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Analysis of Agro Export Response to Macroeconomic Indices in Nigeria (1980 – 2014)

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Authors' contributions

This work was carried out in collaboration between both authors. Author ABS helped with the analytical framework and literature review. Both authors read and approved the final manuscript.

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ABSTRACT

The study examined the relationship between agricultural output and macro-economic variables in Nigeria between 1981– 2014. The data series employed were gathered from the Central Bank of Nigeria, Statistical Bulletin, Economic and Financial Review, Monthly and Annual Reports and Statement of Account for various years, National Bureau of Statistics and Publications of International Monetary Fund. The study employed the Multivariate co-integration methods. The time series property of data employed were first to be investigated. This is then followed by testing for co-integration which appeared in the model. Based on the time series property of data used, the results clearly indicated that there were at most, two co-integrating vectors and this was further confirmed by the maximum Eigen Value which showed two co-integrating vectors. This showed that there was a stable long run relationship between agricultural output and macroeconomic variables during the study period. The coefficients of the long run relationship were then deductively along the general to specific approach. The vector error correction model was adopted to know the short-run relationship between the dependent and explanatory variables. The result showed that the contribution of Agricultural output to Gross Domestic Product was very high from the first quarter up to 6th quarter and then starts declining after the 7th quarter. It is now recommended that there is an urgent need to enhance the production of both domestically consumed and exported crops in Nigeria and that a policy should be initiated to discourage importation of Agricultural output to Nigeria.

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Keywords: Agricultural; output; macro-economic; variables.

1. INTRODUCTION

1.1 Background to the Study

Agriculture has been variously described as the primary for impetus economics development and the mainstay of any well-planned economics throughout the world because it contributes significantly to the National Gross Domestic Product (GDP), creates employment, provides food and earns foreign exchange [1]

In Nigeria, prior to independence, agriculture was the main stay of the economy and a major source of revenue for funding development programmes of government. The reliance of nation's economy on agricultural income led to the establishment of marketing boards with monopolist powers to buy cash crops from farmers and sell them overseas. The role of marketing board was very important especially in stabilizing farm incomes and generating funds for executions of development projects in the country. The sector has continued to be a strategic sector in the nation's economy and target for the transformation process to rescue the country from mono-commodity dependent economy. Based on the World Trade Organization report in 2009, although the petroleum sector dominates the economy of Nigeria, agriculture is more important to most Nigerians because it represents over half of employment and contributed 41.7% of GDP. According to Philip et al. (2008) agriculture contributes more than 30% of the total annual Gross Domestic Product (GDP), employs about 70% of the labour force, account for over 70% of the non-oil exports and provides over 80% of the food needs of the country.

According to Mkpado and Arena [2] Nigeria, agricultural trade policies can be studied under 3 phases with respect to Structural Adjustment Programme (SAP) adopted by the Federal Government in 1986 namely pre SAP, during SAP and post SAP trade policies. The period from 1960s to 1985 was the pre SAP era characterized with the highly regulated exchange rate and quantitative restriction in the form of import and export bans placed on certain agriculture commodities as well as reinforced centralized marketing to improve government revenue characterized. Import-export duties, as well as controlled exchange rate, were major trade policy instrument prior to and many years after independence. However, by 1973 due to the effect of Dutch "disease" suffered by the agro-export as result of oil boom, export duties were abolished in order to revive agriculture export. The main explicit instruments of pre- SAP era policies were export duties, taxes and centralized (Marketing Board).

The SAP period, (1986-94) witness among other things devaluation of the naira abolition of import and export licensing requirement except for fertilizer and few other commodities between 1986 and 1988. Abolition of foreign exchange control system by Central Bank of Nigeria CBN. Also the marketing board was of scraped in 1986. This was followed by further reduction in export duties and the removal of export prohibition for many agricultural crops except food gains. According to Soludo, [3] the effect of customs and excise traffic consolidation decree of 1988 is extended list of banned import by 1991 to about 20 percent of industrial and 30 percent of agricultural products. Import duties were designed to discourage importation of non-essential in the raw materials as well as inputs and commodities that have local substitutes, especially in the agricultural sector. The major policy instrument of SAP era were import duties and outright import prohibition which were designed to discourage importation of non-essential raw material as well as inputs and commodities that have local substitutes, especially in the agricultural sector.

The post SAP police witness the de-emphasizing of the use of import prohibitions and replacement with a new seven- year tariff reform with frequent adjustment and changes in the tariff structure. The high import duties in 1995 were reduced after 1999 [4]. In general recourse to quantitative restriction on imports is on the decline though the ban on importation of maize, sorghum, millet, wheat flour, vegetables, plastic article and all types of meat exist (Ogunkola and Bankole, 2005) [5]. On the other hand, government has been trying to expand with establishment of Nigeria Export Promotion Council (NEPC).

