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# EFFECTS OF AGRICULTURAL COMMODITY PRICES ON AGRICULTURAL OUTPUT IN NIGERIA

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**ABSTRACT**

In Nigeria, there is over-reliance on oil proceeds at the expense of revenue accrued to agriculture, which adversely affects the standard of living. The study examines the effect of commodity prices on agricultural output in Nigeria. In the empirical model, agricultural output depends on maize, wheat, soya beans, and oil prices. Data covering 1991 and 2017 from the Central Bank of Nigeria Statistical Bulletin and Food and Agricultural Organisation was analysed using a fully modified OLS (FMOLS) technique. The result shows that maize and soya bean prices positively affect agricultural output, while wheat prices and oil prices negatively affect agricultural output in Nigeria. This implies that agricultural output increases with increased agricultural commodity prices and falls with an increase in oil prices. The paper recommends the need to expand the production of agricultural commodities through a direct government partnership with farmers in the area of supply of expert knowledge, technology and credit. Also, to redirect the populace's focus from oil in favour of agriculture, there is a need to introduce a subsidy for agricultural output to make its pricing attractive and provide leverage for farmers' occasional shocks in their yield.

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## INTRODUCTION

In economies that export primary commodities, such as developing and emerging market countries, commodity prices have a significant role in how fiscal policy and the economic cycle behave (Lopez-Martin et al., 2016). These findings have been explained by a number of variables, including the fact that governments in many of these nations depend on commodity earnings to fund their budgets. These countries had a huge challenge in terms of their ability to tame variations in economic activity due to their dependence on revenue from these commodities, the price of which tends to be volatile (Lopez-Martin et al., 2016).

While a rise in the price of primary commodities brings about increased export income for their exporters, the associated induced real currency appreciation may displace the exports of non-commodity sectors by reducing their price competitiveness in international commerce (Chen and Lee, 2014). Conversely, the primary causes of rising agricultural commodity prices are the consequence of the complex interplay between macroeconomic variables, including crude oil prices, currency rates, rising food demand, slow development in agricultural production, and national policy decisions (Abbott et al., 2008). Despite the fact that these variables reinforce one another, rising oil prices are believed to be the main driver pushing up the cost of agricultural commodities (FAO, 2008; Mitchell, 2008). In Nigeria, agricultural products and oil are the two important principal commodities (Olasunkanmi and Oladele, 2018). Before the discovery of oil, the economy was characterised by its dominance in producing and consuming agricultural goods, which accounted for over 75% of the nation's income (FAO, 2008). The popularity of oil as an essential source of income after its discovery positioned Nigeria among the prominent oil producer and importers and shifted focus away from agriculture (Olasunkanmi and Oladele, 2018). The nation was forced to rely on importing food and refined crude oil, which exposed the populace to price shocks in both commodities due to the country's almost complete collapse of the agricultural sector and the inability to operate functioning refineries. Meanwhile, shocks in the global price of traded basic commodities alter several variables that can affect macroeconomic equilibrium (Essama-Nssah, 2007).

Nigeria often turns to foreign borrowing due to the nation's reliance on revenue from crude oil exports. The floating rates on Nigeria's debt also rise due to rising interest rates. Since more resources were diverted away from the productive sectors of the economy by higher foreign interest payments, the welfare of the populace suffered. Furthermore, Nigeria's expenditure on food imports has increased steadily due to the country's dependency on imports and growing food costs internationally.

In the literature, a growing number of studies have looked at the effects of commodity price shocks on the economy based

on a panel of countries and a country-specific basis. However, little has been done to examine the effects of commodity price shocks on agricultural output, specifically in a developing country like Nigeria that exports and imports oil as a core commodity. Based on the preceding, the broad objective of this study is to examine commodity prices and agricultural output in Nigeria. The specific objectives are to: investigate the effect of oil prices on agricultural output and assess the effect of agricultural commodity prices on agricultural output in Nigeria.

