

Value Added Agricultural Output and Macroeconomic Dynamics in the Nigerian Economy

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Abstract. This paper investigated the impact of macroeconomic variables on the Nigerian value-added agricultural output from 1971 to 2016 both in the short and the long-run. The descriptive statistics and stationarity tests were conducted prior to the long run tests using the Johansen co-integration procedure and the Vector Error Correction Model (VECM) technique. In the third step, the serial correlation and the heteroscedasticity tests were conducted in addition to the Impulse Response analysis. The result revealed the absence of linkage between each of interest, exchange rate and employment in agriculture, and oil revenue on the one hand and agricultural value added output on the other. However, external reserves and real per capita GDP as a proxy of aggregate demand shock in the short term significantly affected the output of the value chain. In the long run, inflation rate, exchange rate and agricultural employment rates were positively related with and are significant in forecasting the value-added agricultural output. However, the interest rate, external reserves, aggregate demand shock and Oil revenue although significant, inversely affect value added agricultural output. The study recommended continued the diversification of the economic base of the country. In addition, employment – generating policies and measures that create aggregate demand together with subsidized interest rate regime in line with the Anchor borrowers programme should be intensified. Agriculture must run as business.

Keywords: Agricultural output, Exchange rate, Fiscal policy, Inflation rate, Interest rate, Unemployment rate, Monetary policy.

JEL classification codes: E24, E31, E52, E62

1. Introduction

Agricultural production in Nigeria is determined by the functions of macroeconomic environment shaped by monetary, fiscal and trade policies. The contributions of the agricultural sector to GDP have oscillated widely over the years. At the beginning of the time scope of this study in 1971, the annual rate of growth of the agricultural output was a mere 1.7%. The lowest ebb ever was 4.7% recorded in 1986 which coincided with the commencement of the Structural Adjustment Programme initiated by the Babangida government to restructure and diversify the economy. The highest growth of 110% was attained in 2002 (National Bureau of Statistics, 2017).

Several policy formulation and deployment by various governments in promoting agriculture appears to have had minimal effect on the Dutch disease that assailed Nigeria since the advent of the discovery of crude oil in commercial quantities at Oloibiri in 1956. This resource curse is the co-existence of vast wealth in natural resources and extreme personal poverty (Auty, 1993). Before the discovery of crude oil, agricultural produce dominated the export sector

and generated 64.5 per cent of export earnings in addition to contributing 57.0 per cent to gross domestic product, GDP. With the ascendancy in the late 1970s of crude oil, the contribution of agricultural sector to GDP declined to 23.5 per cent and generated measily 5.1 per cent of export earnings (National Bureau of Statistics, 2017).

There exists huge but untapped potentials in the agricultural sector but the marginal contribution of this sector to GDP has declined significantly due to the Dutch Disease. About 42 percent of the arable land as at 2016 was cultivated with low productivity. Indeed, as of the same year, the sector contributed only 25 per cent to GDP and accounted for only 4.8 per cent of its total export earnings (National Bureau of Statistics, 2017).

The need to correct the issue of low capacity utilisation with attendant low agricultural productivity has become manifest. The government of Nigeria deployed several programmes at revamping the sector. They included establishment of River Basin Developing Authorities, the National Accelerated Food Production Project, the Agricultural Development Project, Operation Feed the nation the Agricultural Credit Guarantee Scheme Fund, the National Special Programme for Food Security, Root and Tuber Expansion Project and the National FADAMA I and FADAMA II programmes. The results have been mixed. Recent programmes included the Agricultural Transformation Agenda (ATA) programme established in year 2012. This

increased the sectoral financing granted by the commercial banks' financing to 5 per cent in 2014. This resulted in the growth of agricultural output by 11 per cent between 2012 and 2014 and consequential reduction of the food import bill by N466 billion during the period.

In a bid to accelerate the achievement and sustenance of food security, the Agricultural Promotion Policy (2016-2020) and the Economic Recovery and Growth Plan (ERGP) (2017-2020) were initiated. The results are being awaited (Iwuchukwu & Igbokwe, 2012).

The growth rate of the various macroeconomic factors (interest rate, rate of inflation, rate of exchange and the unemployment rate) together with the resultant Gross Domestic Product fluctuated over the years. Inflation trended upward throughout 2016. Consumer prices from 12.8% in March to 17.6 % in September 2016. In January of 2017 the core inflation rate rose by 17.85% over the correspondent period in 2016.

With respect to employment, it recorded an average of 10.63% from 2006 until 2016. The unemployment rate reached an all-time height of 19.70% 2009 Q4 and lowest value of 5.10% in 2010Q4 about 4.58 million were unemployed as at August 2016 and increased from 12.1% in Q1 to 14.2% in Q4 (Trading Economics, 2016). Portfolio and Foreign direct investments dropped by 9.49% and 23.75% respectively in 2016 (<https://tradingeconomics.com/nigeria>). The trend of selected economic variables from 1971 to 2016 is depicted in Figure 1.