1.2 Statement of the Problem

According to Adubi [6], changes in income earnings of export crop producers come as a result of either increase or decrease in international world price of exports or devaluation of the currency and the subsequent increase in

producers prices. It has been noted that the agro export sector in Nigeria like any other developing countries largely depend on the responsiveness of her agricultural production to commodity price signals in particular. Therefore a decision to produce for export involves uncertainties about the prices in foreign exchange that such sales will realize as well as the exchange rate at which foreign exchange receipts can be converted into domestic currency. No doubt various attempts have been made in terms of policy formulation and fiscal regulations to significantly improve the agricultural export sub-sector .The desire transformation is yet to be seen. although the sector increased afterwards, its share never exceeded 40% thereafter, with different sub-sectors contribution changing regularly and food importation rising [7].

Whichever way it goes, exchange rate variability tends to increase the risk and uncertainty in international transactions in which agricultural commodity trade is not an exception, it may adversely affect trade and investment flows. This will further increase risk on supply of exports. Exchange rate risk measures the variability and changeable pattern of exchange rate movements; the more explosive the movements, the higher the risk) [8].

Producers` exports are not only concerned with the magnitude of the price they receive, they also bother about the stability of such prices as it relates to earning a consistent income. It is expected to be an incentive for export growth. For Nigeria to return to the global agricultural commodity market as a major player again, it is imperative to understand the relationship between selected macroeconomic variables such as GDP, Cocoa Export, cocoa price, cocoa quality, Exchange rate etc. It therefore becomes imperative to ask the questions

- What is the trend in Nigeria agro export and the selected macro-economic variables?
- What are the possible relationship between agricultural commodity export and selected macroeconomic variables?
- What is the nature and direction of agro export response to exchange rate and the other selected macro-economy variables?

It is believed that answer to these questions will give an in-depth understanding of Nigeria agro export response to exchange rate and other selected macro-economic variables.

1.3 Objectives of the Study

The main objective of this study is to examine the response of agro export to macro-economic indices in Nigeria while the specific objectives are to:

i. examine the trend in Nigeria agricultural commodity exports in Nigeria;
ii. determine the relationships between agricultural commodity exports and selected macro-economic variables;
iii. evaluate the impact of commodity prices, exchange rate, quantity and gross Domestic products on agricultural trade flows.

1.4 Justification

There is scarcely any country that lives in absolute independent in the current globalized world. The economies of the entire world are linked directly or indirectly through asset or goods markets. This price of foreign currencies in terms of a local currency (i.e. foreign exchange) is therefore important to the understanding of the growth trajectory of all countries of the world [9]. Although, there appears to be a consensus view on the fact that devaluation or depreciation of local currency could boost domestic production through stimulating the net export component. But according to Adubi and Okunmadewa [6], such price/exchange rate changes, however, may lead to a major decline in future output if they are unpredictable and erratic.

However, the extent to which exporters are able to expand sales abroad using devaluation depends on the foreign elasticity for Nigeria`s agricultural exports which is the nature of these goods and the market conditions. Meanwhile the issue of agricultural response usually dominates economic developmental policies with a positive supply response usually regarded as sin-qua-non for national economic growth. The responsiveness of farmers supply to price and non-price incentives provides a clear picture of the contribution of the agricultural sector to the economy. This depends often on the responsiveness of agricultural production to price in particular. In a developing economy like Nigeria, where export price fluctuates as a result of currency devaluation which is expected to be an incentive for export growth, the primary concern is the nature and magnitude of risk introduced by the price and exchange rate movements in agricultural exports [10]. It is also pertinent to note that many researchers who

conducted researches on the effects of price and exchange rate movements on agricultural tradable had inconclusive results, leaving gap in this area. For instance, Kargbo, [11] found that prices, real exchange rates, domestic production capacity, and real incomes have significant impacts on the agricultural export. Studies by IMF [12] and DeGrauwe [13] show that exchange rate variability causes fluctuations in export revenue.

It is therefore necessary to empirically examine the effects of trade liberalization and exchange rate changes on agro export sector of the Nigeria economy. The understanding of the response of agro export to exchange rate variability will assist the policy maker in adequate formulation of policy that will alleviate any short comings in the current *modus operadi* in the agro export sector of the economy.

