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Full Length Research Article

STRUCTURAL VECTOR AUTOREGRESSIVE MODELING OF SOME FACTORS THAT AFFECT THE ECONOMIC GROWTH IN NIGERIA

Adewole, A. I.[1]., Bodunwa, O. K.[2] and Akinyanju, M. M.[2]

[1]Department of Mathematics, Tai Solarin University of Education Ijagun, Ogun State, Nigeria.
[2]Department of Statistics, Federal University of Technology Akure, Ondo State, Nigeria.

Corresponding Author's Email Address: hayorhade2005@gmail.com Phone: +2348055124368

ABSTRACT
This study investigates how Agriculture, External debt, Importation and Exportation affects the economic growth of Nigeria over the period of 1979-2019 using an annual time series data. A structural vector autoregressive model was used in determining the short and long run pattern. Result from the study shows that there exists a positive relationship between agriculture and the Real Gross Domestic Product on the Nigerian economy. Importation has a positive relationship at the initial period while on the long period exhibit a negative relationship with RGDP. External debt also experienced a negative relationship at the initial period while on the long run exhibit a negative relationship with RGDP. The result from the structural variance decomposition shows that agriculture and importation contribute more variability to RGDP in Nigeria. The study however recommends that the government should come up with a policy that focus on the alternative source of its revenue by focusing more on agriculture and encourage export and strict laws on import diversification in the area of agriculture, agro-investment, and agro-allied industries, oil allied industries which would help improve Real GDP growth in Nigerian economy.

Keywords: External debt, Exchange rate, Agriculture, Economic Growth, ARIMA

INTRODUCTION

Nigeria has the biggest economy in Africa which is in close challenge with South Africa. The nation is the 30th biggest economy on the planet dependent on GDP volume. Economic growth is estimated by increment in the level of goods and services that are manufactured in a country. A developing economy creates more goods and services in each progressive time frame. Economic growth is clearly affected by certain factors, these factors are growth inciting factors which have been recognized by Essien (2001) and Jhingan (1998) as land, labor, capital, human capital, education, training, health and productivity. Economic growth in Nigeria has been on decline throughout the years due to the wretched condition of some social factors which incorporate poor educational infrastructures, high child mortality rate, endemic diseases, growing urban population, and lack of access to sanitation in the urban and rural areas, corruption, weak industrial infrastructure, ethnic conflict /crisis and low per capital income of less than two dollar per day for larger population of the country (Ashinze and Onwiodvokit, 1996). For this study, few economic indicator variables were selected to determine the economic growth of Nigeria. They include; Real GDP (RGDP), External debt (in dollars), Agriculture (in dollars), Exportation and Importation (in dollars). This study aim to investigate the structural effect of agriculture, importation, exportation and external debt on the economic growth.

(Gbaiya, Oluwaseun & Ogundipe, Adeyemi & Osabuohien, Evans & Olugbire, Oluseyi & Adeniran, Odunola & Bolaji-Olutunji, Kofo & Awodele, Daniel & Aduradola, 2013) investigate the short-run and the long-run relationship between agricultural exports and the economic growth in Nigeria using export led growth hypothesis and the neo- classical growth model. Result from this paper shows there exist an elastic relationship between agricultural export which would significantly bring an increase in the Real Gross Domestic Product in Nigeria. There also exist a long run relationship between agricultural export and the economic growth.

(Onafowora, O., Owoye, 2019) examines the different dynamics impact of external debt to Gross Domestic Product, trade openness, inflation , exchange rate and investment in Nigeria from 1970-2014 using an SVAR analysis. Result from this research paper indicate that external debt has a negative impact on economic growth and investment and trade openness, short positive impact on inflation and an insignificant effect on exchange rate.

Ebere and Osundina (2014) inspected the effect of government expenditure on agriculture on financial development in Nigeria throughout the years with time series data of 34 years sourced from the Central bank of Nigeria was utilized. Ordinary Least Square (OLS) procedure of data analysis was used in estimating the secondary data. Gross domestic product was utilized as an intermediary to economic growth, while agricultural output and government expenditure on agriculture were utilized as indicators of government expenditure on agriculture. From the discoveries, agricultural output, government expenditure and GDP are positively related. Olajide *et al*. (2012) broke down the connection between Agricultural resource and economic growth and development in Nigeria utilizing the Ordinary Least. Square regression method in estimating the model.

