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VECTOR AUTOREGRESSION ANALYSIS OF AGRICULTURAL PRODUCED AND ITS ECONOMIC GROWTH IN NIGERIA BETWEEN "2016 – 2020"

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ABSTRACT

This research work investigates the relationship between agricultural produced and its economic growth in Nigeria using the VAR (vector autoregression) approach. It adopted the secondary data sourced from Central Bank of Nigeria covering the monthly average data period from 2016 to 2020. The unit root test for stationarity found all variable to be stationary at first difference 1(1). Johansen cointegration test conducted found out that there are at least three (3) cointegrating equations at 5% level of significant indicating a long run relationship between the variables. The vector error correction model (VECM) reveals that economy would restore its previous equilibrium by 9.4496 % speed of adjustment. A unit increase in agricultural exports would bring a proportionate increase in the Gross Domestic Product in Nigeria.

Keywords: Agricultural products, Stationary Time Series, VAR (vector autoregression), Johansen cointegration test, and the Gross Domestic Product in Nigeria.

INTRODUCTION

During the early days after independence, Nigeria had an agricultural economy because agriculture served as the engine of growth to the overall economy (Ogen 2003). Agriculture was the leading sector contributing about 70% of the Gross Domestic product, employing about the same percentage of the working population and also account for 90% of the federal government earnings and federal government revenue. Nigeria was the largest producer of cocoa and also palm products (Akali 1997). From mid 1970s to mid-1990s the average annual growth rate of agricultural exports declined by 17%. By the year 1996, agriculture accounted for only 2% of exports (Bakare 2011). Decline in agricultural production in Nigeria began with the advent of the petroleum boom in the early 1970s. The boom in the oil sector brought about a distortion of the labor market. The distortion in turn produced adverse effects on the production levels of both food and cash crops. Governments had paid farmers low prices over the years on food for the domestic market in order to satisfy urban demands for cheap basic food products. This policy, in turn, progressively made agricultural work unattractive and enhanced the lure of the cities for farm workers. Collectively, these developments worsened the low productivity, both per unit of land and per worker, due to several factors: inadequate technology, acts of nature such as drought, poor transportation and infrastructure, and trade restrictions.

As food production could not keep pace with its increasing population, Nigeria began to import food. It also lost its status as a net exporter of such cash crops as cocoa, palm oil, and groundnuts. According to U.S. Department of State FY2001 *Country Commercial Guide,* Nigeria's total food and agricultural imports are valued at approximately US$1.6. Billion per year. Among the major imports from the United States are wheat, sugar, milk powder, and consumer-ready food products. Efforts since the late 1970s to revitalize agriculture in order to make Nigeria food self-sufficient again and to increase the export of agricultural products have produced only modest results. The Obasanjo administration, however, has made agriculture the highest priority of its economic policy.https://www.nationsencyclopedia.com/economies/Africa/Nigeria-AGRICULTURE.html#ixzz6rfBVf7MT

A significant portion of the agricultural sector in Nigeria involves cattle herding, fishing, poultry, and lumbering, which contributed more than 2 percent to the GDP in the 1980s. According to the UN Food and Agriculture Organization 1987 estimate, there were 12.2 million cattle, 13.2 million sheep, 26.0 million goats, 1.3 million pigs, 700,000 donkeys, 250,000 horses, and 18,000 camels, mostly in northern Nigeria, and owned mostly by rural dwellers rather than by commercial companies. Fisheries output ranged from 600,000 to 700,000 tons annually in the 1970s. Estimates indicate that the output had fallen to 120,000 tons of fish per year by 1990. This was partly due to environmental degradation and water pollution in Ogoniland and the Delta region in general by the oil companies. https://www.nationsencyclopedia.com/economies/Africa/Nigeria-AGRICULTURE.html#ixzz6rfCvfKya

THEORETICAL FRAME AND LITERATURE REVIEW

From the mid-1970s to the mid-1980s, the average annual growth rate of agricultural exports declined by 17 per cent. By 1996, agriculture accounted for only 2 per cent of exports. As agricultural exports shrank from the

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traditional 12-15 commodities of the 1960s, Nigeria became a net importer of basic food stuff she formerly exported (Bakare, 2011).
In the early 1980s, it became apparent that the agricultural sector could no longer meet domestic food requirements, supply raw materials for industry and earn enough foreign exchange through exports, owing to various economic, social and other environmental problems. Food production has since become a major problem in Nigeria and huge foreign exchange earnings are being utilized in importing food. The food import bill rose from a mere 14,112.88 million annually during 1970-74 to N1, 964.8 million in 1991 (Talabi, 2004).