1.5 Theoretical Framework

Heckscher-Ohlin, theory, thus, states that the main determinant of the pattern of production, specialization and export among regions is the relative availability of factor supplies. Regions or countries have different factor endowments and factor supplies. Therefore, some countries that are rich in capital will export capital-intensive goods and countries that have much labour will export labour-intensive goods. Heckscher-Ohlin theory presents the issue that international and interregional differences in production cost occur because of the differences in the supply of production factor [14]. Those goods that require a large amount of the abundant, that is, less costly, factor will have lower production costs, enabling them to export for less in international markets [15].

1.6 Specification of Model

The modeling of this work is guided by the theoretical framework discussed above and with reference to agricultural export supply model developed by Subramanian [16] and with little modification to accommodate some macroeconomic indicators such as exchange rate, real interest rate, and consumer price index. We now present the below model to examine the relationship between agricultural output and macro-economic variables in Nigeria.

$$\mathrm{AGO} = \mathrm{f}(\mathrm{TOP}, \mathrm{RINTR}, \mathrm{EXR}, \mathrm{CPI}) \quad (1)$$

Specifying the agricultural export supply model in equation form (with an error term, U_t), the following equation may be written:

$$\mathrm{AGO} = \alpha_0 + \alpha_1 \mathrm{TOP} + \alpha_2 \mathrm{RINTR} + \alpha_3 \mathrm{EXTR} + \alpha_4 \mathrm{CPI} + u_t \quad (2)$$

AGO = Agricultural Output
TOP = Openness of Trade
RINTR = Real Interest Rate
EXRT = Exchange Rate
CPI = Consumer Price Index (Proxy of Inflationary Rate)
U_t = Stochastic Error Term
$\alpha_0 - \alpha_4$ = Parameter Estimates

1.7 Estimating Technique

The estimation procedures employed in this empirical investigation is based on Joselius co-integration analysis and vector error correction model (VECM).

1.7.1 Unit root test

Currently, there are some commonly accepted methods of testing for unit roots. These are the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) test.

The Augmented Dickey-Fuller (ADF) test is considered superior to the Dickey-Fuller (DF) test because it adjusts appropriately for the occurrence of serial correlation.

$$X = b_0 + b_1X_{t-1} + b_2X_{t-2} + b_nX_{1-n} + U$$

Where

U = Stochastic Error Term

The null hypothesis that X_t is non-stationary is rejected if b_1 is significantly negative.

The number of lag (n) of X_t is usually chosen to ensure that the regression is approximately white noise. It is simply referred to as the DF test if no such lags are required in which case $b_1 = 0$ (i = 1 …… n). However, the t-ratio from the regression does not have a limiting normal distribution.

Co-integration is based on the properties of the residuals from regression analysis when the series are individually non-stationary.

A series is stationary if it has a constant mean and constant finite variance.

Thus, a time series X_t is stationary if its mean $E(X_t)$ is independent of time and its variance $E\{X - E(X_t)^2\}$ is bounded by some finite number and does not vary systematically with time. It tends to return to its mean with the fluctuations around this mean having constant amplitude.

1.7.2 Co-integration and vector error correction model

The theory of multivariate co-integration, as propounded and propagated by Johansen and Joselius provides a nexus or connection among integrated processes and the notion of long run equilibrium. The co-integration test commenced with a test for the number of co-integrating relation or rank (r) of π using Johansen's maximal Eigen value of the stochastic matrix and the likelihood Ratio (LR) test based on the trace of the stochastic matrix π which is the long run multiplier matrix of m x n that is the matrix of the coefficients. Note that the Eigen Value of π_1 are the roots of the k_{th} order characteristics polynomial/π – vI/obtained by solving the characteristic equation/π_1 – vI/ = 0

The number of non-zero Eigen value the rank of the matrix π. Also, the trace statistic suggested by Johansen to determine the co-integration rank in a multivariate model is based on the ordered (estimated) Eigen value in the following relation:

$$Trace\ {}^{r_0}/_K = -T \sum_{ir=r_0+1}^{K} \ln(1-\lambda_i$$

Where

λ_i = Ordered (estimated) Eigen value

This is the relevant test statistic for the null hypothesis $r \leq r_0$ against the alternative $r \geq r_o + 1$ following a sequence.

Π matrix (the matrix of the coefficient in the VAR models) is a product of two matrices α and β.

Let Y denote and n x 1 vector of the I (1) variables the rank of π which is r, determines how many linear combination of the variables in the levels are stationary. If r = 0 such π = 0, none of the linear combination are stationary. Π can be factored, that is π = αβ. Both α and β are n x r matrices. While β contains the co-integrating vector (thez error-correction mechanism in the system), α is the adjustment parameter.

