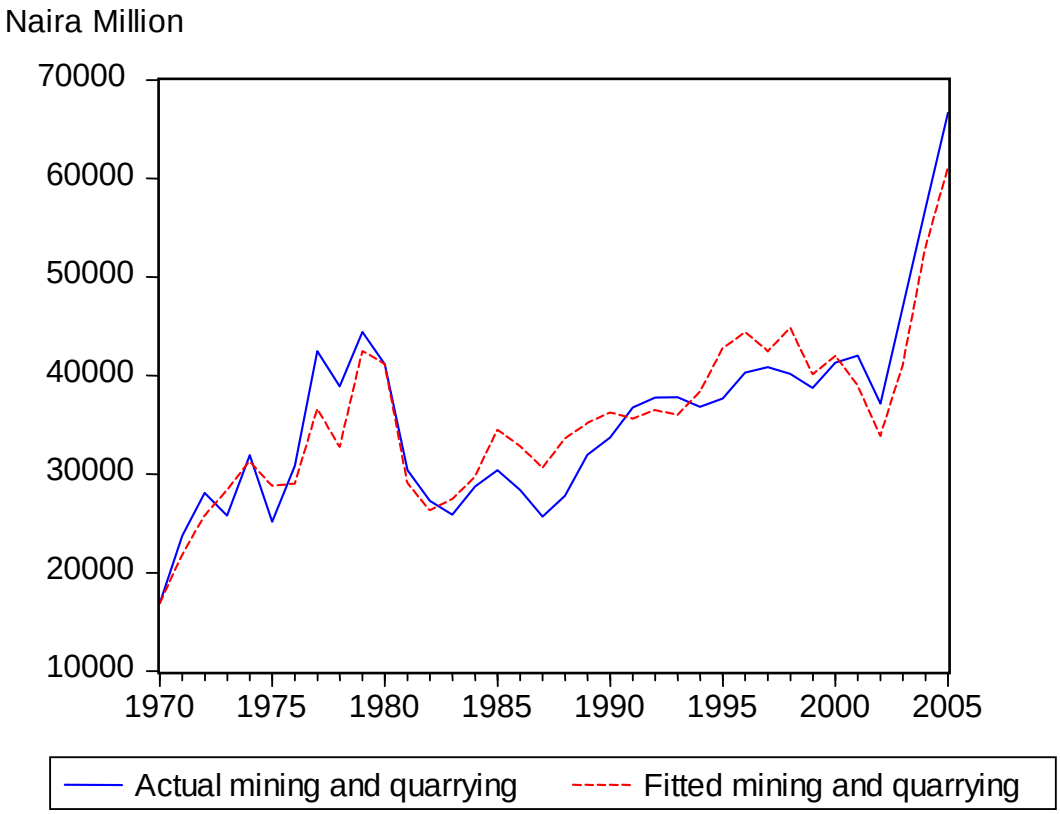
The adjusted coefficients and t-statistics are shown in Table 6.21.

Table 6.21 The adjusted coefficients and t-statistics

Variable	Coefficient	t-Statistic
LNRMINCAP	0.033003	2.346797
LNRLABORMINE	0.354285	52.37803
DUM86SAP	-0.321980	-4.183024
DUM80S	-0.242170	-3.210220
C	19.27908	20.32222
R-squared	0.734754	
Adjusted R-squared	0.700529	

Based on the new adjusted coefficients, the model for dynamic simulation of the actual and fitted mining and quarrying equation was solved. The result is graphically presented in Figure 6.6.

Figure 6. 6 Actual and fitted values of mining and quarrying model



The actual and fitted solved model in Figure 6.6 displays an erratic and slightly onward trend. The trend explains the growth pattern of the Nigeria's mining and quarrying (solid mineral) sector. The sector is characterised by low productive activity over the year due to the government's deliberate policy action. The 1979 and 1999 constitutions of the Federal Republic of Nigeria place the mines and mining and quarrying activities within the exclusive

legislative jurisdiction of the national government (Federal Republic of Nigeria, 1979:16; 1999:131). The deregulation and privatisation of the mining sector would probably improve its growth momentum and potential to contribute to the economic development of Nigeria. Facilitating the productive activity of the sector would enhance rapid onward growth pattern at a faster rate.

The estimation of the cointegration results for valued-added in mining and quarrying shows that the R^2 is 0.734754 or 73 per cent. This implies that all the variations for the period between 1970 and 2005 can be explained by the public capital expenditure for the mining and quarrying and labour in the sector. Similarly, the adjusted R-squared is 0.700529 or 70 per cent, which proves that the model is dependable. The results confirm the basic assumptions stated earlier in Chapter five, that all the coefficients of the variables included in the cointegration estimation model will be positively signed. However, the dum80s which represents the impact of changes in government policies on the sector shows a weak negative relationship with mining and quarrying gross output within the period under consideration.

The negative relationship between the changes in the government policies and the impact on the mining and quarrying sector could perhaps be explained by the fact that the 1979 and 1999 constitutions of the Federal Republic of Nigeria place the mines and the mining and quarrying activities under the control of the national government as mentioned above (Federal Republic of Nigeria, 1979:16; 1999:131). Thus, with the exception of government ministries and agencies, private sector participation mining is extremely difficult in Nigeria. This restriction thus limits the mining or extraction of the solid minerals by private enterprises which could serve as an engine for economic activities and growth in the sector. Limited activity in the mining and quarrying sector could also slow down the contribution of the sector to economic growth and development. It is surprising that the structural adjustment programme launched in 1986 (DUM86SAP) has a negative relationship with the output growth and development of the mining and quarrying sector. Perhaps the exclusive control of the solid minerals by the federal government within the SAP period contributes to the negative policy impact on the sector.

However, the estimation results show that the coefficients of public capital expenditure and labour are positively signed. This implies that a one per cent increase in public capital expenditure will cause the GDP to increase marginally by 0.049 per cent. Similarly, a one per cent increase in labour supply to the mining and quarrying sector will cause the GDP to increase by 0.35 per cent. The results also suggest that these variables could play a crucial positive role in the expansion of mining and quarrying activities, gross national income and poverty reduction in the country. As shown by Onah (2004:1), the development of the mineral sector promotes economic activity through investment, employment of resources, increased output and enlarged aggregate demand. The results of the adjusted coefficients and t-statistics show that public capital expenditure for mining and quarrying dropped marginally to 0.033 per cent, while labour gained slightly after the adjustment process. The t-statistic labour increased to 52.378, but the t-Statistic for public capital expenditure dropped slightly to 2.347.

The variables in the model are subjected to diagnostic statistical testing, and the results confirm that the model is stable and there are no problems of serial correlation. The results show also that the model does not suffer from any specification problem. In the same manner, the values of the adjusted t-statistics show that the coefficients are statistically significant.