This study focuses on the analysis of commodity prices and agricultural output based on a country-level analysis with a special focus on the Nigerian economy. The study used annual time series data covering twenty-seven years (1991-2017). The availability informed the choice of this period of data on the prices of the major agricultural commodities used in the study. This study adds to the limited existing literature on how domestic commodity prices respond to agricultural output. Thus, this study will greatly benefit the government, importer and exporter, policy-makers and citizens alike, especially in their efforts to fashion out sound and effective exchange rate administration. Recommendations from the study will provide the government with insight into how to develop the agricultural industry and make the industry viable enough to make food available and accessible for the people in surplus so that food can be a source of export revenue for the country. The recommendations from this study will go a long way in achieving stability in food prices and making food more accessible and affordable for citizens. The study will also provide recommendations that help the government reduce the uncertainty in commodity prices, which will help both the importer and exporter make realistic forecasts for their investment in a way that brings expansion and profitability. To academia, the study will be an addition to the stock of knowledge on commodity price shocks and invaluable reference material for future studies.

This study is organised as follows: following this introductory section is the literature review which captures the conceptual, theoretical and empirical review. The third section is the methodology, where the theoretical framework is constructed, the model is specified, sources of data and measurement of variables, and estimation technique are discussed. The last section is on results and discussion, where the result emanating from the study is presented and discussed, and a conclusion and recommendations are drawn.

Commodities are oil and non-oil resources such as grains and products extracted from the earth (minerals, oil, natural gas) in their first stage of the consumption process and which are not useful in their immediate form except through additional processing (Miečinskienė and Lapinskaitė, 2014). Obadan (2006) stated that "oil is an international trade commodity that attracts foreign exchange and is a quick source of capital accumulation". It is also defined as "a liquid that is found in a rock under the ground" (Clements and Fry, 2007). The systematic rearing of animals and growing plants to produce food, feed, fibre, and other things is known as agriculture. Forestry, fishing, agricultural product processing, and marketing are subsumed under agriculture. It is the science of using land to grow animals and plants (Ikala, 2010). Basically, it consists of farming, raising cattle, forestry, and fishing (Iganiga and Unemhilin, 2011). In the literature, several theories abound on how price transmits to more output or reduced output. The traditional flow model and purchasing power parity (PPP) are among these theories.

According to the traditional flow model, exchange rates result from the interplay between supply and demand for foreign currency (De la Torre et al., 2003). When the supply and demand for foreign currency are equal, the exchange rate will be at equilibrium (Olisadebe, 1991). According to the model, relative income influences the exchange rate on the premise that domestic income primarily determines domestic demand for domestic commodities. Since assets may be considered to be in demand based on the difference between domestic and international interest rates, this framework also includes this factor as one of the main factors influencing the exchange rate. The model assumes that the exchange rate will balance the flow of supply and demand for foreign currency. Deficits (surpluses) in the current account counterbalance the balance of payment caused by surpluses (deficits) in the capital account. The purchasing power parity (PPP) proposed that the exchange rate between two currencies would be equal to the respective national price levels based on the premise of a lack of trade barriers and transaction costs and the presence of the purchasing power parity (PPP). If all nations produced identical marketable commodities, the PPP philosophy would apply similarly to the application of the law of one price (Johnson and Frenkel, 1978).

In terms of previous literature, studies from industrialised and developing nations have explored the implications of commodity price shocks. For instance, based on data sets covering the monthly period of 1990.01-2014.05 and the Johansen co-integration approach, Bashar and Kabir (2013), show that there are no long-run relationships between the prices of agricultural commodities (Wheat, Corn, and Soybeans) and world oil prices (Europe Brent Spot Price and West Texas Intermediate Spot Price). However, the world oil price and the weak USD positively affect almost all of the 27 agricultural commodity prices. Olasunkanmi and Oladele (2018), using monthly data on oil prices, maize, wheat, and soybean prices, exchange rates, and other variables from 1997 to 2016, have demonstrated that oil price has a significant positive relationship and significant effect on agricultural commodity prices in Nigeria and other developing countries. The study used linear ARDL, non-linear ARDL, and asymmetric tests. According to the permutation method for Hotelling T-Squared, Aronu and Bilesanmi (2013) found that export and import commodity price indices in Nigeria are not equal. Import commodity price indices have consistently been higher than export commodity price indices. The impact of oil prices on agricultural commodity prices varies across the various quantiles of the conditional distribution.