The second is the maximum Eigen value (λ_{max}) statistic:

$\lambda_{max} = - T\ln(1- \lambda_{r+1})$

This test allows for the comparison of a co-integrating rank of rank of r against the alternative of a co-integration rank of r + 1. This test may then be repeated for larger values of r until one fails to reject the null hypothesis.

The Johansen representative theorem establishes formally the theoretical basis of error-correction modeling. According to the theorem, if Y_t and X_t are co-integrated, then there is a long run relationship between them. In addition, the theorem proves that the short-run adjustment dynamics can be usefully described by the error correction model (ECM) as stated in the following equation:

$a(L)\ \Delta Y_t = a_0 - \chi(Y_t - diX_t) + b(L)\ \Delta Y_t + C(L)\ \Sigma_t$

in simple terms, the VECM involves using the lagged residual to correct for deviations of actual values from the long run equilibrium values. To fix ideas, consider the equation above and will discover that the residual from the regression is Ut = Y_t BX_t which is 1(0), since Y_t and X_t are assumed to be co-integrated. In applied work we require that the coefficient of VECM be significant and negative. Its sign should be negative if it is to play the role of error correction. Specially, if actual equilibrium value is too high, the error correction term will reduce it while if it is too low, the error correction term will raise it.

1.8 Source of Data

Data were obtained from annual bulletin of the Nigeria Bureau of Statistics, CBN statistical bulletin and World Bank data tables.

1.9 Estimation Techniques

The data employed in this research work were annual time series data which were secondary in nature. They were sought from the Central Bank of Nigeria, Statistical Bulletin, Economic and financial review, Monthly and annual reports and Statement of Account for various years, National Bureau of Statistics and International Financial Statistics. The data are Agricultural output, Trade openness, export divided by GDP, real interest rate, exchange rate and consumer price index.

1.9.1 Stationary and non-stationary

Most of economic time series consist of reading taken at predetermined equal interval time point so that one might get hourly, monthly, quarterly and annually readings/values. Such data from a discrete time series, denoted by y(t) in which it is possible to take measurements as every moment of time. The initial objective of time series analysis is to make inferences about the properties or basic features of the stochastic or random process from the information contained in the observed series. The first step in the analysis is usually to form certain summary statistics, but the eventual aim is to construct a model from the data; a model that is hoped has similar properties of those of generating mechanism of the stochastic process.

Thus, when a model has been obtained it can be used either to test some hypothesis or theory about the generating mechanism of the process and can be used to forecast future values of the series and it may be used to decide on a system of controlling future values. To fully, characterize random varies, one needs to specify distribution function. If the process is assumed to have normal distribution for every set, then the mean and variance or covariance will be sufficient for a complete characterization of the distributional of properties of the process. If, on the other hand, normally is not assumed, but if the generating process is taken to be linear, in the sense that the process is generated by a linear combination of past and present values of other process, again the major properties of the process are captured in the means and variances.

In summary, a series is said to be stationary if and only if it has a constant mean and constant finite variance while it is non-stationary if it has time-varying mean and variance. Thus, a time series Y_t is stationary if its means $E(y_t)$ is independent of time and its various, $\{E(y-E(y_t)\}^2$ is bounded by some finite number and does not vary systematically with time. A stationary series will tend to its mean with the fluctuation around this having a constant amplitude while non-stationary series will diverge completely from its mean and cannot be referred to without making reference to some particular time period.

Therefore, in time series analysis, the properties of each series must be clearly identified. When all the data series are stationary, we can confidently and convenient apply estimation technique such as the Ordinary Least Square (OLS) method. When 1 non-stationary variable is to be included in a regression, it is generally recommended that first difference form be used in order to transform such series into stationary. This leads us to the order of integration of variables and unit root tests.

1.9.2 Integrated variables and unit root tests

The properties of stationary series, denoted as 1(0) are quite unlike those of non-stationary series, denoted as 1(1). A 1(0) series has a constant mean and variance while a 1(1) series has a variance and mean that change with time. While 1(0) series will be seen to return to the mean value often, a 1(1) series will rarely revert back to any particular value, including its starting point.

Most empirical time series exhibit variation that changes in both the mean and dispersion in proportion to absolute level of the series. For instance, as the narrow money demand (MI) series evolves through time, it is quite evidenced that both mean and variance increase. While application of the difference operator frequently removes a time-dependent mean it has little effect on stabilizing the variance of the empirical time series.