Abolagba et al (2010) emphasize that Nigeria has lost its role as one of the world's leading exporters of agricultural commodities. In addition, the country is currently suffering from a declining as well as fluctuating income from its heavy dependence on oil exports and with the present situation in the oil market, it has become necessary for the country to reconsider its agricultural export position. Olomola (2010) further stated in his study that increased agricultural production is necessary to tackle starvation and malnutrition, and that a rapid growth in agricultural productivity is a pre-condition for economic take off and sustained poverty reduction in Nigeria. In the same vein, this study attempts to find out if a significant long-run relationship exists between agricultural exports and economic growth in Nigeria and to access the long run From the mid-1970s to the mid- 1980s, the average annual growth rate of agricultural exports declined by 17 per cent. By 1996, agriculture accounted for only 2 per cent of exports.

A strong and an efficient agricultural sector would enable a country to feed its growing population, generate employment, earn foreign exchange and provide raw materials for industries. Nigeria is generously endowed with abundant natural resources including biological and non-biological resources. The resources of the entire world should be developed to the fullest extent possible with available means as a whole can progress only by the efficient and rational use of the natural resources. Hence, agriculture constitutes one of the most important sectors of the Nigeria economy (Olajide, 2015). Besides oil, the major strength of the Nigerian economy is its rich agricultural resource base, its human resource and its huge markets. However, these resources have to be effectively mobilized so as to diversify the economic base and reduce dependence on oil and import. The economy remains vulnerable to external shocks emanating from fluctuation in the world prices of crude oil and the rising prices of imports. The resulting external and internal in balances are manifested in the adverse balance of payment position, unemployment and low capacity utilization in virtually all sectors as well as the deteriorating purchasing power of the populace (Atte and Muhammed- Lawal, 2006). The contribution of agriculture to the Nigerian economic growth is very low compared to what it used to be in the past 27 years. Nigerian agriculture to a large extent still possesses the characteristics of a peasant economy that was prominent in the pre-independence period. Given the information above, this study seeks to assess the impact of agriculture on economic growth in Nigeria.

METHODOLOGY

Data Description

The main data source for this study are monthly average agricultural products gotten from Central bank of Nigeria Statistical bulletin and the software used to carry out this analysis is Eviews 8.

The variables to be used for estimation are; GDP= Gross Domestic Product, Agricultural outputs, Government expenditure and Agricultural expenditure. The data covers time series from 2006 to 2010.

Stationary Time Series

A stationary time series $\{X_t\}$ is said to follow an autoregressive moving average of orders p and q, while the difference orders d and D are often chosen so that they sum up to at most 2. At each stage of the differencing process, the series is tasted for stationarity until it is attained. Here, Augmented Dickey Fuller (ADF) test shall be used to test for stationarity after each stage of differencing if the trend is not serially correlated.

A stationary time series $\{X_t\}$ is said to follow an autoregressive moving process of order (p, q) if it satisfies the following difference equation

$$X_t = \alpha_1 X_{t-1} + \alpha_{t-2} X_{t-2} + \cdots + \alpha_p X_{t-p} + \varepsilon_t + \beta_1 \varepsilon_{t-1} + \beta_2 \varepsilon_{t-2} + \cdots + \beta_q \varepsilon_{t-q} \quad (1)$$

where the $\{\varepsilon_t\}$ are a white noise series and the $\{\alpha_i\}$ and the $\{\beta_i\}$ are series of constants chosen so that (I) be stationary as well as invertible.

Generally $\{X_t\}$ will not be stationary in which case differencing it up to a certain integral order would render it stationary. Let this order be d. Then $\nabla^d X_t = (1-L)^d X_t$ is stationary where L is the backshift operator defined by

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$L^kX_t = X_{t-k}$. Insertion of $\nabla^d X_t$ in place of X_t in (I) yields an autoregressive integrated moving average process of order (p,d,q) in $\{X_t\}$.

The Augmented Dickey Fuller (ADF) unit root Test

An **augmented Dickey–Fuller test** (ADF) tests the null hypothesis that a unit root is present in a time series sample. The alternative hypothesis is different depending on which version of the test is used, but is usually stationarity or trend-stationarity. If augmented Dickey–Fuller (ADF) statistic, is used in a test and its appears negative number, then we say that "the more negative it is, the stronger the rejection of the hypothesis is at a unit root at some level of confidence".

Integration and Cointegration

A series that is integrated is a series that is stationary in the mean at order d, denoted I (d). For example, the random walk described earlier is an I (1)-process since its first difference is stationary, which can be written as

$\Delta y_t = y_t - y_{t-1} = e_t$

When multiple individual time-series variables are found to be integrated of order one, an additional test is required to determine whether long-term relationships exist among the variables.