Based on Granger causality in conditional quantiles and daily data from April 19, 2005, to July 31, 2014, for oil prices and the prices of soya beans, wheat, sunflower, and corn. Balcilar et al. (2014) show that the impact on the tails is less severe in South Africa than it is on the rest of the distribution. Additionally, a rise in commodity prices increases the exchange rate when controlled by domestic determinants based on co-integration.

More recently, Sun et al. (2021a) examined the long-term connectedness and causality between Crude oil and agricultural commodity prices using the full bootstrap sample and rolling window causality tests. The results confirm the presence of bidirectional causality and show that Oil prices are as much affected by the agricultural commodity prices ACP as vice versa. Both ACP and Oil prices were found to remain immune to the shocks that originated in both markets during the entire period of the COVID-19 pandemic. In the same vein, Sun et al. (2021b) explore the impact of trade policy uncertainty (TPU) on agricultural commodity prices (ACP) by employing bootstrap full- and subsample rolling-window Granger causality tests. It was found that TPU has both positive and negative effects on ACP, suggesting that TPU may change the supply of and demand for agricultural commodities, leading to fluctuations in ACP. It was also found that ACP exerts a positive effect on TPU, indicating that the agricultural commodity market reflects trade conditions in advance.

Similarly, Hung (2021) analyses the spillover effects and time-frequency connectedness between crude oil prices and agricultural commodity markets using Diebold and Yilmaz's spillover index (2014) and the wavelet coherence model. It was found that in comparison with the pre-Covid-19 period, the return spillover is more apparent during the Covid-19 crisis. However, levels of the intensity of this relationship vary through the period of research, with several intervals witnessing both negative and positive interactions. Further, the findings indicate significant heterogeneity among agriculture commodity markets in the degree of spillover to crude oil prices over time. Also, it was found that there exist significant dependent patterns about the information spillovers across the crude oil and agriculture commodity markets that might provide prominence. Also, Tule et al. (2019) examine the predictability of agricultural commodity prices in Nigeria's inflation forecast via twelve major agricultural commodities evaluated singly and jointly for both food and headline inflation. It was found that the predictor series exhibited persistence, endogeneity and conditional heteroscedasticity effects. Also, the parameters of the agricultural commodity-based inflation model tend to shift over short periods based on the results of the Bai and Perron (1998) test and employ Westerlund and Narayan's (2015) estimator, which accounts for these salient features. The results show that agricultural commodities individually predict both headline and food inflation better than the random walk model, which is the benchmark model for forecasting inflation in the literature. Ezeaku et al. (2021) examine the effects of oil supply and global demand shocks on the volatility of commodity prices in the metal and agricultural commodity markets using the SVAR model based on real-time daily closing international commodity prices covering the period December 2 2019, to October 1 2020. The study provides various patterns on how metal and agricultural commodity prices have been influenced by the COVID-19 pandemic.

**METHODOLOGY**

The theoretical basis for this study is Marconi et al. (2016) export-led growth model, which looked at economic growth as a function of exports. A straightforward causal model, driven by exports as the primary driver of autonomous demand, makes the following assumptions: First, output growth is a function of export growth. Second, export growth is a function of price competitiveness and foreign income growth. Third, price competitiveness is a function of wage growth and productivity growth, and finally, productivity growth is a function of output growth. This is known as Verdoorn Law, and it works through static and dynamic returns to scale. The model is "circular and cumulative" due to this incited productivity development (Dixon and Thirlwall, 1975). Since rapid production growth (induced by export growth) prompts productivity development at a higher rate, this raises the level of competitiveness of products and prompts rapid export growth.

$$y = \gamma [\eta (w - ra + \tau - pf) + d(z)]/(1 + d/L) \quad (1)$$

Where w is the rate of growth of wages, ra is the rate of growth of autonomous productivity, pf is the rate of change of foreign prices, z is the growth of world income, τ is the elasticity of output growth with respect to export growth, η is the price elasticity of demand for exports, and γ is the income elasticity of demand for exports.