Before any sensible regression analysis can be performed, it is highly essential to identify the order of integration of each time series (variable), provide of course that the variable can be transformed into a stationary variable through differencing. A non-stationary series which can be transformed to a stationary series by differencing d times is said to be integrate of order d. This implies that an observable time series variable. Y_t is said to be integrated of order d, denoted by Y_t – 1(d), if $\Delta^d dy_t$ is stationary (where Δ first difference operator i.e. $\Delta = (1 - L) = Y_t - Y_{t-1}$

1.9.3 Augmented Dickey Fuller

Augmented Dickey Fuller test by the following equation:

$$\Delta X_1 = \alpha_0 + x_{t-1} + \alpha_0 \Sigma (\mu_1 = \pi D)$$

Where

$$\Delta X_{t-1} = (X_{t-1} - X_{t-2})$$
$$\Delta X_{t-2} = (X_{t-2} - X_{t-3})$$

μ_t is the error term [17]; [18]

The null hypothesis to be tested is H_0:$a_1 = 0$ against the alternative that H_0:a_{10}. Under the null hypothesis that Chi = 0 the computed t-statistic is known as the T-statistic and does not have the standard t-distribution because the variance is unlimited. The critical values of the T are provided in [19]. If the computed absolute value of the T is less than the critical value, the series is non-stationary, whereas if it exceeds the Dickey Fuller critical value, we do not reject the hypothesis that the given time series is stationary.

The only problem which arises will be how to determine the number of optimal lags of the dependent variable. The purpose of lag length is to ensure that the residual is not serially correlated. It is very important to use an optimal number of lags of the dependent variable in the test regression because if too few lags are included not all of the autocorrelations will be removed and if too many are included there will be an increase in the coefficient standard errors [17] and [20] Although, the number of lagged difference terms to be included is determined empirically, the idea is to include enough terms so that error term is serially independent [18]. The lag length was selected using the Final Prediction Error (FPE) and Akaike Information criterion (AIC).

1.10 Co-integration and Error Correction Modelling Techniques

The grin fact is that in macroeconomic modeling, most time series (i.e. series ordered by time) are subject to some stochastic tends. One remedy suggested above is to difference a series successively until stationary is achieved. Nevertheless, this does not seem to be an ideal solution. It has been shown in earlier studies that applying first differences to variables in a regression (or strictly speaking, to natural logarithms of variables) leads to the loss of long run solution. The desire to evaluate models which combine both short and long run properties and which at the same time maintain stationary in all the variables has prompted reconsideration of the problem regression using variable measured in their levels.

A pertinent question is whether there are situations where one can run a regression between two or more variables in levels, even though the variables are non-stationary. Sometimes, two or more variables will follow random walk, but a linear combination of these variables will be stationary. Granger [21] hypothesized that economic variables may individually be non-stationary, but are not mutually independent. Rather, there seems to be a mechanism that prevents wide divergence. For instance, it may be that the variables X_t and Y_t are random walks but the variable $Z_t = X_t - \Theta Y_t$ stationary (where Z_t is the linear combination of two variables). If this is the case, we say that X_t and Y_t are co-integrated and call Θ the co-integrating parameter or vector if X_t and Y_t are vectors of variables [22].

In the event of non-stationary of the series, we conduct tests of co-integration. Here, we apply both the DF and ADF tests to the residuals of the static co-integrating (long-run) regressions. The intuition behind this definition is that even if each time series is non-stationary, there might exist linear combinations of such time series that are stationary. In that case, multiple time series are co-integrated and share some common stochastic trends. We can interpret the presence of co-integration to imply that long run movement in these multiple times series are related to each other. Indeed, it there is a long run relationship between two or more non-stationary variables, then the ideal of the general concept of co-integration is that deviations from this long run path are stationary. If this is the case, the variables in question are said to be co-integrated. However, time series can only be co-integrated if they are integrated of the same order.

2. RESULTS AND DISCUSSIONS

2.1 Unit root analysis

The Augmented Dickey Fuller (ADF) test is employed in order to analyze unit roots. The results are present in level and first difference. This enables us determine in comparative terms, the unit root among the time series and also to obtain more robust results.