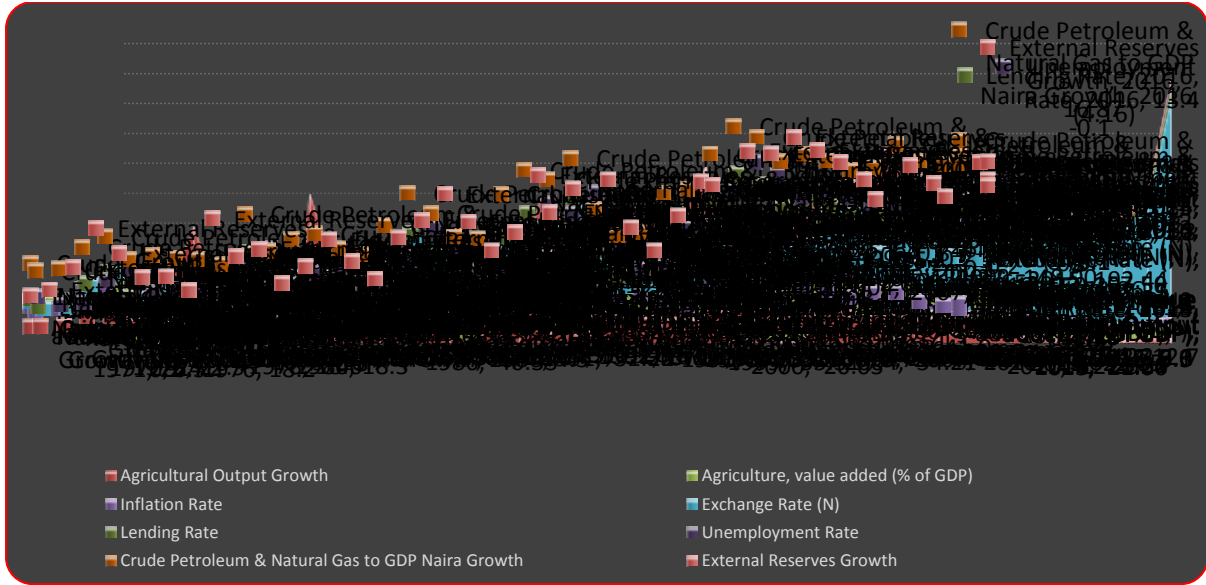


Figure 1: Trend of Selected Economic Variables 1971-2016
 Source: Authors’ Compilation

Policy formulation on these variables have also been varied and sometimes recursive. The findings in the literature have also been mixed. Most of the previous studies have concentrated on the agricultural output. This study however seeks to investigate the individual and joint impact of the macroeconomic variables on the agricultural value chain output using robust econometric techniques. The objective is to ferret out discernible implications for policy deployment both in the short and the long-run.

2. Theoretical and Empirical Literature

2.1 Theoretical Underpinning

The theoretical underpinnings of this research are the Cobb- Douglas (C-D) production function also lends its self to use as a guiding theory. The C-D function relates output (Q) to the inputs of capital and labour in a multiplicative function thus:

$$Q = f(K, L) = AK^a L^b \quad (1)$$

where Q is the output level being the total production (the monetary value of all goods produced in a year); A, a, and b are all positive constant; L = labour input (the total number of person-hours worked in a year); K = capital input (the monetary worth of all machinery,

equipment, and buildings); A = total factor productivity/neutral shift factor; a and b are the output elasticities of labour and capital, respectively. These values as opined by Koutsoyiannis (2002) are constants, determined by available technology. They are also commonly utilised as Cobb-Douglas production function in macroeconomic and microeconomic modelling. The output is measured by either values or quantities

There are supplementary theories including Okun’s law, Phillip Curve. Given that the output of the agriculture is being investigated at the macro level, the Endogenous growth and the Augmented Solow growth theories becomes essential. The study links the two theories to the Keynesian IS-LM framework. The Keynesian theory which posits that inflation can be triggered by rise in demand and/or increase in cost (Jhingan, 2010). The rate of inflation is expected to negatively affect the output of the agricultural sector. This derives from the demand-pull inflation which is a situation where aggregate demand persistently exceeds aggregate supply when the economy is near or at full employment. The supply side factors however have been held to be responsible for causing inflation by the Keynesian theory of cost-push inflation. These theories are

illuminating but sometimes conflicting and so make for robust discernment.