6.5 Dynamic simulation response property of the models

Dynamic adjustment (percentage change) shock on the variables included in the models was executed. The 10 percent shock of the chosen variables from 1980 to 2005 coincides with the period when the civilian administration in Nigeria launched the Green Revolution programme. The Green Revolution is a strategy for the attainment of self-sufficiency in food production through the application of an appropriate technology package to the existing system in a bid to meet Nigeria's growing demand for food. Through this programme, large-scale irrigation schemes, budgetary concessions to commercial farms, joint-venture agricultural enterprises, agricultural credit guarantee schemes and the promotion of integrated rural development projects, the level of agricultural output is expected to rise to exceed the demand in the sector. According to Akor (1985:101), the Green Revolution is a strategy for agricultural transformation with the objective of eliminating rural and urban food shortages and poverty. The civilian administration was able to induce some positive changes capable of improving the macroeconomic stability and growth of the economy, especially with regards to improving the

agricultural production in the country, since the 1980s. Thus, the following section is devoted to the analysis of the response to dynamic shocks of the variables estimated in the models.

6.5.1 Policy shocks

The exogenous variables are shocked in order to analyse the response characteristic of the models. The variables shocked are mostly those included in the long-run estimation of the cointegrated econometric model. These variables include: public capital expenditure for agriculture (Agcap); labour in the agricultural sector (Aglabor); foreign direct investment into the manufacturing sector (Fdim) and labour engaged in manufacturing (manlabor). Others include: public capital expenditure for the mining and quarrying (mincap) and labour force in mining and quarrying (labormine). The shocked variables are subjected to a permanent increase of 10 per cent. All the variables are shocked from 1980 onwards. The resulting effects of the shocks are illustrated graphically in Figures 6.7 to 6.12.

Figure 6.7 The effect of a 10 percent increase in public capital expenditure on the agricultural gross product

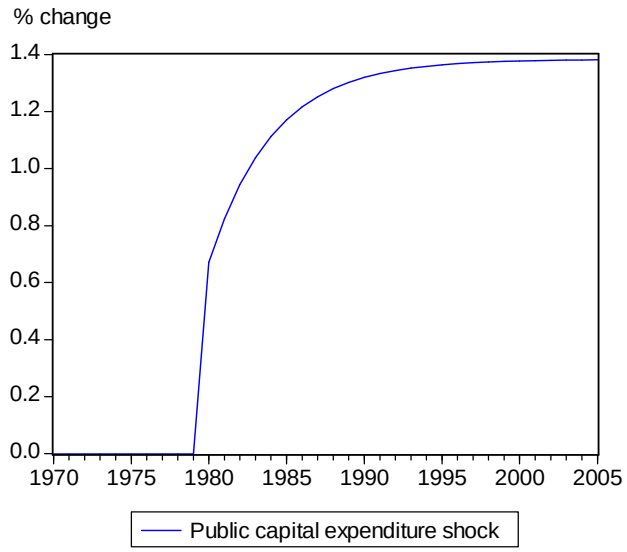


Figure 6.7 shows the dynamic adjustment (percentage change) caused by the public capital expenditure for agricultural production. A 10 per cent increase in capital expenditure for the agricultural sector causes an increase of more than 1 percent in agricultural production. The

effect of the shock is seen as the GDP increases onward from the base year 1980 to 1995, before it returns to equilibrium through 2005.

Figure 6.8 The effect of a 10 percent increase in labour on the agricultural gross product

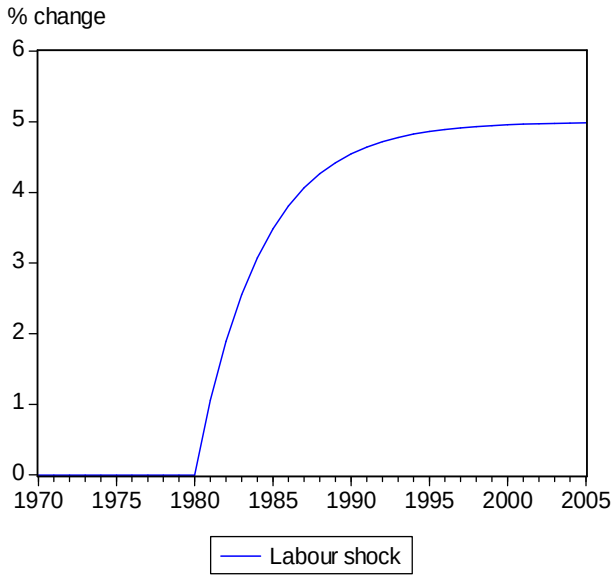


Figure 6.8 shows the dynamic adjustment (percentage change) caused by a 10 per cent increase in labour supply on agricultural production. A 10 per cent increase in labour causes an increase of more than 1 per cent from the base year 1980 to 1995 before it returns to equilibrium through 2005.

Figure 6. 9 The effect of a 10 per cent increase in FDI on the manufacturing gross product

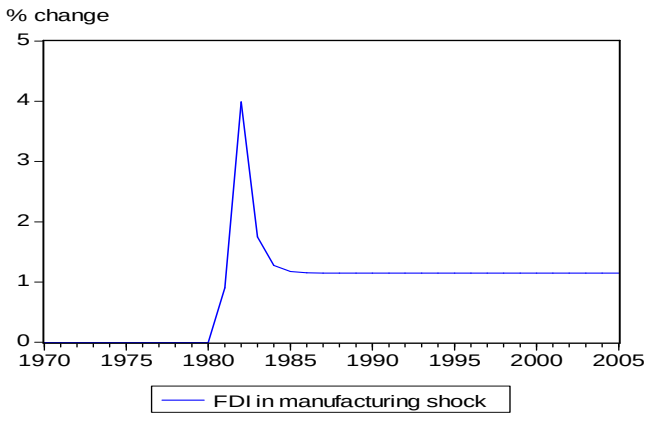


Figure 6.9 shows the dynamic adjustment (percentage change) caused by a 10 per cent increase in FDI into the manufacturing sector. The effect of this shock shows that a 10 per cent increase in FDI inflow will cause an onward increase from the base year 1980 to 1983 before it returns to equilibrium through 2005. This effect shows that FDI can impact positively to the growth of the manufacturing GDP.