Lawal *et al*. (2016) examined the impact of exchange rate fluctuation on the Nigerian economic growth for period of first quarter of 1981 to fourth quarter of 2013. The result uncovered that real exchange rate positively affects the economic growth. In a related report, Akpan (2008) focused on the implications of exchange rate movement on economic growth. The ordinary least square (OLS) technique was adopted using time series data on exchange rate movement, volatility of exchange rate (EXCHR), labor force, gross domestic investment and technology. Volatility of exchange rate is measured by three years moving average of standard deviation of real exchange rate. The paper maintains that, in view of the positive relationship between exchange rate, volatility and economic growth in Nigeria, exchange rate policy should be designed to bridge the savings investment gap so as to enhance government revenue, as well as reduce the fiscal lacuna through the curtailing of deficit geared at increased and sustained

economic growth. Jelilov (2015) investigated the effects of foreign debts on economic growth, the research revealed the existence of positive relationship existing between external debts and economic growth.

MATERIALS AND METHODS

This study applied the structural vector autoregression model to examine the effect of the selected economic variables on the economic growth of Nigeria. The data used was a secondary time series data obtained from a comprehensive data portal with country-level facts and statistics called Index mundi. The data was gathered from multiple sources (which include World Bank national accounts for data, and OECD National Accounts for data). The selected economic growth determinant variables include; Importation of goods and services, Exportation of goods and services, Exchange rate, Agriculture. The model used for this study is expressed as;

RGDP = f (AGR, EXTD, EXP, IMP)

Where,

RGDP = Real GDP

AGR = AGRICULTURE

EXTD = EXTERNAL DEBT

EXP = EXPORTATION OF GOODS AND SERVICES

IMP = IMPORTATION OF GOODS AND SERVICES

The econometrics model which is stated below would be used to estimate the equation;

$$RGDP = \beta_O + \beta_1 AGR + \beta_2 EXP + \beta_3 IMP + \beta_4 EXTD + B\varepsilon_t$$

β_O = $constantterm$, β's = the parameters to be estimated, $B\varepsilon t$ = $structuralshocks$

A VAR model checks for the interaction between all the variables used in the analysis and thus treating them as an endogenous variable and a function of all variables in lags. The variables can be represented as below:

Y_t= (y_{1t}... y2t, ...,y_{st})

where s = 1…p

A structural VAR (p) - process is then defined as:

$$AZ_t = A_O + C(L)Z_{t-1} + B\varepsilon_t$$

Where A is a (k x k) coefficient matrix of the structural coefficients, Z a (k x1) vector of the different endogenous variables and they consist of Real GDP (RGDP), Agriculture (AGR), Exportation (EXP), Importation (IMP), and External debt (EXTD) at a time t. A_O is a (k x 1) vector of intercept, $C(L)$ is a (k x k) matrix of lag with length L which indicate the structural impulse associated with the shock of the different elements. B expresses the linear relation between a structural shock and the others in their reduced form (A (k x k) matrix).ε_t is a (k x 1) structural noise which are uncorrelated and identically normally distributed. One of the important characteristics associated with a VAR (p) model is its robustness and stability. A VAR (p) model can also be shown in its reduced form by multiplying the above equation with A^{-1}which gives:

$$Z_t = A^{-1}A_O + A^{-1}C(L)Z_{t-1} + A^{-1}B\varepsilon_t$$

$$Z_t = j + K(L)Z_{t-1} + u_t$$

Where j =$A^{-1}A_O$, K (L) = $A^{-1}C(L)$ and u = $A^{-1}B\varepsilon_t$

In this study, we would use an SVAR which is imposed on the Real Gross Domestic Product labelled as C (1) on the other variables using a Cholesky triangular factorization. The following equation shows the short and long run estimates pattern matrix which assumes RGDP to be the most endogenous variable in the model and it is not affected by the shocks to all the other variables in the model. The second equation indicates agriculture has been recently affected by RGDP but does not affect importation, exportation and external debt. The third equation indicate that the shocks to RGDP and agriculture, recently affected exportation, but does not affect importation and external debt. Forth equation indicate that shocks to RGDP, agriculture and exportation recently affect importation but does not affect external debt. For equations five, indicate that shocks to RGDP, agriculture, exportation and importation recently affected external debt.