From Table 1. (a & b) it can be observed that RINTR is the only variable that was stationary at level while other variables were not stationary at level, but they became stationary only after first difference, which connotes that all the variables are integrated of order one I(1). This implies that all the variables used in the study retain innovative shock passed on them, only for short period of time after which they let go. Hence, confirmation of the presence of non-stationary variables in the series, which brings to book the

Table 1a. Augmented dickey fuller unit root test at level (1981-2014)

Variable	ADF Test Statistics	95% Critical ADF Value	Remark
AGO	0.237626	-2.954021	Non-stationary
CPI	-0.065643	-2.954021	Non-stationary
EXR	-0.206693	-2.954021	Non-stationary
RINTR	-5.919967	-2.954021	Stationary
TOP	1.282269	-2.957110	Non-stationary

Source: Computed data analysis (2016)

Table 1b. Augmented dickey fuller unit root test at first differences (1981-2014)

Variable	ADF Test statistics	95% critical ADF value	Remark
AGO	-4.325446	-2.957110	Non-stationary
CPI	-5.375807	-2.957110	Non-stationary
EXR	-5.401072	-2.957110	Non-stationary
RINTR	-7.046648	-2.957110	Stationary
TOP	-6.598686	-2.957110	Non-stationary

Source: Computed data analysis (2016)

possibility of spurious relationship the short run due to the presence of random walk, suggests that long run relationship test should be carried out to test for the presence of co-integrating equation amidst the multivariate series in the long run. The co-integration test was done using Johansen maximum likelihood ratio approach.

2.2 Lag Length Selection

After the unit root test, another pre-condition for VECM model is the lag selection criteria and then Johansen's co-integration. Thus, we applied different criteria, for optimal lag selection i.e. Likelihood Ratio test (LR), final prediction Error criteria (FPE), Akaike information criterion (AIC), Schwarz information criterion (SIC) and Hannan-Quinn Information Criteria (HQIC). All of the Criteria suggesting one lag, so we select one lag for the estimation of proposed VECM model.

2.3 Johansen Co-integration Test Result

Since the variables of interest such as agricultural output (AGO), consumer price index (CPI), exchange rate (EXR), real interest rate (RINTR), and trade openness (TOP) were integrated of the same order I(1), then we can now proceed to long run using Johasen co-integration test.

Co-integration test result presented in Table 2 above is the summary of co-integration analysis using Johansen trace and max-Eigen statistics

Table 2. Information criteria regarding selection of lag length

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-1264.402	NA	1.97e+28	79.33763	79.56665	79.41354
1	-1064.523	324.8033	3.60e+23*	68.40769*	69.78182*	68.86318*
2	-1044.098	26.80804	5.42e+23	68.69362	71.21285	69.52867

**Indicates lag order selected by the criterion*
Source: Computed Data analysis (2016)

Table 3. Series AGO, CPI, EXR, RINTR and TOP unrestricted co-integration rank test (trace)

Hypothesized No of CE(s)	Eigen Value	Race Statistic	0.05 Critical value	Prob. **
None	0.817029	106.7351	69.81889	0.0000
At most 1	0.612856	54.08392	47.85613	0.0116
At most 2	0.353787	24.66624	29.79707	0.1737
At most 3	0.217253	11.13082	15.49471	0.2036
At most 4	0.107843	3.537496	3.841466	0.0600

Trace test indicates 2 Co-integrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level*
*** p-values*

Table 4. Unrestricted co-integration rank test (maximum eigen value)

Hypothesized no of CE(s)	Eigen value	Ma-Eigen statistic	0.05 Critical value	Prob. **
None *	0.817029	52.65121	33.87687	0.0001
At most 1*	0.612856	29.41768	27.58434	0.0288
At most 2	0.353787	13.53541	21.13162	0.4043
At most 3	0.217253	7.593326	14.26460	0.4216
At most 4	0.107843	3.537496	3.841466	0.0600

Max-eigenvalue test indicates 2 co-integrating eqn(s) at the 0.05 level
** denotes rejection of the hypothesis at the 0.05 level.*
***p-values.*

Table 5. Normalized co-integrating coefficient (standard error in parentheses)

AGO	CPI	EXR	RINTR	TOP
1.000000	-185809.3	183691.6	2781.500	-0.099537
	(39026.1)	(38650.7)	(1494.29)	(0.03159

approach. This test statistics strongly rejects the null hypothesis of co-integration, in favour of two co-integrating equation at 5 percent significance level.

2.4 Vector Error Correction Model (VECM)

After establishing that long run relationship existed between the dependent variable and the independent variables through Johansen co-integration estimation of the normalized co-integration equation. Vector Error correction modeling (VECM) was also carried out to estimate the existence of long-run co-integration equation model. Impulse response and variance decomposition techniques were estimated to show the response of agricultural output and the independent variables such as inflation rate, consumer price index, exchange rate, and trade openness.

The error correction model (ECM) in the vector error correction modeling is C(1) which at the same time is the speed of adjustment towards long run equilibrium which implies that is must be significant and the sign must be negative. From Table 6 C(1) with the coefficient of -0.057853, implies that the co-integrating equation coefficient is negative and has a probability value of 0.0072 which indicate that it is significant and shows that there exist a long run relationship between the dependent variable (AGO) and the independent variables such as CPI, EXR, RINTR, and TOP.