Figure 6.10 The effect of a 10 per cent increase in labour on the manufacturing gross product

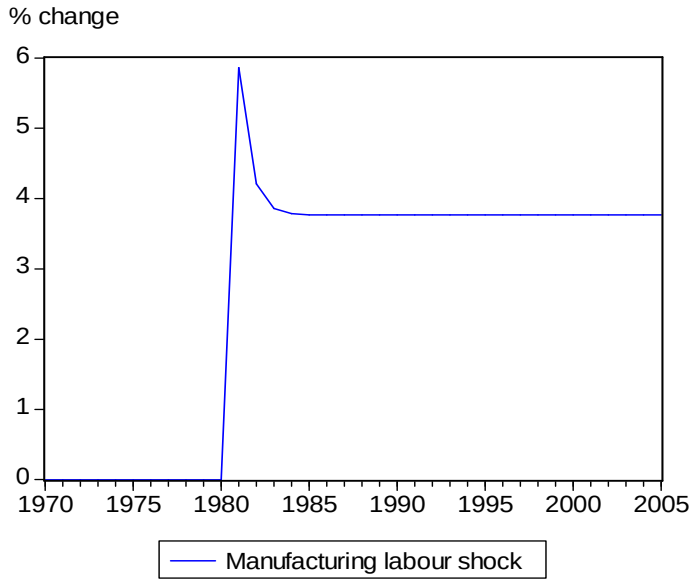


Figure 6.10 shows the dynamic adjustment (percentage change) caused by a 10 per cent increase in labour supply in the manufacturing sector. The effect of this shock shows that a 10 per cent increase in labour supply will cause an onward increase from the base year 1980 to 1983 before it returns to equilibrium through 2005. This effect shows that labour can impact positively to the growth of the manufacturing GDP.

Figure 6.11 The effect of a 10 per cent increase in capital on the mining and quarrying gross product

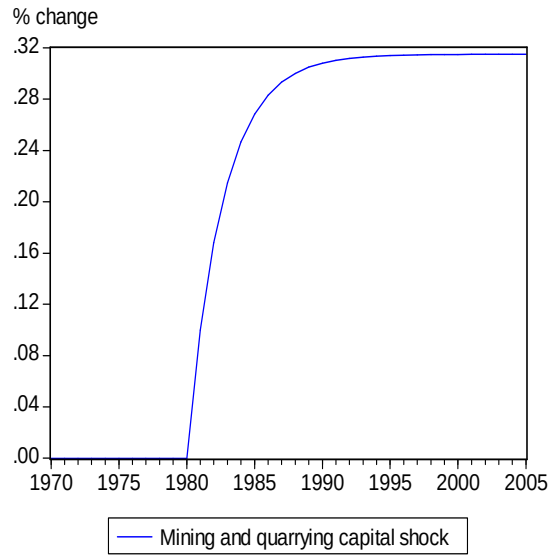


Figure 6.11 shows the dynamic adjustment (percentage change) caused by an increase in 10 per cent in public capital expenditure for the mining and quarrying sector. A 10 per cent increase in capital to the mining and quarrying sector will cause a sharp increase of less than 1 per cent in the GDP of mining and quarrying from the base year 1980 to 1990 before it reaches equilibrium and stabilises through 2005.

Figure 6.12 The effect of a 10 per cent increase in labour supply on the mining and quarrying gross product

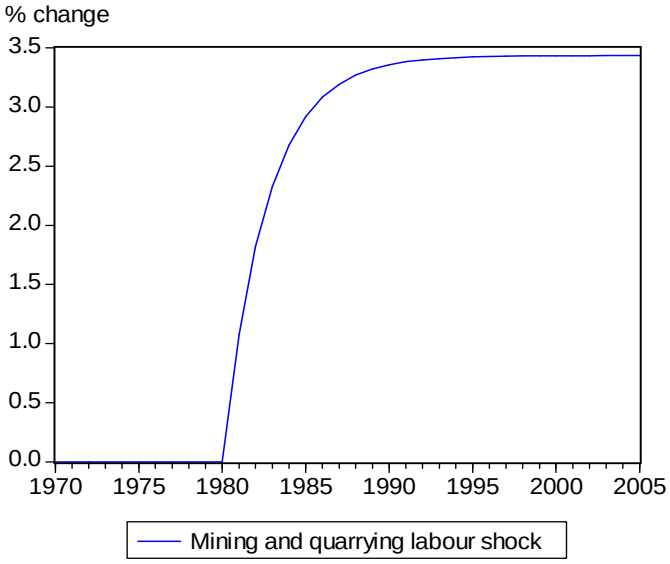


Figure 6.12 shows the dynamic adjustment (percentage change) caused by an increase in 10 per cent in labour supply to the mining and quarrying sector. A 10 per cent increase in labour supply to the mining and quarrying sector will cause a sharp increase of more than 1 per cent in the GDP of mining and quarrying from the base year 1980 before it reaches equilibrium and stabilises through 2005.

Thus these dynamic increases (shocks) in the exogenous variables included in the cointegration econometric models cause significant positive responses overall, suggesting those factors potential for accelerating the agricultural, manufacturing and mining and quarrying sectors growth and development. In the following section, the estimated models forecast from 2005 to 2008 are presented. The actual and forecast values in the models are then compared, to ascertain the policy interventions needed to achieve the forecast for the agricultural, manufacturing, mining and quarrying production in Nigeria.

6. 5. 2 Forecasts

Despite the limited availability of cointegrating data for the econometric estimation, the variables included in the models in the previous section were successfully solved for the period of 1970 through 2005. Now using the estimated values for the variables for years 2006, 2007 and 2008, the forecast and actual values of all endogenous variables are determined in the models, as presented below.

Figure 6.13 depicts the actual and forecast for the real agricultural GDP. The amount for real agricultural output forecast is ₦6.42 billion for 2006, ₦6.44 billion for 2007 and ₦6.52 billion for 2008. The actual amount generated during these years is included for comparison. The forecast values for Nigeria's agricultural sector estimated can be achieved if the country's relatively large active labour force is motivated to engage in agriculture (see Meier & Rauch, 2005:393) It is also important that the public capital expenditure for the agricultural sector be increased, implemented and monitored to achieve the policy strategy and objective of the government to boost production in the sector. In addition, the banks should be encouraged to expand their loans portfolios for agricultural production while keeping the interest rates regime as robust as possible. The supply of fertiliser to the farmers at affordable cost, should be

encouraged in order to mass produce crops for both domestic and foreign markets. The graphical illustration of the forecast model is presented also in Figure 6.13.