C (1) =

$$\begin{bmatrix} variables \\ RGDP_t \\ AGR_t \\ EXP_t \\ IMP_t \\ EXTD_t \end{bmatrix} \begin{bmatrix} \mathcal{E}^{RGDP_t} & \mathcal{E}^{AGR_t} & \mathcal{E}^{EXP_t} & \mathcal{E}^{IMP_t} & \mathcal{E}^{EXTD_t} \\ 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix} =$$

$$\begin{bmatrix} variables \\ u_t RGDP_t \\ u_t AGR_t \\ u_t EXP_t \\ u_t IMP_t \\ u_t EXTD_t \end{bmatrix} =$$

$$\begin{bmatrix} \mathcal{E}^{RGDP_t} & \mathcal{E}^{AGR_t} & \mathcal{E}^{EXP_t} & \mathcal{E}^{IMP_t} & \mathcal{E}^{EXTD_t} \\ b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{12} & 0 & 0 & 0 \\ 0 & 0 & b_{13} & 0 & 0 \\ 0 & 0 & 0 & b_{14} & 0 \\ 0 & 0 & 0 & 0 & b_{15} \end{bmatrix} =$$

$$\begin{bmatrix} \mathcal{E}^{RGDP_t} & \mathcal{E}^{AGR_t} & \mathcal{E}^{EXP_t} & \mathcal{E}^{IMP_t} & \mathcal{E}^{EXTD_t} \\ 1 & 0 & 0 & 0 & 0 \\ NA & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ NA & NA & NA & 1 & 0 \\ NA & NA & NA & NA & 1 \end{bmatrix}$$

Structural VAR Estimate on Short- run pattern matrix

Structural VAR Estimate on Short- run pattern matrix

Estimate Result on matrix

A $\begin{bmatrix} variables \\ RGDP \\ AGR \\ EXP \\ IMP \\ EXTD \end{bmatrix} \begin{bmatrix} \mathcal{E}^{RGDP_t} & \mathcal{E}^{AGR_t} & \mathcal{E}^{EXP_t} & \mathcal{E}^{IMP_t} & \mathcal{E}^{EXTD_t} \\ 1 & 0 & 0 & 0 & 0 \\ c_{21} & 1 & 0 & 0 & 0 \\ c_{31} & c_{32} & 1 & 0 & 0 \\ c_{41} & c_{42} & c_{43} & 1 & 0 \\ c_{51} & c_{52} & c_{53} & c_{54} & 1 \end{bmatrix}$

Estimate Result on matrix

B $\begin{bmatrix} variables \\ RGDP \\ AGR \\ EXP \\ IMP \\ EXTD \end{bmatrix} \begin{bmatrix} \mathcal{E}^{RGDP_t} & \mathcal{E}^{AGR_t} & \mathcal{E}^{EXP_t} & \mathcal{E}^{IMP_t} & \mathcal{E}^{EXTD_t} \\ c_{11} & 0 & 0 & 0 & 0 \\ 0 & c_{11} & 0 & 0 & 0 \\ 0 & 0 & c_{11} & 0 & 0 \\ 0 & 0 & 0 & c_{11} & 0 \\ 0 & 0 & 0 & 0 & c_{11} \end{bmatrix}$

Structural VAR Estimate on Long- run pattern matrix

$$\begin{bmatrix} variables \\ RGDP_t \\ AGR_t \\ EXP_t \\ IMP_t \\ EXTD_t \end{bmatrix} \begin{bmatrix} \varepsilon^{RGDP_t} & \varepsilon^{AGR_t} & \varepsilon^{EXP_t} & \varepsilon^{IMP_t} & \varepsilon^{EXTD_t} \\ C_1 & 0 & 0 & 0 & 0 \\ 0 & C_2 & 0 & 0 & 0 \\ 0 & 0 & C_3 & 0 & 0 \\ 0 & 0 & 0 & C_4 & 0 \\ 0 & 0 & 0 & 0 & C_5 \end{bmatrix}$$

This matrix are however computed and also used to calculate the structural impulse response function which is used to determine and get the path of the effect of the structural shocks of the variables under consideration.

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistics for the different variables used in this study is presented in the Table 1 below. The variables appears to be normally distributed as their different skewness are more than zero. Looking through the table, all the variables are positively skewed. Additionally, all the variables except external debt have a lower, less distinct peak since their kurtosis were negative, external debt have a relatively peaked distribution since the kurtosis is positive.