Vector Error Correction Model (VECM)

The vector error correction model is abbreviated VECM. Consider the VAR (p) model described by Engel and Granger (1987) showed that any VAR model can be written as

$\Delta \boldsymbol{y}_t = \boldsymbol{y}_t - \boldsymbol{y}_{t-1} = \boldsymbol{\varphi} + \boldsymbol{\pi}\boldsymbol{y}_{t-1} + \Sigma\, \boldsymbol{\delta} \boldsymbol{i} * \Delta \boldsymbol{y}_{t-i} + \boldsymbol{e}_t$

Where $\boldsymbol{e}_t$ is defined as before and $\boldsymbol{\pi} = -(\boldsymbol{I} - \boldsymbol{\delta}_1 - \boldsymbol{\delta}_2 - \cdots - \boldsymbol{\delta}_p)$.

Further, $\boldsymbol{\pi}$ can be written as $\boldsymbol{\alpha\beta'}$ where $\boldsymbol{\beta}$ contains the cointegration vectors and $\boldsymbol{\alpha}$ contains the *speed of adjustment* parameters (Tsay, 2005). In order to describe the cointegration vectors we can consider two cointegrated series, then the following series (where both vectors has dimension (M, 1))

$\boldsymbol{\beta'} \boldsymbol{y} t$ is stationary in the mean. The *speed of adjustment* parameters determines the speed at which the series are returning to the common stochastic trend after a shock. In the bivariate case, by assuming no autocorrelation, this representation is written as

$\Delta \boldsymbol{y}_t = \boldsymbol{\varphi} + \boldsymbol{\pi}\boldsymbol{y}_{t-1} + \boldsymbol{e}_t,$

The Johansen trace statistic

To carry out the Johansen trace test, consider the following bivariate VAR (1) model

$$\boldsymbol{y}_t = \boldsymbol{\varphi} + \boldsymbol{\delta}_1 \boldsymbol{y}_{t-1} + \boldsymbol{e}_t.$$

Now, by estimating two models using ordinary least squares (OLS) we can acquire four canonical correlations between the columns in $\boldsymbol{D}$ and $\boldsymbol{E}$; where $\boldsymbol{D}$ and $\boldsymbol{E}$ are two matrices of dimensions $(T,2)$, where T is the number of observations, containing the estimated residuals after estimation of the parameters in the following models, respectively

$$\Delta\boldsymbol{y}_t = \mathbf{b}_0 + \mathbf{b}_1 \Delta\boldsymbol{y}_{t-1} + \boldsymbol{a}_1$$

And

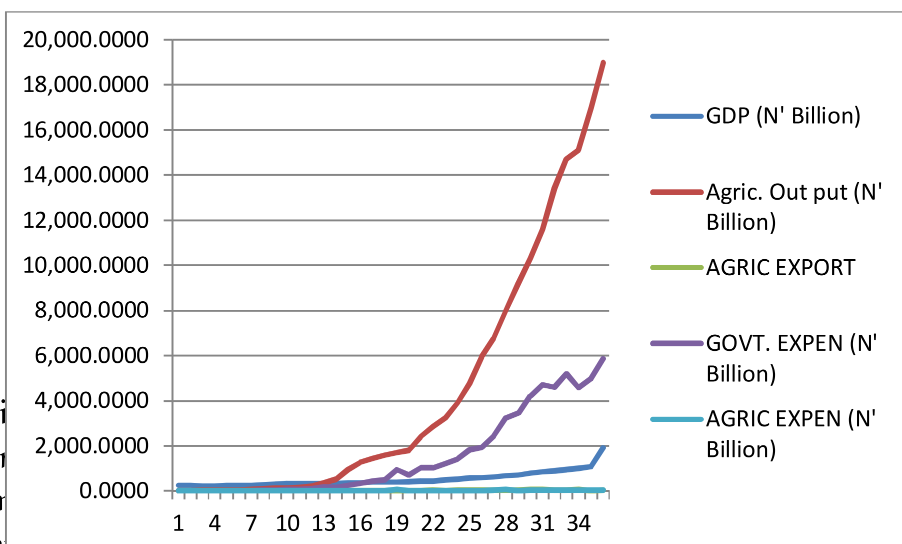
$$\boldsymbol{y}_{t-1} = \mathbf{b}_2 + \mathbf{b}_3 \Delta\boldsymbol{y}_{t-1} + \boldsymbol{a}_2.$$

RESULTS AND DISCUSSION

The main data source for this study are monthly average agricultural products gotten from Central bank of Nigeria Statistical bulletin and the software used to carry out this analysis is Eviews 8.