Figure 6.13 Actual and forecast for the real agricultural GDP from 2006 to 2008

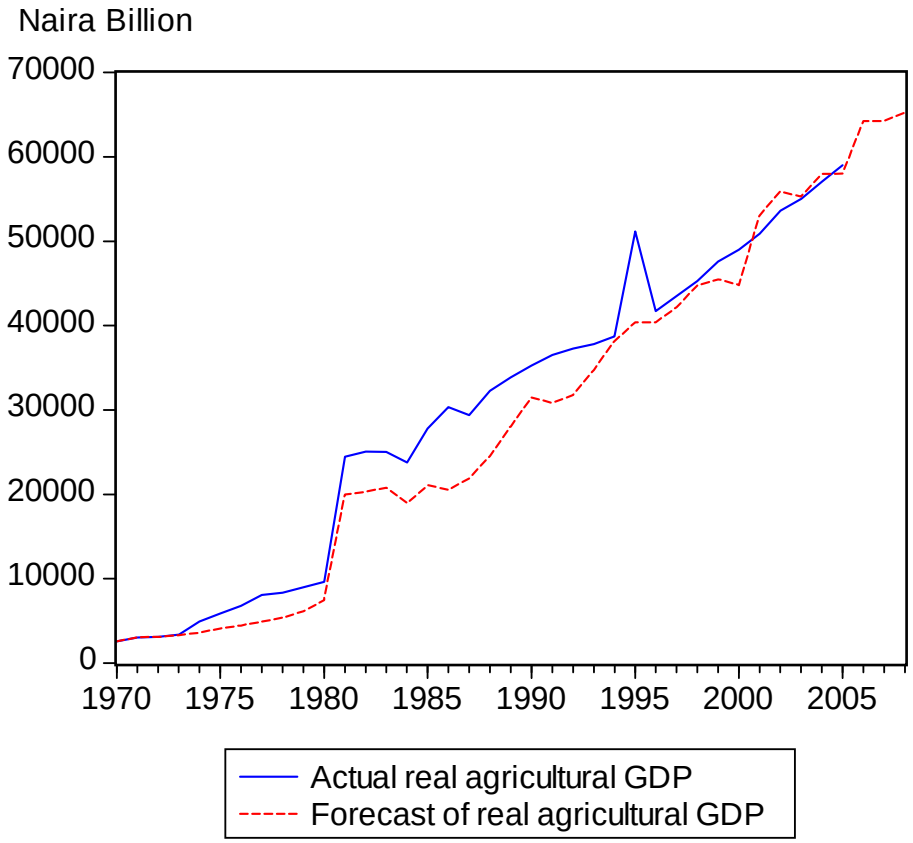


Figure 6.14 shows the estimated impact of labour, FDI into the manufacturing sector and the SAP introduced in 1986 in Nigeria. The amount for the real manufacturing gross output forecast is ₦13.46 billion for 2006, ₦13.99 billion for 2007 and ₦14.63 billion for 2008. However, to ensure that the forecast values of the manufacturing GDP are achieved, it is important that the government improves the investment climate by addressing the challenges in the manufacturing sector in Nigeria. These challenges include infrastructure and security. In addition, the manufacturers need to focus on research and development. Adopting new modern machinery, equipment and technologies should be given top priority in the sector. The graphical illustration of the forecast model is presented in Figure 6.14.

Figure 6.14 Actual and forecast for the real manufacturing GDP from 2006 to 2008

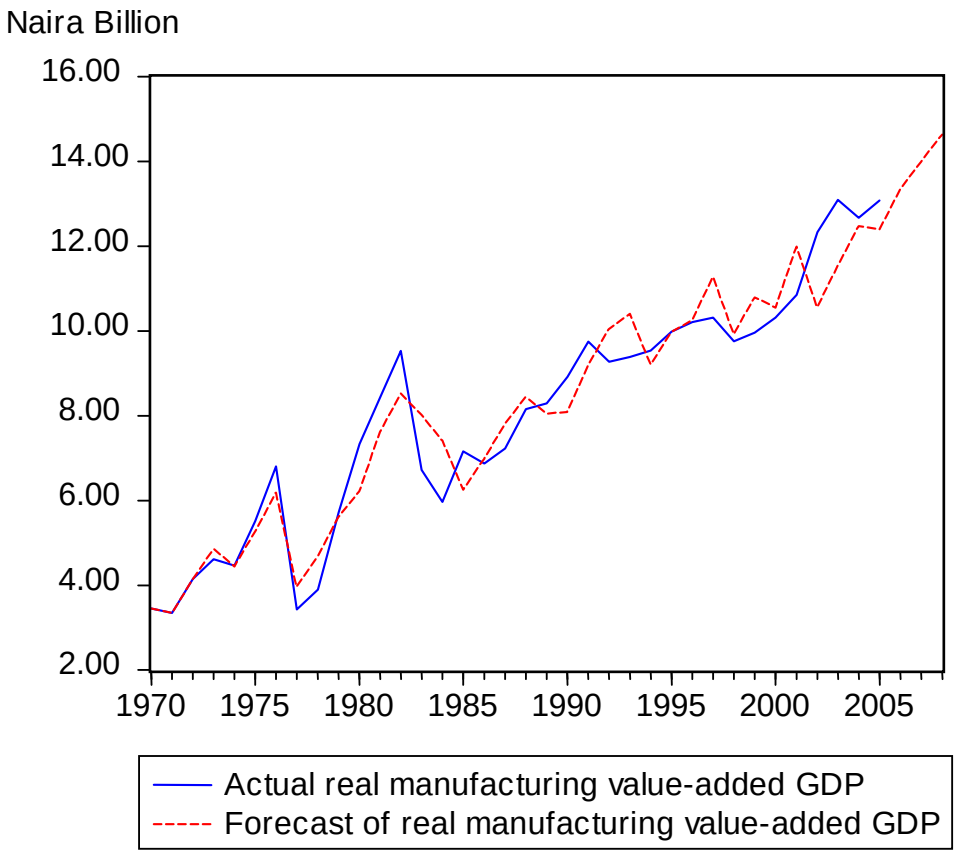
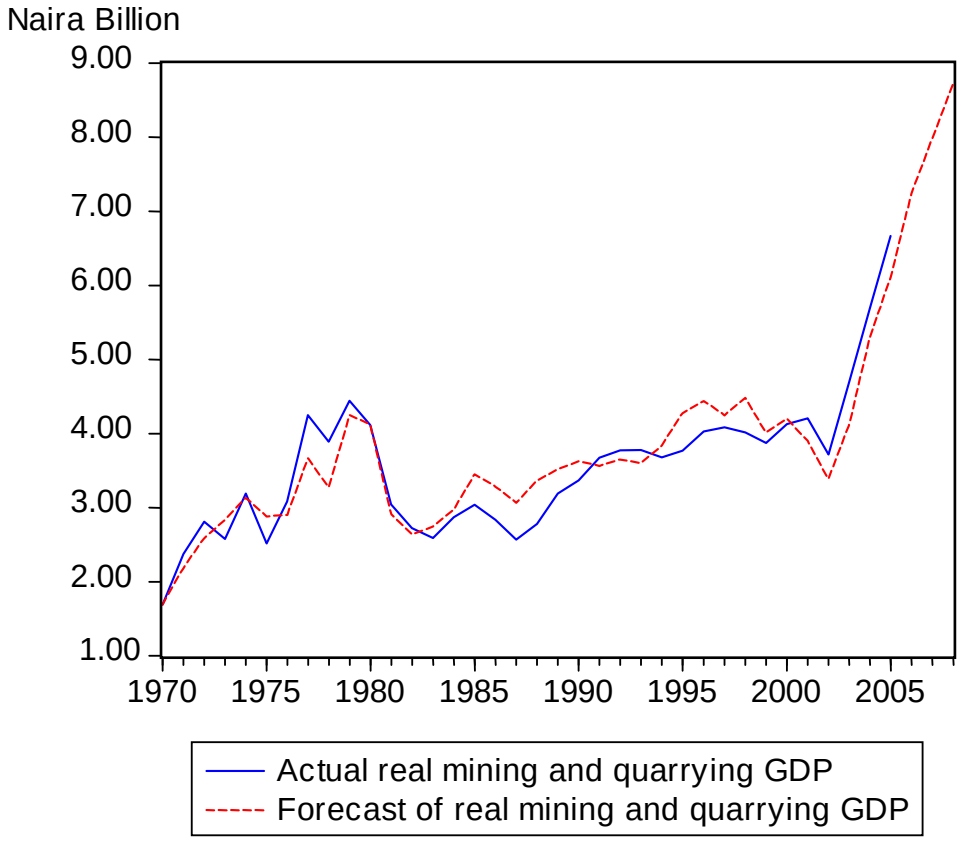