Table 1. Descriptive statistics

	RGDP	AGRICULTURE	EXPORTATION	IMPORTATION	EXTERNAL_DEBT
Mean	2.15E+11	3.41E+10	3.21E+10	2.74E+10	3.35E+09
Median	1.45E+11	15235150000	17759720000	15253130000	1361622000
Maximum	4.64E+11	1.14E+11	1.02E+11	9.08E+10	1.76E+10
Minimum	1.01E+11	5.12E+09	2.81E+09	3.53E+09	3.34E+08
SD	1.22E+11	3.41E+10	3.06E+10	2.65E+10	4.36E+09
Skewness	0.95	1.08	1.05	1.09	1.69
Kurtosis	-0.73	-0.4	-0.32	-0.25	2.03
Observations	4.10E+01	4.10E+01	4.10E+01	4.10E+01	4.10E+01

Unit root and stability test

The issue of structural change and its implication for the structural breaks in the different macroeconomics time series data must be addressed in order to determine the results of the unit tests of the data collected. We take into consideration the possibility that there might be the occurrence of structural break in the series due to the different events visible from the data, we therefore test if there exist a unit roots using the endogenous structural breaks using the Zivot and Andrews unit root test. The major reason why this test was used is because it allows for possibility of structural break as the trend property of the variable when compared to other conventional unit root tests.

Table 2. Results of Zivot and Andrew unit root test

Variable Series	t-statistics	Structural Break Location	Structural Break Year	Order of Integration
RGDP	-7.6951***	C	2004	I(1)
AGRICULTURE	-9.3807***	C	2010	I(1)
EXPORTATION	-6.2511**	B	2011	I(1)
IMPORTATION	-8.274*	C	2010	I(1)
EXCHANGE RATE	-5.6114***	A	2005	I(1)

The critical value for Zivot and Andrews test are -5.57, -5.08, -4.82 at 1%, 5% and 10% levels of significance respectively. ***, **, * indicate significant at 1%, 5% and 10% levels respectively.
Break location: A = Intercept, B = Trend, C = Trend and Intercept

The lag lengths for the ZA is chosen by using Schwarz Information Criterion

The table above shows the Zivot-Andrew unit root test and it indicates that there exist a structural break in the variables. This test was performed in order to determine the time of the structural break in the data in order to reduce the bias in the unit root test. The result shows that all of the variables exhibit a structural breaks during the 2000's which are clustered around 2004 to 2011. This result however rejects the null hypothesis that the series has a unit root in both the intercept and the trend at the 10 percent level of significance. All the variables were however found to be stationary at the same level I (1) which is shown by the t-statistics of the different variable.

Optimum lag test and stability tests

Since the unit root test cannot be rejected at the level data but are rejected when it was difference once, a Var model was carried out to determine the number of optimum lag to be included in the model before performing a structural long run test. The optimum lag used were however chosen by using all the five different criteria. Table 3A below however shows that all the criteria accept at lag 2 except for the Schwarz Information Criterion which accepts at lag 0. Thus lag 2 was used as the maximum lag in building the model.

Table 3A. Results of optimum lag test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-4566.429	NA	2.14E+98	240.6015	240.8170*	240.6782
1	-4530.91	59.82045	1.24E+98	240.0479	241.3407	240.5079
2	-4492.869	54.05908*	6.73e+97*	239.3615*	241.7317	240.2048*

Note that * indicate lag order selected by the criterion. LR: sequential modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike Information Criterion, SC: Schwarz Information Criterion and HQ: Hannan-Quinn Information Criterion

We also performed the stability test (Stationary property of the variable) using the AR root table and graph. Result as observed in table 3B below shows that all the roots of the characteristic polynomial are less than one and the graph also shows all the unit lying inside the circle. This observed result indicates that the VAR model is variance and covariance stationary which satisfies the stationary condition.