2.2 Empirical Review

Macroeconomic variables are critical in the sustenance and development of agricultural production and export. Studies include Brownson, Vincent, Emmanuel and Etim, (2012), Olarinde and Hussainatu (2014), Odior (2014), Kadir and Tunggal (2015), Akpan and Inimfon (2015), Chughtai, Malik and Aftab (2015), Oluwatoyese, Applanaidu and Razak (2016), Kwon and Koo (2016). Different methodologies ranging from Cobb-Douglas, Multiple linear regression, Modified ordinary least square, Time dependent regression model, Bi-directional Granger-Causality approach, Vector error correction model, Nerlove model, were deployed in the linkage investigation and direction between macroeconomic variables and agricultural production.

Specifically, the One-step Dynamic Forecasting Analysis was adopted by Odior (2014) to examine the crucial role that real monetary aggregate, technological change and agriculture sector performance played on the agricultural component of the Nigerian GDP. Oluwatoyese, Applanaidu and Razak (2016) applied the production function framework to study Nigeria and provided evidence that the oil sector remained the engine of economic growth despite the various governmental policies and investment in the agricultural sectors.

Using the Greedy Equivalent Search (GES) algorithm, Kwon and Koo (2016) recognized the interdependence between macroeconomic variables and agricultural output. They also established that the sources of agricultural instability are due to the slow adjustment speed by the manufacturers (domestic shock) and the volatility in the exchange rate and interest rates (international shock). Chughtai, Malik and Aftab (2015) studied the Pakistani economy using the multiple linear regression models and concluded that the influence of macro-economic variables on the growth performance of any country is partly based on its agricultural output.

The investigation by Kadir and Tunggal (2015) on the impact of macro-economic variables on agricultural production in Malaysia deploys the Auto-regression distribution lag (ARDL) technique. They confirm the long run relationship between value-added agricultural productivity and macro-economic variables. The investigation by Adekunle and Ndukwe (2018) examined the possible impact of dynamic asymmetric variations in the real exchange rate on the output of Nigerian agricultural sector from 1981 to 2016. It utilises the Bounds cointegration test and report no impact of asymmetric changes of real exchange rate on the output of agriculture.

Given the plethora variables affecting the output of agriculture, this study specifically, seeks to establish the individual and joint impact of the macroeconomic variables (inflation rate, real external reserves, nominal exchange rate, real per capita GDP as a proxy of aggregate demand shock (Nm/person), commercial interest rate (proxy for lending rate to agricultural sector), employment in agriculture (% of total employment) and oil revenue as a ratio of GDP) on the agricultural output both in the short and the long run links between agricultural productivity and some key macroeconomic fundamentals.

3. Methodology

The study which covers forty six years from 1971 to 2016 is broad enough to capture major economic trade cycles. Data was sourced from several CBN Statistical Bulletins, National Bureau of Statistics, World Development Indicators, World Bank data. In the absence of complete data on the employment in the agricultural sector (data availability only from 1991), the study deployed the national agricultural employment rate data. The agriculture value added (% of GDP) was sourced from Knoema.com/atlas/Nigeria.

3.2 Model Specification

This study is grounded on the Keynesian IS-LM framework which connects both the endogenous growth theory and the Augmented Solow growth theory. The latter treats human capital

investment and innovation as key drivers of economic growth achievable through capital accumulation. The acquisition of capital however depends on the investment decisions which are in part affected by the level of the rate of interest rate. Indeed, the reduction in interest rate increases inflation rate with consequential impact on the investment level, price and the employment levels. These effects are manifested in the liquidity and price puzzles of the Keynesian IS-LM framework. In the formulation of the model, the Agricultural Value Add as a ratio of total GDP (AGD) serves as the dependent variable. The value addition rather than the raw output better reflects the various programmes of government aimed at enhancing the quality of the output of the sector.

One of the explanatory variables is the real interest rate (INT) which is the inflation-adjusted rate (by the GDP deflator). This lending rate is utilised to meet the short and medium-term financing needs of the private sector. Although the government had instituted many concessional lending rates including the Anchor borrowing scheme of the Central Bank of Nigeria, majority of the farmers in the country operate outside the formal banking sector. The applicable interest rate is therefore the same lending rate at which other sectors obtain facilities from the financial institutions. Other explanatory variable are Inflation rate (INF), Employment in agriculture as percentage of total employment (EMP).

Since the country is not in autarky, the intervening impact of an open economy including foreign competition, and currency pricing are brought to bear on the output of the agricultural sector. The nominal exchange rate (EXC) and real external reserves have been included in the model to reflect the impact of international trade. The ascendancy of the oil and gas sector as the major source of government external revenue earning led to the Dutch disease hence the inclusion of oil revenue as a ratio of GDP (OIL). The real per capita GDP (PCRGDP) was utilised as proxy for the aggregate demand shock in the economy. The Consumer price index (2003 = 100) was used to convert the nominal values to real values. The

estimated empirical model is stated in equation (1):

$$AGD_t = \delta_0 + \delta_1 EXR_t + \delta_2 EXC_t + \delta_3 LnINF_t + \delta_4 PCRGDP_t + \delta_5 LnINTR_t + \delta_6 LnUNEMP_t + \delta_7 LnOIL_t + U_t \quad (2)$$

Where:

AGD_t = Agricultural Value Add as a ratio of total GDP

INF_t = Inflation rate (%)

EXR_t = Real External Reserves

EXC_t = Nominal Exchange Rate

PCRGDP_t = Real per capita GDP as a proxy of aggregate demand shock (Nm/person)

INTR_t = Commercial Interest rate (proxy for lending rate to agricultural sector)

EMP_t = Employment in agriculture (% of total employment)

OIL_t = Oil revenue as a ratio of GDP

U_t = stochastic error term.