Figure 6.15 represents the actual and forecast output for the mining and quarrying for the period 2005 through 2008. The model estimates the impact of labour and public capital expenditure for the mining and quarrying sector. The gross output of mining and quarrying forecast for 2006 is ₦7.23 billion, ₦7.98 billion for 2007 and ₦8.72 billion for 2008. The forecast values for mining and quarrying GDP can be attained through speedily privatisation of the mines, engaging more active labour in the sector and increasing the export of the commodities. The 1979 and 1999 constitutions of the Federal Republic of Nigeria placed the mines and mining and quarrying activities under the exclusive control of the national government (Federal Republic of Nigeria, 1979:16; 1999:131). The deregulation and privatisation of the sector would trigger more productive activity in the mining and quarrying sector.

The forecast values of the GDP of the mining and quarrying sector should be attained for Nigeria to experience high level of development. Consequently, large injection of foreign capital through new FDI should be targeted; policy advocates that deal with creating an enabling business environment in the sector need to emphasise tax incentive packages for the present and potential mining firms. This will encourage these firms to efficiently engage in mining activity rather than keeping the mines dormant. Sustained increases in the public expenditure for social and community services coupled with improved social responsibility of the mining companies to the communities where the mineral deposits are found will foster peace and productivity in the sector. The graphical illustration of the forecast model is presented in Figure 6.15.

Figure 6. 15 Actual and forecast real value-added GDP for the mining and quarrying from 2006 to 2008



The actual and forecast models reveal that the dynamic econometric cointegration estimation depends generally on the joint behaviour of the variables in the respective models. The observed variations and positive trends of the fitted models have proven that the models are dependable.

As shown in the forecast figures for GDP of agriculture, manufacturing and mining and quarrying, the growth sectors of Nigeria's economy could be stimulated to rapid growth by domestic and foreign financial investment into the sectors. It is significant that the growth path of the agricultural GDP suggests that more people could be productively engaged in the agricultural production, especially in large-scale commercial farming. With improved financial intermediation and investment by the commercial banks through efficient mechanisms put in place for the smooth operation of the agricultural credit guarantee scheme (ACGS), increased public (budgetary) expenditure for social and community services especially to the rural areas, improved fertiliser usage, the output potential of the sectors could be significantly harnessed for the development of the Nigerian economy. More foreign exchange could accrue to the country through the exports of the agricultural and solid mineral commodities.

6. 6 Dynamic simulation of the results and the policy-scenarios

The dynamic simulation of results for the various policy scenarios are shown in Table 6.22. The simulations are run for the policy scenario from the results of the long-run cointegration econometric estimated models. The simulation results of the policy proposals highlight the relevance of the results for the policy targets, policy goal and action steps that must be taken to harness the resource potentials of the agricultural, manufacturing and the mining and quarrying sectors of the Nigerian economy.

Table 6. 22 Policy proposals based on the empirical results

Scenarios	Variables	Policy targets	Policy goal
Control/strategy	Positive significant		
Improved production and socio-economic conditions	▪ Agcap: the public capital expenditure for the agricultural and mining and quarrying sectors	▪ Improved housing and rural electricity provision; ▪ Improved primary and secondary education; ▪ Improved health care, (availability, affordability/accessibility and quality) ▪ Improved adult literacy; ▪ Improved life expectancy; ▪ Decrease in mortal rate ▪ Decrease in violence and unrest at the grass roots; disincentives to rural-urban migration; and ▪ Improved telecommunications and information flow to rural population ▪ Improved mining and quarrying (solid mineral) policy with incentives structure for private sector ▪ Improved interaction and consultation between firms exploiting the natural resources (land, forest, and minerals)	-eradication of water-borne diseases -improved productive socio-economic activities -improved economic and political stability -efficiency in production -improved quality of labour -improved welfare and service delivery -improved indigenous human capital development -facilitate economic growth and development across geo-political zones of the country
Increased financing of growth sectors	▪ Credit guarantee scheme to the agricultural sector	▪ Improved cost-effective production; ▪ Lower cost of production; ▪ Disincentive to higher consumer prices; ▪ Create and empower entrepreneurial investment (small and medium scale enterprises); and ▪ Induce growth, development and political stability	-improved sustainable growth of diversified economy -improved research institutions and modern agriculture -enhanced export-led industrial production
Increased foreign investment	▪ FDI in to the manufacturing sector	▪ Increased drive for investment and government to encourage the proliferation FDI large-scale and small-scale mining ▪ Create investment friendly environment; ▪ Accelerate foreign business registration; ▪ Reduce the cost of doing business in the country, by eradicating corruption; ▪ Induce cost-effective production; and put in place a robust package of industrial policy-incentives (fiscal and monetary) ▪ Ensure orderly and competitive playing field for the various growth sectors of the economy ▪ Improved mining and quarrying (solid mineral) policy with incentives structure for private sector	-improved socio economic environment and attractiveness of Nigeria as preferred investment destination -improved social, legal, good governance and rule of law -improved efficiency of production and cost-effective investment opportunities
Increased soil fertility and crops production	▪ Fertiliser improves soil nutrients	▪ Increased incentive for high crop yields ▪ Disincentive for environmental degradation ▪ Improved farming system and land/soil conservation	-stimulate fertiliser production plants/firms in the country - contributes to foreign exchange earning and save excessive imports of fertiliser
Increased labour productivity and employment generation	▪ Labour employed in agriculture, manufacturing	▪ Improved productivity of for peasant farmers ▪ Increased production by commercial agriculture	-create more new jobs in the rural areas arising from large commercial agricultural activities,

	and mining and quarrying sectors		manufacturing absorbing more labour from agriculture and mining sectors

Source: Extracted from the empirical results

6. 7 Summary of the main findings and conclusion

Three behavioural equations defined in the form of a neoclassical supply-side model for the Nigerian economy are estimated individually. Of the three equations, one each is specified for the agricultural sector, the manufacturing, and for the mining and quarrying sectors respectively.