2.4.1 VECM impulse response analysis

Impulse Response function assesses the effect of one of the innovations of the endogenous variables of a model within a given period of time. In other words, it is used to predict or forecast the response of each endogenous variable to a standard deviation change in all other exogenous variables. The results of impulse response function are therefore presented.

Table 6. Fitted VECM (AGO as dependent variable)

	Coefficient	Std. Error	t-Statistics	Prob.
C(1)	-0.057853	0.019751	-2.929107	0.0072
C(2)	0.328911	0.192387	1.709636	0.0072
C(3)	-5022842	77.65203	-0.646840	0.0997
C(4)	6151.088	2080.312	2.956811	0.5236
C(5)	57.71128	41.75330	1.382197	0.1791
C(6)	-0.005358	0.002646	-2.024728	0.0537
C(7)	-29394.91	-29394.91	-2.783350	0.0101

D(AGO) = C(1) (AGO(-1) – 105579.61866* CPI (-1) + 104272.825042* EXR(-1) + 1187.3686229* RINTR (-1) – 0.0686117669638* TOP(-1) -519620.014173+ C (2)* d (AGO (-1) + C(3)*D(CPI (-1)) + C (4)* D(EXR(-1) + C(5)* D(RINTR (-1)) + C (6)* d (TOP (-1)) + C(7)*