The model parameters are $\delta_0, \delta_1, \delta_2, \delta_3, \delta_4, \delta_5, \delta_6$ and δ_7 . U_t is the disturbance term.

3.3 Method of Data Analysis

A three-prong data analysis procedure was adopted. The pre-estimation phase consists of descriptive statistics and stationarity tests. The results obtained determined use of the Johansen co-integration technique since the variables were stationary at the first difference. Prior to the deployment of this technique, the optimal lag was selected. The Vector Error Correction Model (VECM) technique was thereafter applied to determine the existence or otherwise of short-run linkages among the variables.

Given the possibility of existence of multicollinearity because of the nature of time series, which may affect the validity of the estimated result, the study strived to reduce its effect by using the centred values of the variables. This was done by computing the mean of independent variable, and then replacing each value with the difference between it and the mean (Y- \bar{Y}).

The Johansen cointegration technique may not disclose the total interactions amongst the variables of a system. The Impulse Response Function is therefore deployed for this test. Also known as the forecast error, it is modeled in the

context of a Vector Autoregression to illustrate the reaction economy over time to exogenous impulses, endogenous macroeconomic variables and time variation (Hamilton, 1994 & Lütkepohl, 2008).

The post-estimation tests were conducted in order to determine the robustness or otherwise of the estimated model. These included the serial correlation and the heteroscedasticity tests. The E-views tool was deployed for estimation and to remove the collinear variable from the analysis. Results obtained were tested for compliance with economic theory and literature.

4. Findings and Discussions

Preliminary Analyses

The preliminary analyses are in two parts: Descriptive Statistics and Stationarity test

Descriptive Statistics

The characteristics of the data and the summary of the descriptive statistics of the variables are presented in Table 1.

Table 1: Descriptive Statistics

| STATISTICS | AGD | INF | INTR | LNEXC | LNEXR | LNRPCGDP | OILGDP | EMP |
|--------------|------|-------|------|-------|-------|----------|--------|------|
| Std. Dev. | 7.95 | 16.23 | 6.29 | 2.34 | 1.41 | 0.25 | 0.57 | 4.63 |
| Skewness | 0.12 | 1.82 | 0.11 | -0.16 | 0.043 | 0.19 | 1.93 | 0.88 |
| Kurtosis | 2.07 | 5.39 | 2.37 | 1.38 | 1.97 | 1.63 | 7.01 | 2.70 |
| Jarque-Bera | 1.76 | 36.11 | 0.86 | 5.23 | 2.05 | 3.88 | 59.22 | 6.05 |
| Probability | 0.41 | 0.00 | 0.65 | 0.07 | 0.36 | 0.14 | 0.00 | 0.05 |
| Observations | 46 | 46 | 46 | 46 | 46 | 46 | 46 | 46 |

Source: Author's computation using E-views 8.0 (2018)

All the variables platykurtic in nature except inflation and the contribution of the Oil and Gas sector to GDP whose Kurtosis value were higher than 3. This is also manifested in the skewness values of the variables and the Jacque-Bera statistics. Consequently, the series are not normal except for the Agricultural Value Add as a ratio of total GDP and inflation rate. The confirmation of the stability of the variables is the next matter for discussion.

Stationarity Test Results

The results of the Augmented Dickey Fuller (ADF) test and the Phillip Perron test are presented in Table 2. The decision criteria for the unit root tests are that the null hypothesis is rejected if the test statistic is greater than the critical value.

Table 2: Unit Root Test Results: Augmented Dickey Fuller and Phillip Perron Test

| Series | 5% Critical Value | ADF Test at first difference (Prob.) | Phillip Perron Test At First Difference (Prob.) | Equation Specification | Order of integration |
|----------|-------------------|--------------------------------------|---|------------------------|----------------------|
| AGD | -2.93 | -6.38 (0.00) | -6.82 (0.00) | Intercept | I(1) |
| INF | -2.93 | -6.78 (0.00) | -9.74 (0.00) | Intercept | I(1) |
| INTR | -2.93 | -7.44 (0.00) | -7.45 (0.00) | Intercept | I(1) |
| LNEXC | -2.93 | -5.20 (0.00) | -5.19 (0.00) | Intercept | I(1) |
| LNEXR | -2.93 | -5.80 (0.00) | -5.85 (0.00) | Intercept | I(1) |
| LNRPCGDP | -2.93 | -5.50 (0.00) | -5.50 (0.00) | Intercept | I(1) |
| OILGDP | -2.93 | -8.82 (0.00) | -36.21 (0.00) | Intercept | I(1) |
| EMP | -2.93 | -6.85 (0.00) | -7.84 (0.00) | Intercept | I(1) |