Table 3B. Results of AR root table

Root	Modulus
-0.163002 - 0.841894i	0.857529
-0.163002 + 0.841894i	0.857529
0.81897	0.81897
0.222459 - 0.781098i	0.812159
0.222459 + 0.781098i	0.812159
0.470677 - 0.452707i	0.653055
0.470677 + 0.452707i	0.653055
-0.56571	0.56571
-0.468747 - 0.270802i	0.541347
-0.468747 + 0.270802i	0.541347

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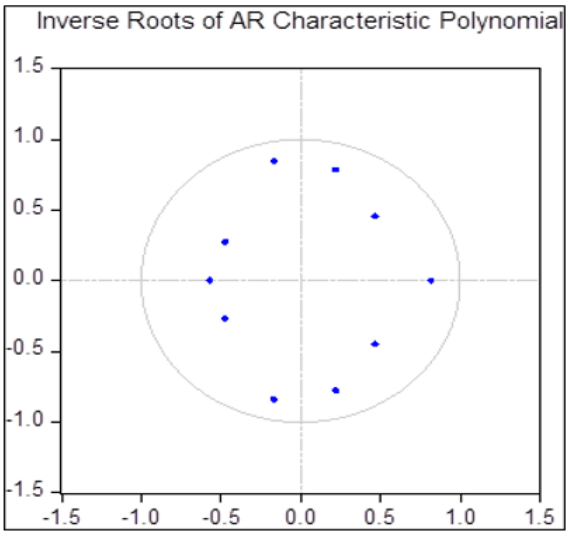

Figure 1. AR root graph

Structural VAR Estimate on Short- run pattern matrix

Table 4. Results of Structural VAR Estimate on Short- run pattern

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.6776	3.96E-11	1.71E+10	0.0000***
C(2)	0.149906	2.84E-11	5.27E+09	0.0000***
C(3)	-0.414343	4.13E-11	-1.00E+10	0.0000***
C(4)	0.047366	7.71E-11	6.15E+08	0.0000***

Note that ***. ** and * indicate significant at 1%, 5% and 10% levels respectively

From Table 4 above, RGDP shock consist of agriculture C(1), exportation C(2), importation C(3), external debt C(4). Result above shows that RGDP is positively related to agriculture, exportation and external debt while it is negatively related to importation. Evidence from the above result indicate that we reject our assumption that RGDP is the most endogenous variable in the model which cannot be affected by the shocks to all other variables in the model but instead the above model shows it was affected by shocks from importation as shown in the model given C(3). All variables are significant at the 1% level.

Structural VAR Estimate on Short- run pattern matrix

Table 5. Results of Structural VAR Estimate on Long- run pattern

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	1.01E+10	1.16E+09	8.717797	0.0000***
C(2)	4.58E+10	9.02E+09	5.073984	0.0000***
C(3)	-8.22E+09	7.85E+09	-1.047111	0.295
C(4)	6.74E+09	1.22E+10	0.554225	0.5794
C(5)	-3.65E+09	1.82E+09	-2.002813	0.0452**

Log likelihood	-4.64E+03
LR test for over-identification:	
Chi-square(6)	2.28E+02***

Note that ***. ** and * indicate significant at 1%, 5% and 10% levels respectively

The table above shows that RGDP shock has recently affected agriculture and importation given that C (1) is statistically significant at 1% level given p-value (0.0000). RGDP is positively related to agriculture and importation in recent times while exportation and external debt are negatively related to RGDP. The value of the test statistics is 227.6238 at 1% level of significance with p-value (0.0000). We thus accept the hypothesis at the 5% level of significance that agriculture and importation have a long run effect on the economic growth of Nigeria.

Structural impulse responses

The structural impulse response function would enable us describe the evolution of the model variable in reaction to the shock and also determine the future values observable to a one unit change in the present value of one structural shock while assuming all the other shocks are equal.