This research modified the model used in Olasunkanmi and Oladele (2018) study on the impact of the oil price shock on agricultural commodity prices in Nigeria where oil price was the dependent variable while maize, wheat, soybeans prices and exchange rate were the independent variables. As a modification, the present study used only the commodities' prices in its framework while introducing agricultural output as the dependent variable. The functional form of the model is stated as follows.

$$AGRO = f(WETP, MAZP, SYBP) \quad (2)$$

For the purpose of estimation, equation 2 can be expressed as:

$$AGRO = \beta_0 + \beta_1 WETP + \beta_2 MAZP + \beta_3 SYBP + \beta_4 OILP + u_t \quad (3)$$

Where;

AGRO = Agricultural output

*MAZP* = Maize price

*WETP* = Wheat price

*SYBP* = soybeans price

OILP = Oil price

The following differentials provide a concise summary of the predicted signs of the explanatory variable coefficients: On Nigeria's agricultural production, maize pricing is anticipated to have a favourable impact. i.e. $\frac{\partial AGRO}{\partial WETP} > 0$; wheat price is expected to exert a positive effect on agricultural output in Nigeria i.e. $\frac{\partial AGRO}{\partial MAZP} > 0$; Oil price is expected to affect agricultural output negatively i.e. $\frac{\partial AGRO}{\partial OILP} < 0$; and in line with a priori theoretical expectation, soya beans price is expected to exert a positive effect on agricultural output in Nigeria i.e. $\frac{\partial AGRO}{\partial SYBP} > 0$. The period covered is 1991 to 2017 because statistics on the prices of the main agricultural commodities for Nigeria utilised in the research were only available from 1991; this time frame was chosen. The data was compiled from the Food and Agricultural Organization (FAO, 2020). Data on agricultural production was obtained from the Central Bank of Nigeria (CBN, various issues). The data used in the study was

presented in appendix A. A fully Modified Ordinary Least Square (FM-LS) multiple regression analysis was used to estimate the data. Due to its simplicity and estimating power, OLS was chosen as the estimate approach. The OLS findings have desired qualities, which is another key factor in why the FM-LS was chosen.

**RESULTS AND DISCUSSION**

The Jarque-Bera test results of normality are presented in Table 1. In Table 1, the result shows that the mean of agricultural output, wheat prices and oil prices are greater than their median, indicating that the variables are positively skewed. In contrast, for maize price and Soybeans price, the mean is less than their median, indicating the variables are not positively skewed. The values of the Jarque-Bera statistics showed that Agricultural output, wheat prices, maize prices and Soybeans prices with the exception of the oil price, are not normally distributed since their p-values are statistically significant at a 5% level of significance. The result of the correlation analysis is presented in Table 2 as follows:

The results, as presented in Table 2, showed a positive association between wheat price and agricultural output, maize price and agricultural output, as well as soya bean and oil price and agricultural output in Nigeria. The correlation coefficients of Agricultural output, wheat prices, maize prices, oil prices and Soybeans prices are not very strong since they are below 0.95, indicating the absence of the problem of multicorrelation among the independent variables. The trend of agricultural output and commodity price in Nigeria, as stated in the first objective, is presented using the line graph as follows.

Table 1. Descriptive statistics.

| Statistics | AGRO | WETP | MAZP | SYBP | OILP |
|---|---|---|---|---|---|
| Mean | 9138.224 | 37032.89 | 37334.25 | 49710.42 | 20.45316 |
| Median | 8888.570 | 34973.19 | 44580.00 | 63340.00 | 12.54000 |
| Maximum | 17179.50 | 80500.00 | 82452.00 | 85374.00 | 72.73000 |
| Minimum | 3590.840 | 5342.000 | 3318.000 | 3960.000 | 5.410000 |
| Std. Dev. | 4768.268 | 17065.36 | 20879.15 | 24024.76 | 19.62719 |
| Skewness | 0.235668 | 0.299692 | -0.077282 | -0.569794 | 1.704326 |
| Kurtosis | 1.565368 | 3.328527 | 2.121208 | 1.991591 | 4.466247 |
| Jarque-Bera | 2.565369 | 0.525589 | 0.895686 | 2.604996 | 10.90029 |
| Probability | 0.277292 | 0.768900 | 0.639005 | 0.271852 | 0.004296 |
| Sum | 246732.0 | 999888.1 | 1008025. | 1342181. | 388.6100 |
| Sum Sq. Dev. | 5.91E+08 | 7.57E+09 | 1.13E+10 | 1.50E+10 | 6934.077 |
| Observations | 27 | 27 | 27 | 27 | 27 |

Source: Author, 2019.