Source: Authors computation using E-Views 8.0 (2018)

The result shows that all the variables are stationary at first difference at 5% significance level. The Johansen cointegration test which is predicated on the unrestricted vector autoregressive (VAR) model as specified in error-correction form therefore lends, itself for determination of the long-run relationship (Johansen, 1988). This technique is set out in the next section after the determination of the optimal lag length.

Estimation Results

Optimal Lag Length Selection

Presented in Table 3 is the result of the selected optimal lag length.

Table 3: Optimal Lag Length Selection Criteria

| Lag | LogL | LR | FPE | AIC | SC | HQ |
|-----|---------|--------|-------|--------|--------|--------|
| 0 | -511.06 | NA | 7.50 | 24.72 | 25.05* | 24.84* |
| 1 | -446.21 | 101.91 | 7.60 | 24.68 | 27.66 | 25.77 |
| 2 | -385.79 | 71.94 | 12.64 | 24.85 | 30.47 | 26.91 |
| 3 | -279.90 | 85.72* | 4.94* | 22.85* | 31.13 | 25.89 |

Source: Authors computation using E-views 8.0(2018)

* indicates 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

HQ: -Hannan- Quinn information criterion

The result shows that SC and HQ suggest the lag of one period as against the three lag period of LR, FPE and AIC. The AIC and FPE criterion are superior to the other criteria in the way their ability to minimize under estimation while maximizing the chance of recovering the true lag length for less than 120 observations (Liew, 2004). Therefore, this study adopts the recommended three-lag period.

Cointegration Test Result

Two types of tests were considered - Eigenvalue and Trace statistic tests (equation 3 and 4). The result is presented in Table 4.

$$\lambda_{\text{trace}} = -T \sum_{i=r+1}^n \ln(1 - \lambda_i^2) \tag{3}$$

$$\lambda_{\text{max}} = -T \ln(1 - \lambda_{r+1}) \tag{4}$$

Where, λ_i = values of the eigenvalues

T = Number of the observations after the lag adjustment.

Table 4: Result of Johansen Co-integration test based on Trace Statistic and Max Eigenvalue

| No. of CE(s) | Trace Statistic | | | | Max. Eigen Value | | |
|--------------|-----------------|-----------------|---------------------|-------|------------------|---------------------|---------|
| | Eigen value | Trace Statistic | Critical Value 0.05 | Prob. | Max-Eigen Value | Critical Value 0.05 | Prob.** |
| None * | 0.89 | 295.51 | 159.53 | 0.00 | 94.62 | 52.36 | 0.00 |
| At most 1 * | 0.76 | 200.89 | 125.62 | 0.00 | 59.27 | 46.23 | 0.00 |
| At most 2* | 0.72 | 141.62 | 95.75 | 0.00 | 52.68 | 40.08 | 0.00 |
| At most 3* | 0.54 | 88.95 | 69.82 | 0.00 | 32.99 | 33.88 | 0.06 |
| At most 4* | 0.45 | 55.96 | 47.86 | 0.01 | 25.03 | 27.58 | 0.11 |

| | | | | | | | |
|------------|------|-------|-------|------|-------|-------|------|
| At most 5* | 0.33 | 30.93 | 29.80 | 0.04 | 17.07 | 21.13 | 0.17 |
| At most 6 | 0.19 | 13.85 | 15.50 | 0.09 | 8.68 | 14.27 | 0.31 |
| At most 7* | 0.17 | 5.18 | 3.84 | 0.02 | 5.18 | 3.84 | 0.02 |

Source: Authors computation using E-views 8.0 (2018)

Notes:

Trace test indicates 6 cointegrating eqn(s) at the 0.05 level

Max-eigenvalue test indicates 3 cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

The co-integration computation suggests that at most the 7 variables have a long-run connection with the dependent variable. Thus, there exists a long-run relationship between agricultural value add as a ratio of total GDP and each of inflation rate, real external reserves, nominal exchange rate, real per capital GDP, interest rate, employment rate, and oil revenue as a ratio of GDP.

The result of the deployed Vector Error Correction Model is, presented in Table 5.