The variables to be used for estimation are; GDP= Gross Domestic Product, Agricultural outputs, Agricultural exports, Government expenditure and Agricultural expenditure. The data covers time series from 2016 to 2020.

The time plot of the five series is shown in figure 1 below



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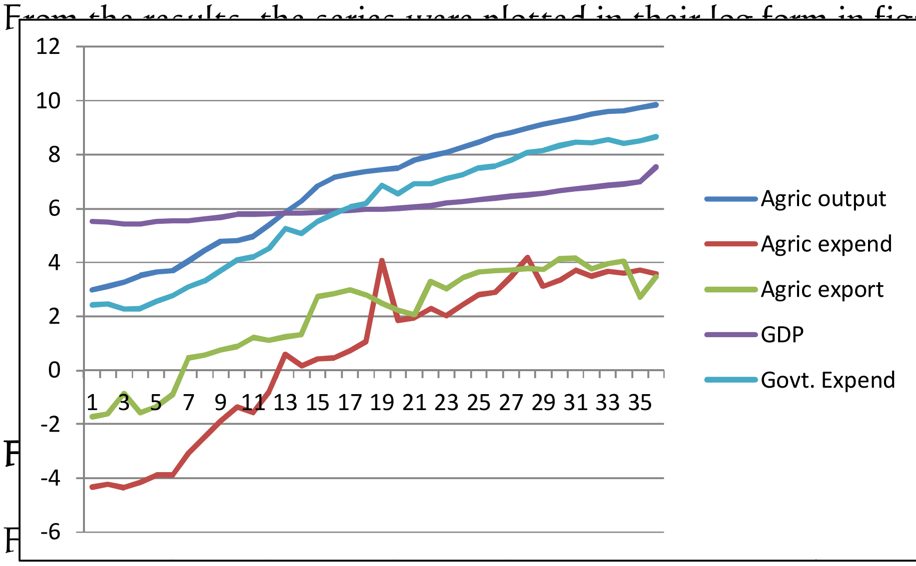
From the results, the series were plotted in their log form in figure 2 below.



F

F transformation technique helped to stabilize the variance of the series but there still exist linear trend in the mean which requires differencing to de-trend and make them stationary as shown in figure 3 below.

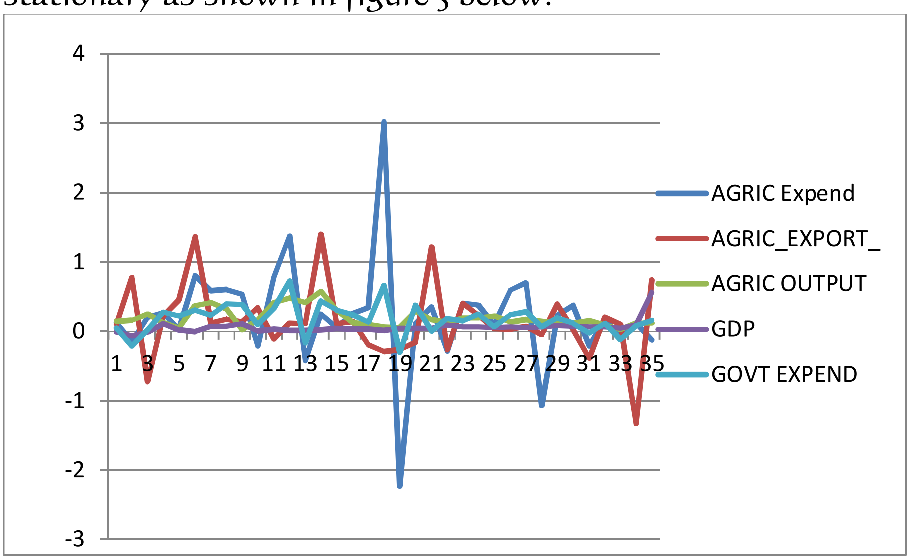


Figure 3: The Differenced Time Series Plot of the Log Transformed Series

We then proceed to check for unit root in the series to determine the order of integration. The ADF test indicate evidence of unit root in the series at level and at first difference, the series became stationary. Hence the series are said to be integrated of order one

Table 1: Showing the Unit root test for Stationarity in the Series.

Test Series	ADF TEST	
	Level	1st Difference
Agric Output	-2.837303	-2.441124**
Agric Expend.	-2.837303	-2.841124**
Agric Export	-2.847110	-2.841114**
GDP	-2.843021	-2.841124**
Govt. Expend.	-2.852861	-2.850311**

** significant at 5% levels.

Since all the series are integrated of order one (I (1)), we then examine if there exists evidence of long run relationship among the series using the Johansen co-integration test.