The estimated agricultural equation shows that the gross domestic output is strongly and positively related to labour, public capital expenditure, fertiliser and the agricultural credit guarantee scheme. An empirical study by Wiebe et al (2003:433) finds that labour and fertiliser increase the productivity of agriculture. This finding is consistent with the results of this study. As seen in the results, Nigerian agriculture is highly labour-intensive. This result also agrees with Meier and Rauch (2005:393), who assert that more people in the developing countries need to be encouraged to engage in agricultural production in order to feed the teeming population and eradicate poverty.

This implies that if more people go into agriculture, the gross output is likely to increase. In order to attract more labour into the sector, there should be public education programmes on the importance of agriculture. There is also an urgent need to intensify the on-going efforts at rural development. These efforts should concentrate on the provision of basic infrastructure and amenities such as electricity, clean and drinkable water, access roads and other things people in the rural areas think of as modernisation.

The results also show a strong positive relationship between fertiliser and the gross output of the sector. This result confirms the Federal Office of Statistics (2004:87) report that shows an increasing performance in agricultural production arising from improvements in fertiliser supply, distribution and utilisation in Nigeria.

The role of the government's involvement in agricultural production is seen from the results. The capital expenditure of Nigeria's federal government in the sector has a strong positive relationship with the gross output. By implication, the capital expenditure for the agricultural

sector needs to be increased in order to increase output. The government should however direct its attention to the provision of quality and functional primary education, healthcare and irrigation facilities in the country's rural agricultural areas. Policy attention should be given to agricultural research and extension services for training farmers and improving methods of farming. HIV/AIDS intervention programmes must be incorporated in the training of the agricultural extension workers so that farmers can be adequately informed on the prevention of the diseases and the treatment and care of the infected.

For the manufacturing equation, the results show that labour, FDI and the SAP coefficients are positively related to the GDP of manufacturing. However, the positive signs of the labour, FDI and the SAP coefficients in the results call attention to the need to inject fresh foreign capital and adopt modern technologies in the manufacturing sector. Enabling investment climate needs to be encouraged so that private domestic and foreign investment into the manufacturing sector can easily be attracted to drive the growth process in the sector.

The results of the estimated mining and quarrying equation show that labour force and public capital expenditure for mining and quarrying sector are positively related to the value-added mining and quarrying GDP. This result is consistent with Onah (2004:1) who states that the development of the solid mineral sector promotes economic activity through investment and employment of resources. Kazilimani, Graca and McMahon (2003:256) state that about 90 per cent of the active population of mining communities engage in diverse activities such as extraction, transporting, processing, trade and businesses established at markets. The estimated results and the discussion in the literature support the potential role of the mining and quarrying sector in the economic development of Nigeria.

The results of the estimated value-added manufacturing equation show an erratic onward growth pattern. This growth trend is attributable to the poor infrastructure, high cost of importing raw materials, obsolete machinery and equipment and dearth of foreign capital challenges the sector has faced over the years (Ogwuma, 1996:69). Thus, to ensure that the manufacturing sector is stimulated to increase its contribution to the economic development of Nigeria, the investment climate should address the challenges in the manufacturing sector of the country. In addition, the

manufacturers need to focus on research and development. Also, the adoption of modern machinery, equipment and technologies should be given top priority in the sector.

The slow erratic growth of the mining and quarrying output requires well designed public policy to stimulate the sector. The trend of growth of Nigeria's mining and quarrying (solid mineral) sector is probably due to low productive activity over the years due to the government's deliberate policy action. The 1979 and 1999 constitutions of the Federal Republic of Nigeria placed the mines and mining and quarrying activities under the exclusive control of the national government (Federal Republic of Nigeria, 1979:16; 1999:131). Therefore, the deregulation and privatisation of the mining sector is needed for growth and contribution to the economic development of Nigeria. Facilitating the productive activity of the sector can enhance accelerated growth.

Policy interventions to stimulate the sector will require large foreign capital injection, therefore, FDI inflow should be targeted. Creating an enabling business environment in the sector need to emphasis tax incentive packages for the present and potential mining firms. Sustained increase in the public expenditure for social and community services coupled with the social responsibility of the mining companies to the communities will foster peace and productivity in the sector.

All the values of the adjusted coefficients are high, a clear indication that the coefficients are statistically significant. The coefficients in the cointegration estimations in the three models were diagnosed statistically for the presence of autocorrelation and serial correlation, and the results show that there are no serious problems with autocorrelation and serial correlation. Moreover, the diagnostic tests prove that all the models are correctly specified.

Dynamic simulation of results were undertaken to assess the effect of a 10 percent increase dynamic adjustment (shocks) on the relevant exogenous variables. The response properties show positive significant impact due to the shocks. The actual and forecast values of the three models and the forecast amount in billion Naira from 2006 to 2008 were presented graphically.
In Chapter seven, attention is given to the summary of the major findings, the concluding remarks, policy recommendations, the limitations of the study and suggested areas for further study.

CHAPTER SEVEN

SUMMARY OF MAJOR FINDINGS AND POLICY IMPLICATIONS, CONCLUDING REMARKS, LIMITATIONS, RECOMMENDATIONS AND SUGGESTIONS FOR FUTURE WORK

7.1 Summary of major findings and policy implications

This study is structured into seven chapters. The first chapter, the introduction, discusses the background of Nigeria's economic development. The state of the country's development experience is attributed to many factors, most important of which is its inability to take advantage of oil revenue to diversify its productive base. Nigeria has experienced long periods of political problems, governed by corrupt military dictators who did not advance its development agenda in spite of the country's rich renewable and non-renewable resources (Arnold, 1997:124). Three pivotal statement of problem for this study are: Why is Nigeria still an underdeveloped and low-income country?, What should the country do to make rapid economic progress?, How can Nigeria attain a diversified and sustainable economic development and growth?

Chapter Two contains the literature review. It focuses on contemporary and relevant issues in the economic development of developing countries. Included here is an overview of the state and trends of development in Nigeria, a review of the development prospects of Nigeria and a general development model from the newly developed countries of South East Asia. Also discussed is a development model that can be applied to Nigeria. In spite of the development impediments identified in the literature, the country has great prospects since it has undertaken some economic reforms aimed at recovering from ill effects of the past. Some lessons of practical development experience from the East Asian economies are reviewed and development models drawn for Nigeria, especially from Malaysia.