Table 5: Result of Vector Error Correction Model Test

| Variable | Co-Efficient (After Normalization) | Standard Error | T-Statistic (df38 = 2.042) | Significance of 0.05 level |
|----------|------------------------------------|----------------|----------------------------|----------------------------|
| AGD | 1.00 | | | |
| INF | 0.12 | 0.12 | 1.01 | No |
| INTR | -1.05 | 0.44 | 2.39 | Yes |
| LNEXC | 9.49 | 1.34 | 6.96 | Yes |
| LNEXR | -19.91 | 1.87 | -10.62 | Yes |
| LNRPCGDP | -63.53 | 8.63 | -7.36 | Yes |
| OILGDP | -29.75 | 4.82 | -6.17 | Yes |
| EMP | 3.98 | 0.42 | 9.53 | Yes |

Source: Authors Computation using E-Views 8.0(2018)

The estimated long run model is shown in equation 5

$$AGD = 0.12INF - 1.05INTR + 9.49LNEXC - 19.91LNEXR - 63.53LNRPCGDP - 29.75OILGDP + 3.98EMP \tag{5}$$

The result in Table 5 as linearly stated in equation (4) signifies that a positive but insignificant relationship exists between value adding agricultural output as a ratio of total GDP and inflation rate at 5 percent level. However, the exchange, and unemployment rates are positively related and significant in forecasting the agricultural value add as a ratio of total GDP.

However, the interest rate, external reserves, real per capita GDP as a proxy of aggregate demand shock and Oil revenue as a ratio of GDP although significant, inversely affect value added agricultural output. A percentage increase interest rate in the reduction in AGD by about the same margin (1.05%). Similar percentage increases in external reserves, real per capita GDP as a proxy of aggregate demand shock and Oil revenue as a ratio of GDP results in fall in the agricultural value chain output by 20%, 64% and 30% respectively.

Having established the long run relationships and estimates, the next phase is to determine the short-run dynamics.

Vector Error Correction Model

The short-run relationship test is carried out after the application of the Vector Auto-Regressive Model (VAR) which is done to integrate the multi-variate time series. It is employed in order to determine the

existence or otherwise of a short-run relationship amongst the variables and the dynamics which helps to maintain the long-run equilibrium. The result is contained in Table 6.

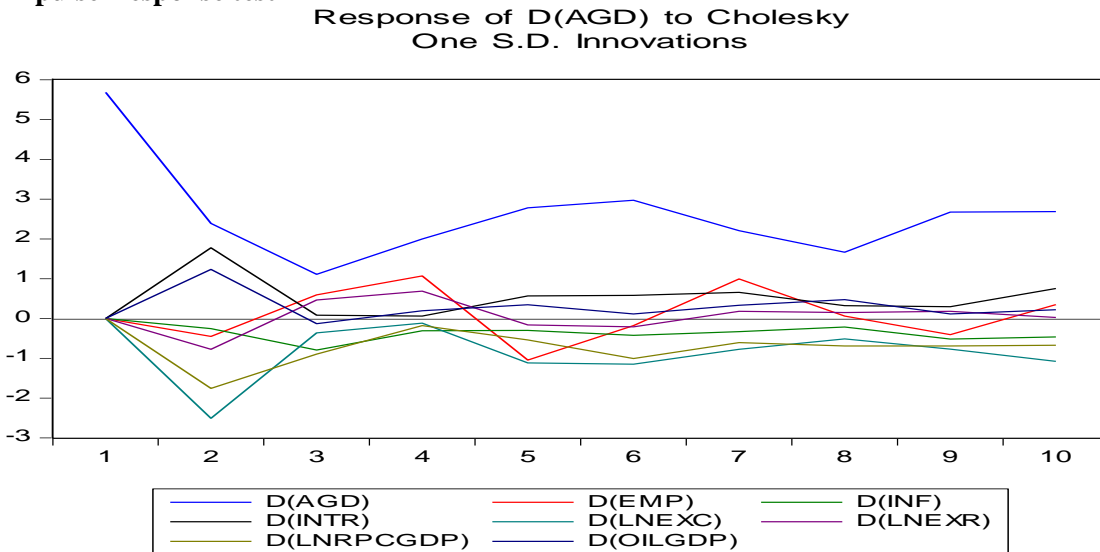
Table 6: Vector Error Correction Model (VECM) Result.

| Error Correction: | D(INF) | D(INTR) | D(LNEXC) | D(LNEXR) | D(LNRPCGDP) | D(OILGDP) | D(EMP) |
|-------------------|--------|---------|----------|----------|-------------|-----------|--------|
| CointEq1 | 0.34 | -0.02 | 0.00 | -0.03 | -0.00 | -0.00 | 0.02 |
| | (0.17) | (0.03) | (0.00) | (0.01) | (0.00) | (0.01) | (0.05) |
| T-stat (Cal) | [1.99] | [-0.70] | [0.04] | [-3.23] | [-3.40] | [-0.48] | [0.34] |

Source: Authors computation using E-views 8.0 (2018)

Given that the tabulated T-stats value (2.042) is greater than the calculated values INF (1.99), INTR (0.70), LNEXC (0.04), OILGDP (0.48), EMP (0.34), the study accepts the null hypotheses as espoused by Lutkepohl (2006) that there is no short run relationship between these variables and the agricultural value chain output. This is however not applicable to external reserves and real per capita GDP as a proxy of aggregate demand shock in which short term connection subsist.