Johansen Co-Integration Test

The Johannsen cointegration test is measured using the Max eigenvalue and the trace statistics against the critical value to determine if there exist a relationship between the variables as seen in table 2 below.

Table 2: Showing the Johansen Co-Integration Test Results

Hypothesized	Trace Statistic		Hypothesized	Maximum Eigenvalues Statistic	
No. of CE(s)	λ_{trace}	Critical value	No. of CE(s)	λ_{max}	Critical value
None *	102.0132	58.71778	None *	26.24222	26.24222
At most 1 *	55.55011	36.74512	At most 1 *	20.80833	16.47523
At most 2 *	24.64056	18.68606	At most 2	20.11847	21.13151
At most 3 *	14.62107	14.48361	At most 3 *	14.62761	14.25350
At most 4	0.001264	2.741256	At most 4	0.001265	2.731355

The results in table 2 indicate evidence of co-integration between the series with at least three (3) co-integrating equation. This is shown by the Trace test and the Maximum Eigenvalue test statistic which rejected the null of no co-integration equation.at 0.05 significance level. Since there exist cog-integrating equation among the variables, this form the basis of conducting Vector error correction model (VECM).

Vector Error Correction Model for the Series

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Having established that the series are co-integrated, implying that a long-run relationship exists between the two series, we proceed to run the Vector Error Correction Model (VECM). The VECM examines the dynamic co-movement among the five series as well as the short-term adjustment process towards the long-term equilibrium. The VECM results shown below

Table 3: vector error correction coefficient model

	Coefficient	Std. Error	t-Statistic	Prob.
VECM (-1)	-0.094496	0.362011	-0.301497	0.161497

VECM (Vector error correction model equation for GDP)

D(GDP) = C(28)*(AGRIC_EXPEND(-1) + 1.25849503136*GDP(-1) - 1.56906159673*GOVT__EXPEND(-1) + 0.888293491827) + C(29)*(AGRIC_EXPORT(-1) - 0.222834651215*GDP(-1) - 0.84399786434*GOVT__EXPEND(-1) + 4.26159610356) + C(30)*(AGRIC_OUTPUT(-1) - 0.327257700974*GDP(-1) - 0.966471772349*GOVT__EXPEND(-1) + 0.796032795401) + C(31)*D(AGRIC_EXPEND(-1)) + C(32)*D(AGRIC_EXPORT(-1)) + C(33)*D(AGRIC_OUTPUT(-1)) + C(34)*D(GDP(-1)) + C(35)*D(GOVT__EXPEND(-1)) + C(36)

D(GDP) = 0.0074055326625*(AGRIC_EXPEND(-1) + 1.25849503136*GDP(-1) - 1.56906159673*GOVT__EXPEND(-1) + 0.888293491827) - 0.08090275068*(AGRIC_EXPORT(-1) - 0.222834651215*GDP(-1) - 0.84399786434*GOVT__EXPEND(-1) + 4.26159610356) + 0.161496515268*(AGRIC_OUTPUT(-1) - 0.327257700974*GDP(-1) - 0.966471772349*GOVT__EXPEND(-1) + 0.796032795401) + 0.0376292808298*D(AGRIC_EXPEND(-1)) - 0.0260756329823*D(AGRIC_EXPORT(-1)) + 0.123617963459*D(AGRIC_OUTPUT(-1)) + 0.861288161006*D(GDP(-1)) - 0.113339762686*D(GOVT__EXPEND(-1)) + 0.013024235751

CONCLUSION

This paper investigates the relationship between agricultural export and economic growth in Nigeria using the VAR (vector autoregression) approach. The unit root test for stationarity found all variable to be stationary at first difference 1(1). Johansen cointegration test conducted found out that there are at least three (3) cointegrating equations at 5% level of significant indicating a long run relationship between the variables. The VECM reveals that economy would restore its previous equilibrium by 9.4496 % speed of adjustment. A unit increase in agricultural exports would bring a proportionate increase in the Gross Domestic Product in Nigeria.

CONTRIBUTION TO KNOWLEDGE

This paper was able to identify that the agricultural products and its economy would grow and restore its previous equilibrium by 8.3385 % if speed adjustment is put into consideration.

Authors'

*This work was carried out in collaboration among all authors. "***Robinson Amos Ibuchi***" designed and performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript. ."* **Joseph Dagogo** *wrote the literature researches with the referencing. While "***Benson Tina Ibienebaka"** *drafted the methodology part of the researches. All authors read and approved the final manuscript.*

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