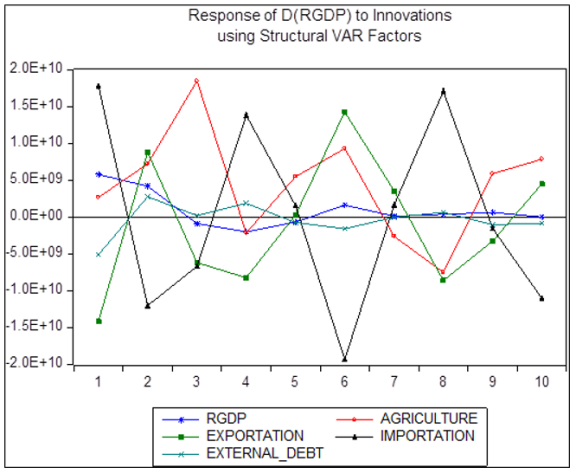

Figure 2. Structural response to RGDP

We see from the figure above that the x-axis is labelled from one to ten with 1 indicating 4.1 years which is from 1979-1982, 2 indicates 8.2 years which is from 1979-1986, 3 indicates 12.3 years which is from 1979-1990, 4 indicates 16.4 years which is from 1979-1994, 5 indicates 20.5 years which is from 1979-1999, 6 indicates 24.6 years which is from 1979-2003, 7 indicates 28.7 years which is from 1979-2007, 8 indicates 32.8 years which is from 1979-2011, 9 indicates 36.9 years which is from 1979-2015, 10 indicates 41 years which is from 1979-2019.Agriculture have positive effect to RGDP shock from 1979 to 1990 that is 12 years, there exist a sharp decline from the 3rd to4th period with an increase from the 4th to 6th period. There however seems to be an increase from the 8th period up to the present moment. This is a clear indicative that there exist a positive relationship between RGDP and agriculture from recent year to the present year (2019). Exportation has a negative effect on RGDP from 1979 to early 1980s, but it was observed from the graph that there exist an upward and downward movement in the effect but the long run pattern shows a positive relationship with RGDP. Importation has a positive relationship for the first few year, the long run pattern indicate a negative relationship with RGDP. External debt experienced a negative relationship from the beginning of the period and also on the long run exhibit a negative relationship with RGDP.

Structural variance decomposition

Result from the table below shows the variance decomposition of the forecast error variance in RGDP explained by its own innovations and innovations in agriculture, exportation, importation and external dept. RGDP dominates its own innovation with 47.76 to 100% of the variance of its forecast. However it contributes more variability to agriculture with 2.87 to 26.91%, exportation with 1.10 to 7.45%, importation with 4.42 to 9.80% and external debt with 8.07 to 16.49% from 1979 to 2019.

Table 5. Results of Structural variance decomposition to RGDP

Period	S.E.	D(RGDP)	D(AGRICULTURE)	D(EXPORTATION)	D(IMPORTATION)	D(EXTERNAL_DEBT)
1	1.06E+10	100	0.00000	0.00000	0.00000	0.00000
2	1.26E+10	75.10965	2.872697	1.09875	4.424088	16.49481
3	1.47E+10	59.44979	20.41101	1.651958	6.315633	12.17162
4	1.55E+10	53.88011	27.07324	1.693199	6.354068	10.99938
5	1.71E+10	50.66905	30.47688	4.032007	5.539435	9.282635
6	1.79E+10	49.01993	28.08705	6.128137	8.16923	8.595653
7	1.81E+10	48.44839	27.69133	7.517361	7.961378	8.381541
8	1.83E+10	48.10175	27.3362	7.374161	8.945224	8.242659
9	1.85E+10	48.21236	27.09834	7.538349	9.008115	8.142845
10	1.86E+10	47.75686	26.91161	7.453976	9.799115	8.078436

Summary and Conclusion

There has been fluctuation in the economic growth of Nigeria in recent years. Various factors have played a major role in economic development and growth. Few variables were selected to assess the economic growth which include; Agriculture, Exportation, Importation and External debt. The structural vector autoregression (SVAR) model was used to meet the objectives of this study.

This paper characterize the dynamic effects of real GDP on agriculture, exportation, importation and external debt in Nigeria over the period of 1979-2019 with an SVAR framework using the short-run and long-run restriction. We confirm the stability and robustness of the SVAR model specification using the inverse roots of VAR characteristics polynomial.

The result from the findings indicate that RGDP has been recently affected agriculture, exportation, importation and external debt in both the long and the short run period. Result from the structural impulse response function indicates that agriculture has a high positive impact on RGDP at the initial period, negative impact between the period and then a positive period at the end of the period. The results justified the results of Sani and Ali (2018) that investigated the effect of crude oil, food imports, exchange rate and inflation on Nigeria economy; they found out that food imports have high negative effect on GDP suggesting that if our government can invest well on Agriculture, it will bring high positive impact on RGDP. Exportation also has a negative impact on RGDP at the beginning of the period but had a positive impact at the end of the period. Both importation and external debt however has a negative impact on RGDP at the end of the period. The result of variance decomposition also tallies with that of the impulse response analysis as agriculture and importation contribute more variability to RGDP in Nigeria.

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