In Chapter Three, the policy framework of the MDGs, efforts and challenges and the role of external partners to complement Nigeria's development activity is discussed. It also assesses the impact of the national economic and development strategy (NEEDS), a medium to long-term plan to enable the country to attain the MDGs by 2015. Most of the economic reform packages identified in the plan, like privatisation of public enterprises, empowering organised private

sector participation in the economy, improving the quality of education and healthcare services, are well articulated.

However, findings based on the World Bank's (2006:82-83) economic and social indicators for Nigeria show that the gross national income per capita of $430 is below the average for sub-Saharan Africa which is (SSA), $600; life expectancy at birth is 44 years, well below the average for the SSA (46 years); maternal mortality rate (per 10,000 live births) is 800, below the average for the SSA (874); HIV prevalent rate (ages 15-49) is 3.9 per cent, below the average for the SSA (6.1): student teacher ratio (primary school) is 36 below the average for the SSA (46); gross primary enrolment, total (of relevant age group) 99 percent above the average for SSA (92); ratio of girls to boys in primary and secondary schools is 88 which is the average for SSA (88); labour force participation rate of females (ages 15-64) is 47 percent, below the average for SSA (63 percent); improved sanitation (of rural population with access) is 48 percent, below the average for SSA (55 percent). The findings show that the millennium development goals (MDGs) poverty and social indicators for Nigeria compare unfavourable with the average for low income country (OECD-ADB, 2006:419).

The analysis of the official development assistance (ODA) shows that Nigeria receives less aid from all donors, DAC countries and multilateral sources between 1999 to 2004 compared with net total flows to two other West African countries namely Burkina Faso and Ghana (OECD-ADB, 2006:566-567). However, FDI inflow into Nigeria within the same period have really increased and far above inflows into Burkina Faso and Ghana. With respect to the country's terms of trade index (2000=100), the country has 125, above average for SSA (121); exports of goods and services (% GDP) is 55 per cent above the average for SSA (35 per cent). Similarly, imports of goods and services (% GDP) is 54 per cent compared with the average for SSA of 40 per cent. While Nigeria's central government revenue (%GDP) is 43 per cent above the average for SSA of 24 per cent, the country's total external debt (% GDP) is 50 per cent, above the average for the SSA 45 per cent (World Bank, 2006:82-83). The outlook for Nigeria's economic and social development shows it is still faced with challenges and has not performed above the average for SSA.

In Chapter Four, the analysis of the relevance of the growth sectors, namely agriculture, manufacturing and mining (solid minerals), and of the growth support sectors, namely education and health care delivery, in Nigeria is discussed. The findings show that the agricultural, manufacturing and mining and quarrying sectors have the potential for creating more jobs and income, reducing poverty and increasing productivity for sustainable economic development in Nigeria. There is a strong linkage between the three important growth sectors in Nigeria.

Three behavioural equations defined in the form of a neoclassical supply-side model for the Nigerian economy are estimated individually. The three equations, one each is specified for the agricultural sector, one for the manufacturing and one for the mining and quarrying sector respectively. The agricultural equation shows that the gross domestic output is strongly and positively related to labour, public capital expenditure, fertiliser, agricultural credit guarantee scheme and the dum86sap which measures the impact of the SAP on agricultural production in Nigeria. An empirical study by Wiebe et al. (2003:433) finds that labour and fertiliser increase the productivity of agriculture, and this finding is consistent with the results of this study. This result also agrees with Meier and Rauch (2005:393), who assert that more people in developing countries need to be encouraged to engage in agricultural production in order to feed the population and eradicate poverty. This findings also shows that Nigerian agriculture is highly labour-intensive. In order to attract more labour into the sector, there should be public education programmes on the importance of agriculture.

Efforts should concentrate on the provision of basic infrastructure and amenities such as electricity, clean and drinkable water, access roads, and other necessities. Electricity supply in the rural areas of Nigeria is 28 per cent higher than the average for SSA (6 per cent); water sources are available in 49 per cent of rural areas of Nigeria, above the average for SSA (45 per cent); but sanitation is available in only 48 per cent of rural areas, below the average for SSA (55 percent) (World Bank, 2006:83).

The results also show a strong positive relationship between fertiliser and the gross output of the sector. This result confirms the Federal Office of Statistics (2004:87) report that shows an

increased performance in agricultural production arising from improvements in fertiliser supply, distribution and utilisation in Nigeria.

The role of the government's involvement in agricultural production is seen from this study's results. The capital expenditure of Nigeria's federal government in the sector has a strong positive relationship with the gross output. By implication, capital expenditure for the agricultural sector needs to be increased in order to increase output. The government should direct this money to the provision of quality and functional primary education, healthcare and irrigation facilities in the country's rural agricultural areas. Policy attention should be given to agricultural research and extension services for training farmers and improving methods of farming. HIV/AIDS intervention programmes must be incorporated in the training of the agricultural workers so that farmers are adequately informed about the prevention of the disease and the treatment and care of the infected.

The coefficient of the interest rate is negatively signed. This shows an inverse relationship between the GDP of agriculture and interest rate. It gives an indication that a robust interest rate regime is in put place for the agricultural sector for ease access to credit. However, the farmers need to reciprocate this incentive through lower food prices and production of surplus commodities for exports.

Furthermore, the agricultural credit guarantee scheme has a strong positive relationship with the gross output of agriculture. According to the Federal Office of Statistics (2004:87), increased performance in agricultural production between 1999 and 2005 is attributable to farmers' increased access to credit. The Federal Office of Statistics (2004) also reports a sustained increase in the capitalisation of the agricultural sector market, resulting in improved agricultural production in Nigeria. This supports empirical evidence that the financial institutions can a play positive role in financing development in the Nigerian agricultural sector.

Nevertheless, dum86sap shows a positive impact on the agricultural production in Nigeria. The results show that the introduction of the structural adjustment programmes (SAP) causes the agricultural production to increase to about 0.30 per cent. The sharp increase in agricultural

production between 1986 and 1990 reflected a favourable response of agricultural production to the SAP measures (Central Bank of Nigeria, 2000:38).

For the manufacturing equation, the results show that labour, FDI and dum86sap representing the SAP are positively related with the GDP of manufacturing. The positive signs of labour and FDI coefficients in the results suggests an urgent need to inject fresh foreign capital and adopt modern technologies in the manufacturing sector. The importance of sustaining research, training and development in the sector is reflected in the positive relationship between the gross output of manufacturing and labour coefficient.