Table 2. Correlation analysis matrix.

| Variables | AGRO | WETP | MAZP | SYBP | OILP |
|---|---|---|---|---|---|
| AGRO | 1.000000 | 0.318525 | 0.778222 | 0.860037 | 0.662712 |
| WETP | 0.318525 | 1.000000 | 0.784284 | 0.705425 | 0.395326 |
| MAZP | 0.778222 | 0.784284 | 1.000000 | 0.918400 | -0.500725 |
| SYBP | 0.860037 | 0.705425 | 0.918400 | 1.000000 | 0.533125 |
| OILP | 0.662712 | 0.395326 | -0.500725 | 0.533125 | 1.000000 |

Source: Author, 2019.

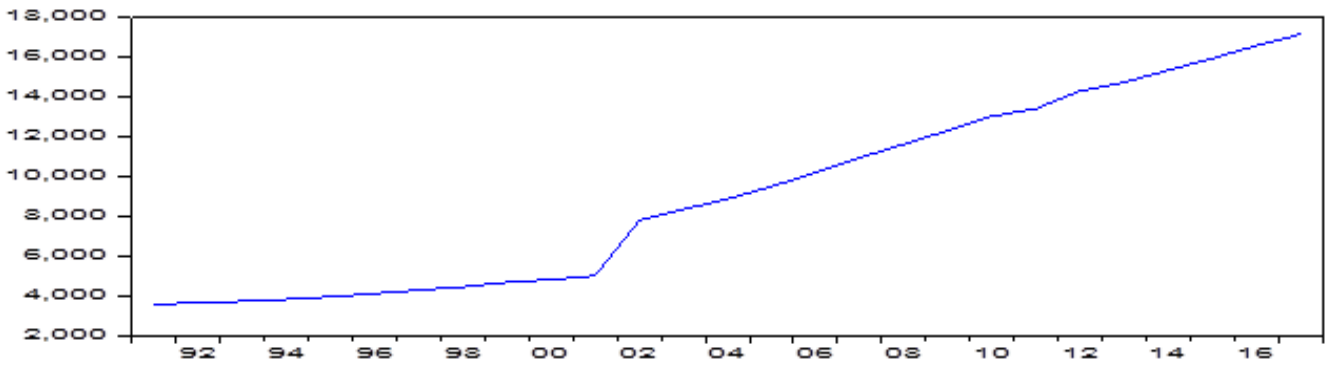


Figure 1. Agricultural output in Nigeria 1991-2017.
Source: Authors, 2019.