Impulse Response test



Source: Authors Computation using E-views 8.0(2018)

Figure 2: Response of Agricultural Value Add as a ratio of total GDP

The shock effect of changes in the macroeconomic variables to Agriculture value added output is varied. One standard deviation of interest rate led Agriculture value chain output to reach its peak in the second year and fall intensely the next year below the trend line at the fifth year and oscillated until the tenth year. The Agriculture value added output falls below the line all through the duration of the tenth year as caused by real per capital GDP. Employment in agriculture fell in the second year and peaked in the fourth. It thereafter oscillated till the tenth year.

Furthermore, the shocks induced by exchange rate and oil contribution to GDP cause agriculture value chain output to fall in the first year before fluctuating in the long run. Similar shock effect of inflation caused disturbances in the value of agriculture value added.

Post-Estimation Tests

The results of the post estimation techniques are presented in the following sections.

Breusch-Godfrey Serial Correlation Lm Test

The end-result of the test for possible serial relationship between the variables (Breusch-Godfrey Serial Correlation Lm Test) can be found in Table 7.

Table 7: Result of Breusch-Godfrey Serial Correlation LM Test

| | | | |
|---------------|------|---------------------|------|
| F-statistic | 3.17 | Prob. F(2,35) | 0.05 |
| Obs*R-squared | 6.90 | Prob. Chi-Square(2) | 0.03 |

Source: Authors computation using E-views 8.0 (2018)

From the result obtained, the presence of serial correlation is manifest because the tabulated chi-square value (6.90) is greater than the calculated chi-square (0.03) at the 0.05 significance level.

Durbin Watson statistics Tests

This test was to find out the level of auto-correlation between the dependent and independent variables. The result is contained in Table 8.

Table 8: Durbin Watson Autocorrelation Test Results

| DW value (d) | D-UPPER ($d_{U,as}$) | D-LOWER ($d_{L,as}$) | DECISION CRITERIA |
|--------------|------------------------|------------------------|-------------------------|
| 2.17 | 1.84 | 0.82 | No negative correlation |

Source: Authors computation using E-views8.0 (2018)

The test results depict a no negative correlation in the variables since $4 - d_u \leq d \leq 4 - d_L$.

Breusch-Pagan-Heteroscedasticity Tests

The test for heteroscedasticity was done using Breusch Pagan Heteroscedasticity test to show the fitness of the model. This result is presented in Table 9.

Table 9: Result of Breusch-Pagan-Godfrey Heteroscedasticity Test

| | | | |
|---------------------|------|----------------------|------|
| F-statistic | 0.13 | Prob. F (7,37) | 0.99 |
| Obs*R-squared | 1.11 | Prob. Chi-Square (7) | 0.99 |
| Scaled explained SS | 2.69 | Prob. Chi Square (7) | 0.91 |

Source: Authors computation using E-views 8.0 (2018)

The result revealed an absence of heteroskedasticity since the Prob. Value (0.99) greater than the tabulated value (0.91) at 0.05 significance level.

5. Discussion of Findings

The theoretical underpinnings of this research are the Endogenous growth and the Augmented Solow growth theories. The study links the two theories to the Keynesian IS-LM framework. The results of the Impulse Response Function negates the predictions of the Augmented Solow growth and Endogenous growth theories on interest rate, as the current value of interest rate, its two to three past period values impacted

positively on the growth of the Nigerian economy. The period one value contributed negatively on agricultural output

The findings of this study are mixed. The study records the insignificance of inflation on agricultural output especially toward optimizing its value chain in the short run. This is because most of the raw agricultural products are demand-inelastic particularly so since the level of industrialisation and product conversion is low. This corroborates the findings of Oluwatoyese, Applanaidu, and Razak (2015) also on Nigeria. It is also consistent with the Keynesian theory of cost-push inflation arising from supply side resource rigidities (Jhingan,

2010). The inflation rate as the last quarter of 2016 stood at about 18.3% as a result of the target level of inflation by the Central bank of Nigeria. Indeed, this high level of inflation is coupled with high unemployment rate. This stagflation condition of simultaneous increase in both inflation and unemployment blunted the possible deleterious impact of inflation on the economic growth and by extension on the agricultural value chain output.