Furthermore, the results of the estimated mining and quarrying equation show that labour and public capital expenditure for the sector are positively related to the value-added GDP of the mining and quarrying. This result is consistent with Onah's (2004:1) report that the development of the solid mineral sector promotes economic activity through investment and employment of resources. Kazilimani, et al. (2003:256) state that about 90 per cent of the active population of mining communities engage in diverse activities such as extraction, transport, processing, trade and businesses established at markets. The estimated results and facts from the literature support the importance of the role the mining and quarrying the in economic development of Nigeria.

However, the dum80s which represents the impact of changes in government policies on the sector shows a weak negative relationship with mining and quarrying gross output within the period under consideration. The negative relationship between the changes in the government policies and the impact on the mining and quarrying sector could perhaps be explained by the fact that the 1979 and 1999 constitutions of the Federal Republic of Nigeria place the mines and the mining and quarrying activities under the control of the national government as mentioned above (Federal Republic of Nigeria, 1979:16; 1999:131). Thus, with the exception of government ministries and agencies, private sector participation mining is extremely difficult in Nigeria. This restriction thus limits the mining or extraction of the solid minerals by private enterprises which could serve as an engine for economic activities and growth in the sector. Limited activity in the mining and quarrying sector could also slow down the contribution of the sector to economic growth and development. It is surprising that the structural adjustment programme launched in 1986 (DUM86SAP) has a negative relationship

with the output growth and development of the mining and quarrying sector. Perhaps the exclusive control of the solid minerals by the federal government within the SAP period contributes to the negative policy impact on the sector.

Mining and quarrying is a growth and development sector in many other African countries, including Botswana, DR Congo, Ghana, Ivory Coast, Namibia and South Africa, and a host of other countries on the continent depend on it to a large extent for domestic and foreign income. According to Hilson (2003:18), the activity of mining is mainly poverty reduction-driven; hence it is a people-initiated and direct poverty-alleviation measure available for any country, with little cost and limited intervention required on the part of the government.

7 .2 Concluding remarks

This study attempts to develop prototype sectoral econometric models that could aid Nigeria to boost its real sectors' productive base, and to make progress towards achieving a high level of economic diversification by harnessing development and growth potentials of the real sectors. Data analysis is used for economic, historical, descriptive and quantitative investigation.

In the 1960s, Nigeria was on par with its fellow oil-producing countries like Malaysia, Indonesia and Singapore in its aspiration to achieve high levels of economic growth and development, but failed to keep the pace. Some of the reasons for this identified in this study include the serious effect of "Dutch disease", reflected in the country's inability to manage and diversify its oil wealth to transform its industrial (manufacturing), agricultural, mining, educational, health and other growth sectors. Nigeria has also had a troubled political history during which the military remained in power for too long.

Under Nigeria's new democratic dispensation, there must be large investment in the growth and support sectors from both domestic and external sources if the country is to attain a high level of economic development and the global growth target of fulfilling the MDGs. With a strong will to become a patriotic civil society, and sufficient wisdom to elect leaders of good will and fairly good knowledge of the country's economy, the people of Nigeria may yet achieve a strong and vibrant economy.

7.3 Limitations of the study

The initial methodology of this study favours the use of a computable general equilibrium (CGE) modelling framework to capture the behaviour and interactions of various macroeconomic variables in the Nigerian economy. But this causes some limitations in the process of seeking and constructing a social accounting matrix (SAM), as none of the research institutions in the country responded to my emails and requests for a SAM for this study. Furthermore, it was difficult in securing flexible system dynamic software like Powersim and Veinsim Models to make up for the CGE model. In the end, because of ambiguous licensing policies and problems with manufacturers, it became obvious to revert to a multivariate cointegration Engle-Yoo three-step econometric methodology.

However, the study is designed to make what appear as complex options feasible. In view of this, the growth models are designed to provide insights into the possible quantitative impacts of domestic and foreign financial resources for the development of the agricultural, manufacturing and mining and quarrying sectors. Of course, a model, no mater how sophisticated, is still an abstraction from reality and as such may not sufficiently embody all the complexities and interactions of the real world. There is no doubt that the model applied in this study is therefore a compromise between the ambition to capture a seemly comprehensive reality and the actual computational feasibility of a foregone CGE model for the Nigerian economy. Notwithstanding this compromise, the model adopted in this study is sufficiently robust to help in responding to the research questions: Why is Nigeria still an underdeveloped and low income country? What should the country do to make rapid economic progress? How can Nigeria attain a diversified and sustainable economic development and growth?

7.4 Policy recommendations

The following tentative recommendations based on the results of the estimated models for the agriculture, manufacturing and mining and quarrying sectors of the Nigerian economy are proposed:

- Improved land distribution and administration, well-managed irrigation and the dissemination of environmentally sound farming methods should be efficiently implemented to ensure environmentally sustainable agricultural production.

- Increased agricultural production in Nigeria should be matched by the engagement of a larger labour force in the rural areas to stem the tide of urban migration.
- The timely provision of fertiliser, seeds and agro-chemical to the farmers at low cost should be encouraged.
- The monetary authorities should encourage rural banking and reward commercial banks that make significant investment to the agricultural sector.
- The monetary authorities should increase the agricultural credit guarantee scheme from 75 per cent to 85 per cent to enhance credit delivery by banks to farmers and to ensure that farmers reciprocate the impetus by reducing the prices of food products.
- Modern and tested agricultural machinery and equipment that will reduce drudgery and enhance productivity should be encouraged.
- Capital expenditure for the agricultural sector should be increased to encourage research and development, HIV/AIDS intervention programmes, adequate housing and rural electricity projects and other amenities which rural farmers will perceive as modernization
- Public expenditure for social and community services should be increased, especially in the rural agricultural areas. This will ensure good quality of health care and service delivery, and free compulsory education for the poor.
- Sustained efforts are needed to create a conducive economic environment to ensure the inflow of local and foreign private investment into the agricultural sector.
- Policy strategies and incentives for industrialisation in Nigeria should give priority to creating a conducive investment climate for both local and foreign enterprises. Basic physical infrastructure and a robust tax regime must be created and land for industrial estates mapped out and efficiently allocated.
- Manufacturing enterprises in Nigeria should constantly update their plants through the injection fresh capital, as this will enable them to boost productivity and produce high quality goods of international standard.
- The investment effort in education and training must be strengthened to sustain the level of human capital development and ensure high productivity among the labour force in Nigeria.
- The exploitation of minerals requires large capital outlay; therefore, the government, especially at the state level, should give financial support to local enterprises engaged in mining activities.

- Increased investment and employment of more active labour in large-medium and small-scale mining should be encouraged to expand economic activities and impact positively on the poverty reduction campaign in Nigeria.

7.5 Suggestions for future work

The scope of this study can be enlarged in different directions, one of which could be to apply alternative functional Cobb-Douglas production functions and CES production functions to the data. Moreover, the utilisation of a CGE model to assess the policy impact of the growth sectors in Nigeria could be considered.