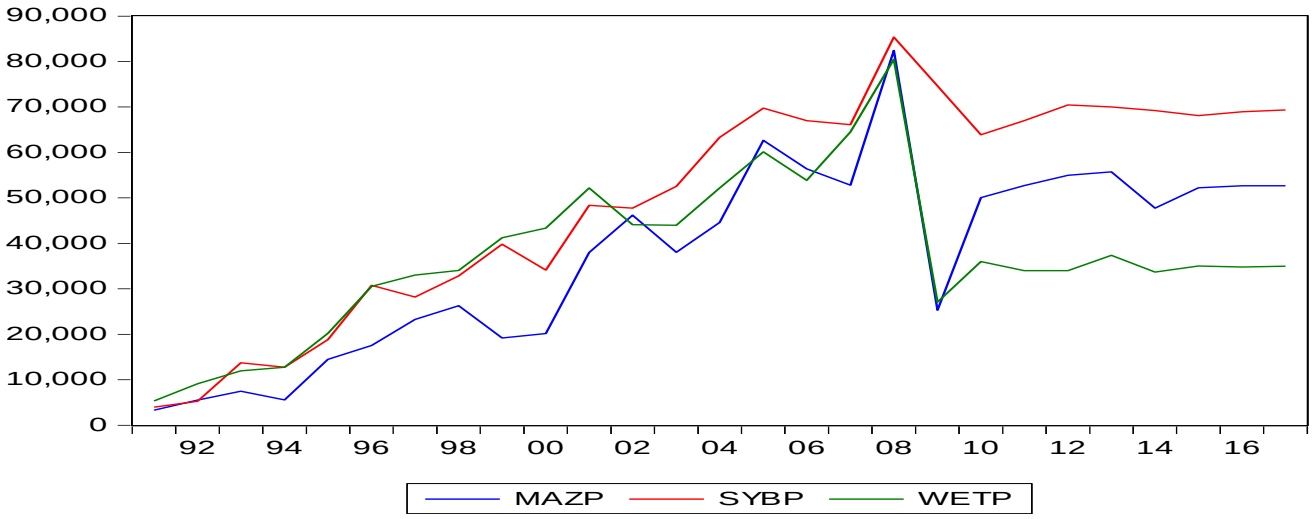


Figure 2. Commodity prices in Nigeria 1991-2017.
Source: Author, 2019.

Table 3. Fully modified ordinary leasts squares (FMOLS) regression.

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| MAZP | 0.844097 | 0.152121 | 5.548867 | 0.0000 |
| SYBP | 0.478607 | 0.155669 | 3.074518 | 0.0055 |
| WETP | -1.118225 | 0.136869 | -8.170007 | 0.0000 |
| OILP | -0.261402 | 0.288925 | -2.904740 | 0.0454 |
| C | 6.853552 | 0.804533 | 8.518667 | 0.0000 |
| R-squared | 0.904215 | | | |
| Adjusted R-squared | 0.891154 | | | |
| Long-run variance | 0.031590 | | | |

Dependent variable is GDPG; Source: Author, 2019.

Figure 1 shows that between 1992 and 2001, agricultural output grew very sluggishly. However, from 2001 to 2012, there was a sharp rise in agriculture, and thereafter, agricultural output has been growing steadily up till 2017.

The trend analysis, as shown in Figure 2, shows that from 1991 to 2005, all the commodity prices have risen sharply in a volatile pattern. The prices of each commodity dropped sharply between 2005 and 2007, but between 2007 and 2008, they rose very sharply, and the prices fell back again between 2008 and 2009. However, between 2009 and 2017, the prices of all three commodities maintained a stable straight pattern. Also, from 1991 to 2001, the growth in wheat price was higher than soya bean price, and both prices were above the price of maize; between 2001 and 2005, soya bean price was higher than both the prices of wheat and maize while between 2008 and 2017 soya bean price grew higher than the price of maize and maize price was higher than the wheat price.

In order to determine the effect of commodity prices on agricultural output in Nigeria, the study used the Fully Modified Ordinary Least Squares (FMOLS) regression, and the result is presented in Table 3.

In Table 3, maize price (β =0.844097, t = 5.548867, p<0.05) and soya bean price (β =0.478607, t=3.074518, p<0.05) exert a significant positive effect on agricultural output in Nigeria while wheat price (β= -1.118225, t=-8.170007, p<0.05) and oil price (β =0.000011, t=0.476542, p>0.05) exert a significant negative effect on agricultural output in Nigeria. The result shows that agricultural output increases with increased commodity prices in line with a priori expectations. The only agricultural commodity for which agricultural output falls even with the increase in its price is wheat which may be attributed to the low level of wheat consumption in Nigeria.

The result shows that maize price (β =0.844097, t = 5.548867, p<0.05) and soya bean price (β =0.478607, t=3.074518, p<0.05) exert a significant positive effect on agricultural output in Nigeria while wheat price (β= -1.118225, t=-8.170007, p<0.05) and oil price (β =0.000011, t=0.476542, p>0.05) exert a significant negative effect on agricultural output in Nigeria. This means that the higher the price of maize and soya beans, the higher the agricultural output, while the higher the wheat price, the lower the agricultural output in Nigeria.