The implication of this being that short term palliative policies in terms of Commercial loan interest to agricultural sector, exchange, and agricultural employment rate have had scant or no effect on the agricultural sector. On the other hand, the impact of variation in the external reserves and aggregate demand is manifest in the short term. This study provide support for Brownson, Vincent, Emmanuel and Etim (2012) as against Eyo (2008) which reports that exchange rate, interest rate and inflation rate as negative, positive and negative relationship respectively in relations to agricultural output.

The relationship in the long run is also mixed. Apart from the rate of inflation, the other variables are significant in the long run. This upholds the findings of Hussainatu and Olarinde (2014). This also suggests that increasing level of interest rate is undesirable as it increases the cost of agricultural conversion and production. However recent government and Central Bank of Nigeria, Agricultural Transformation Support Agenda (ATA) programme established in year 2014 specifically increased the sectoral financing to be granted by the commercial banks. It directed Commercial banks to provide concessionary interest rate to farmers at 5 per cent. The main objective of this programme targeted at smallholder farmers and rural entrepreneurs engaged in the production, processing, storage and marketing of the selected commodity value chains. However, the negative coefficient on interest rate supports the existence of crowding out hypothesis with respect to the agricultural production and conversion in Nigeria.

The case of exchange rate the impact which is positive and significant in the long-run suggests

the beneficial attempts by the Central Bank of Nigeria to liberalise the foreign exchange market. This in addition to the diversification policy of the non-oil sector as contained in the both the 2018-20 Medium term expenditure Framework (MTEF) and the Fiscal Policy Paper (FSP) together with the Economic Recovery and Growth Plan (ERGP) 2017-2020 may help sustain this trend.

The impact of the price of crude oil in the agricultural value chain is negative, significant, and predictable. This is because although the export price of crude oil is exogenously determined OPEC. The sustained reliance of the country on the oil and gas sector for foreign exchange earning has had deleterious impact on the development of the agricultural sector.

The impact of external reserves on the agricultural value chain is negative. Indeed, the amount has fluctuated over the years. It reached a peak of 62.9 USD billion in September of 2008 and the lowest point of 63.2 USD Million in June of 1968. The finding is consistent with Augmented Solow growth theory which predicts that the expensive nature of a country's exportable caused by an inflow of foreign currency reduces the level of growth with implications for the external reserves. The low agricultural terms of trade with consequential implication on external reserves accounts for the negative relationship.

Consistent with the postulation of Okun's law (1962) on the relationship positive relationship between the employment and growth, the study finds employment in agriculture to propel the output of agricultural value adding output. This also supports the investigation by Oloni (2013) in Nigeria.

The real per capita GDP as a proxy of aggregate demand shock (Nm/person) is negatively and significantly related to agricultural value chain output. This is however inconsistent with the nexus established among finance, agriculture and economic growth in the experienced in developed countries which is critical for the structural transformation accompanying economic growth (Moody, 1981). The argument in the developed economies is that the agriculture sector of the economy transfers investible surpluses from resources generated to

the non-agricultural sector (Kuznets, 1961). The expectation is that the developing countries could also leverage (explicitly or implicitly) on surplus resources from agriculture to engender industrial development (Ohkawa and Rosovsky 1996; Johnston and Kilby, 1975). This is however not the case in the findings of this research given the rigidities and infrastructural limitations in the production and conversion of agricultural products.

6. Policy Implications, Recommendations and Conclusion

The management of the five key macroeconomic variables is an arduous task even in developed economy more so in the Nigerian economy which is largely mono-cultural. Given the preponderance of exogenous influence on the efficacy of both the fiscal and monetary policies, the government is enjoined to continue the diversification of the economic base of the country. Employment – generating policies and measures that create aggregate demand in addition to subsidized interest rate regime in line with the Anchor borrowers programme should be intensified.

Macroeconomic policy changes therefore, affect the agricultural economy through their impacts on interest rates and inflation. Changing interest rates influence variable production costs, long-term capital investments, cash flow, land values, and exchange rates, while inflation affects input prices, commodity prices, real interest rates and land prices. These economic and financial variables shape the structural characteristics of the firm including economies of size and learning curve, strategies deployed at risk mitigation and the operation and ownership of land resources.

Arising from the positive agriculture-employment nexus, there is also a requirement for up-skilling human capital. There is the need to provide and improve the capabilities of the entrepreneurs and managers in the management of agriculture and agro allied industry. As production agriculture becomes less commodity oriented, the agricultural value chain industry

need to provide more unique and differentiated products.

Given the growing integration of the world economy, future domestic and foreign policy changes may play an even greater role in determining the financial performance of the agricultural industry.

There is the need to further diversify the economy through restructuring of the agricultural value chain. Specifically, the use of technology to drive structural change in the methods of agricultural production including auto-steer and guidance, bio / nutritional technology, monitoring /measuring /communication technology and process control technology. Therefore, it is becoming increasingly important that farmers and agribusinesses understand the linkages between the macro economy and agriculture in making sound business decisions. Making business out of farming is the way forward

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