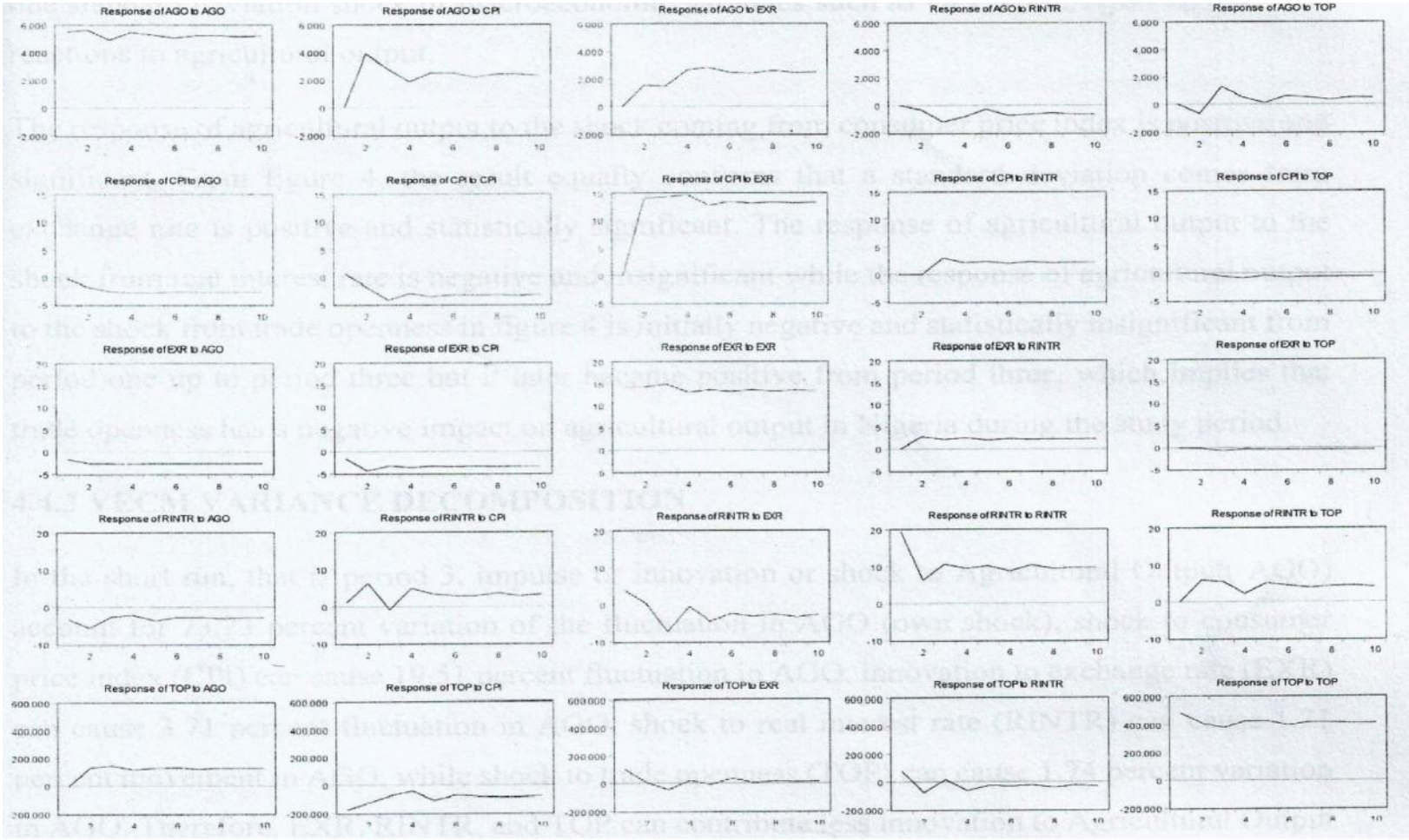

Fig. 1. Response to Cholesky one standard innovations

Source: Computed data analysis (2016)

2.4.2 Response of AGO to macroeconomic variables

This shows the reactions of macroeconomic variables to agricultural output that is, the effect of one standard deviation shock of macroeconomic variables such as CPI, EXR, RINTR, and TOP reactions to agricultural output.

The response of agricultural output to the shock coming from consumer price index is positive and statistically significant. The response of agricultural output to the shock from real interest rate is negative and insignificant while the response of agricultural output to the shock from trade openness in Fig. 1 is initially negative and statically insignificant from period one up to period to period three but in later became positive from period three, which implies that trade openness has a negative impact on agricultural output in Nigeria during the study period.

2.4.3 VECM variance decomposition

In the short run, that is period 3, impulse or innovator or shock to agricultural output (AGO) account for 73.73 percent variation of the fluctuation in AGO (own shock), shock to consumer price index (CPI) can cause 19.51 percent fluctuation in AGO, innovation to exchange rate (EXR) can cause 3.71 percent fluctuation in AGO, shock to real interest rate (RINTR) can cause 1.31 percent movement in AGO, while shock to trade openness (TOP) can cause 1.74 percent variation in AGO. Therefore, EXR, RINTR, and TOP can contribute less innovation to agricultural output while AGO (own shock) and CPI contribute in the forecast error variance of Agricultural output in the short run under the study period.

In the long, that is 10 period, forecast error variance of AGO account for 70.13 percent fluctuation in AGO (own shock), shock to CPOI account for 15.26 percent variation of the fluctuation in AGO, EXR can cause 12.59 percent fluctuation in AGO, RINTR innovation account for 1.13 percent variation of the movement in AGO, while TOP can cause 0.89 percent fluctuation in AGO. However, both TOP and RINTR can contribute less impulse variation to agricultural output while EXR, CPI, and AGO (own shock) can contribute more forecast error variance to agricultural output while in the long run under the study period.

3. CONCLUSION

It is very clear that cocoa, rubber and palm kernel exports supply have been responding negatively to real producer prices in the short-run. However, the response of these agricultural commodities export supply to real producer price in the long-run is positive. These results show that there may be a promise for increased cocoa, rubber and palm kernel exports in the long-run, when it would have been possible for harvested hectare to be expanded and / or existing low-yielding and aged trees replaced. This would, however, depend on the domestic utilization capacity. Nonetheless, with increased reliance on other substitutes by importing countries, the export supply response might even be more inelastic if not negative in the long-run.

Despite the fact that there is no short run equilibrium equation as a result of the presence of non-stationary series in the model, on the long run there is equilibrium relationship, meaning linear combination of all the series will produce a stationary error term on the long run. Normalized long run estimate concluded that CPI and TOP exert significant negative impact on AGO on the long run. It is concluded that a long run relationship between the dependent variable (AGO) and the independent variables such as CPI, EXR, RINTR and TOP exists. It is further concluded that trade openness has a negative impact on agricultural output in Nigeria during the study period. It is concluded that both TOP and RINTR can contribute less impulse variation to agricultural output while EXR, CPI and AGO can contribute more forecast error variance to agricultural output in the long run under the study period.

4. RECOMMENDATIONS

In view of the findings of this study, it is therefore recommended that there is an urgent need to enhance the production of these crops. This can be achieved by pursuing policy that would enhance the productive capacities of farmers of these crops such as provision of basic farm inputs, extension advice as well as ensuring proper financing.

Trade policies that would discourage importation of these crops such as tariff imposition and outright ban should be pursued. However, the effectiveness of these measures would depend on the strength of Nigeria borders. Hence, to

achieve maximum result, security should be strengthened in the said borders.

Also policies that would encourage exportation of these crops should equally be pursued. Such policies should be tailored towards the provision of storage facilities, granting of tax holidays and long termed export credits at concessionary interest rates to exporters of these crops.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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