Olasunkanmi and Oladele (2018) found a similar association between the influence of oil price shocks and the pricing of agricultural commodities in Nigeria. The analysis discovered substantial rises in oil prices in all situations with the anticipated positive sign, suggesting that rising oil prices cause rising prices for agricultural goods. The exchange rate, which was used as a control variable, also showed a substantial positive association with agricultural commodities. The research supported the findings of a study by Bashar and Kabir (2013) that examined the connection between commodity prices and exchange rates in the context of the global financial crisis using evidence from Australia and quarterly data spanning more than 30 years, from 1982Q3 to 2013Q2. According to the research, in the long run, the exchange rate is

influenced by events like the Global Financial Crisis, interest rates, and commodity prices.

## CONCLUSIONS AND RECOMMENDATIONS

By and large, the study submitted that agricultural output increases with the increase in agricultural commodity prices but falls with the increase in oil prices. The only agricultural commodity for which agricultural output falls, even with the increase in price, is wheat. This means that the higher the price of maize and soya beans, the higher the agricultural output, while the higher the wheat and oil price, the lower the agricultural output in Nigeria. The implication of this result is that increase in the price of maize and soybeans enhance agricultural output in line with the law of supply. However, since wheat and oil prices indicate a negative relationship with agricultural output, this is an exception to the law of supply. This may result from the fact that the two commodities are either considered inferior or luxury or the consumer panic about an increase in the price of the commodities in future. Based on the outcome of the result of the data analysis it is suggested that government should restructure its trade and foreign exchange policies to stimulate competitiveness and viability of the export sector and economic growth. Also, the economy needs to be diversified from oil export to non-oil export. Also, the government should restructure its trade and foreign exchange policies to stimulate competitiveness and viability of the export sector and economic growth.

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**Appendix**

Appendix A. Data on agricultural production, price of oil (OILP) and prices maize (MAZP), wheat (WETP), and soybeans (SYPBP).

| YEAR | AGRO | WETP | MAZP | SYBP | OILP |
|---|---|---|---|---|---|
| 1991 | 3,590.84 | 5342 | 3318 | 3960 | 15.78 |
| 1992 | 3,674.79 | 9120 | 5514 | 5275 | 16.21 |
| 1993 | 3,743.67 | 11940 | 7460 | 13740 | 16.33 |
| 1994 | 3,839.68 | 12760 | 5580 | 12756 | 15.53 |
| 1995 | 3,977.38 | 20210 | 14480 | 18827 | 16.86 |
| 1996 | 4,133.55 | 30520 | 17560 | 30778 | 20.29 |
| 1997 | 4,305.68 | 33020 | 23250 | 28192 | 18.86 |
| 1998 | 4,475.24 | 34030 | 26290 | 32850 | 12.28 |
| 1999 | 4,703.64 | 41230 | 19190 | 39813 | 17.44 |
| 2000 | 4,840.97 | 43341 | 20173 | 34119 | 27.6 |
| 2001 | 5,024.54 | 52180 | 37970 | 48390 | 23.12 |
| 2002 | 7,817.08 | 44110 | 46180 | 47750 | 24.36 |
| 2003 | 8,364.83 | 44000 | 38020 | 52540 | 28.1 |
| 2004 | 8,888.57 | 52180 | 44580 | 63340 | 36.05 |
| 2005 | 9,516.99 | 60140 | 62670 | 69770 | 50.59 |
| 2006 | 10,222.47 | 53856 | 56394 | 66987 | 61.0 |
| 2007 | 10,958.47 | 64501 | 52796 | 66117 | 69.04 |
| 2008 | 11,645.37 | 80500 | 82452 | 85374 | 94.1 |
| 2009 | 12,330.33 | 27069 | 25300 | 74632 | 60.86 |
| 2010 | 13,048.89 | 36000 | 50050 | 63890 | 77.36 |
| 2011 | 13,429.38 | 34000 | 52730 | 67010 | 107.46 |
| 2012 | 14,329.71 | 34000 | 54970 | 70450 | 109.45 |
| 2013 | 14,750.52 | 37360 | 55730 | 70010 | 105.87 |
| 2014 | 15,380.39 | 33685.8 | 47756 | 69198.4 | 96.29 |
| 2015 | 15,952.22 | 35009.16 | 52247.2 | 68111.68 | 49.49 |
| 2016 | 16,607.34 | 34810.99 | 52686.64 | 68956.02 | 40.76 |
| 2017 | 17,179.50 | 34973.19 | 52677.97 | 69345.22 | 52.51 |