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**Article**

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## The Relationships of Inflationary Trend, Agricultural Productivity and Economic Growth in Nigeria

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*This study investigates the links existing between inflationary trend, agricultural productivity and economic growth in Nigeria using time series data spanning from 1970 to 2011. The results of the analyses indicate a unidirectional causality from inflationary trend to agricultural productivity, unidirectional causality from agricultural productivity to economic growth with no causality between inflationary trend and economic growth. Based on these findings, it is recommended that the Central Bank of Nigeria should pay more attention to the trend of inflation and pursue policies that will ensure single digit inflation.*

**Keywords:** Inflation, Agriculture, Economic growth, Link

**JEL Classification:** E31, O11, O47, O55, Q10

### 1.0 Introduction

Inflation has been apparent in Nigeria from the outset of her national life as it was propelled in the 1960s through the “cheap money policy” adopted by the government to stimulate development after independence (Bayo, 2005). Nigeria has experienced all manners of inflationary episodes; from creeping to moderate and from high to galloping (Olubusoye and Oyaromade, 2008). Inflationary pressure in Nigeria was largely contained in 2010 and 2011, though the rate remained above the national and the West African Monetary Zone (WAMZ) single-digit inflation rate target (CBN, 2011). However, the 12-month moving average headline inflation rate was 10.8 percent in 2011, compared with 13.7 percent at end-December 2010.

The agricultural sector is strategic to national economic development and contributes 42.1% of the current GDP (Eleri *et al.*, 2012). It remains a major source of food and raw material for agro-industrial processing and has strong links to employment, national income, market opportunities for industrial production and strong potentials for poverty reduction and health improvement. However, Nigerian agriculture faces tremendous challenges which include the rising food prices amongst others.

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Food price inflation has risen in recent years because of many factors; on and off farms throughout the world (Oppedahl, 2009). The future direction of world food prices will depend on whether research and development increases agricultural productivity faster than the growth in world food demand. Key sources and features of recent increases of food prices in developing countries have been identified as being the underinvestment in agricultural innovation and rural infrastructure, shift of land and crops towards biofuel feedstocks, natural disasters, high global energy prices, unequal distribution of resources, mismanagement of natural resources, population growth and competition for land and water (Alam and Shahiduzzaman, 2008)

Global food prices registered a new high in February 2011, rising by more than 30 percent year-on-year, underpinned by large increases in the prices of cereals, edible oils, and meat (ADB, 2011). While the recent price increases were triggered largely by production shortfalls due to bad weather, structural and cyclical factors that were at play during the 2007–2008, food crisis continue to be relevant, especially in the light of the strong recovery of many emerging economies from the global economic crisis.

Inflation is undeniably one of the most leading and dynamic macroeconomic issues confronting most economies of the world and has become a leading topic of discussion in Nigerian families and press as its effects penetrate more deeply into nation's life due to prevailing increase in prices (Olatunji *et al.*, 2010). The consumer price index for food over the years in Nigeria constituted a larger proportion of the composite consumer price index and as noted by Oppedahl (2009), households in developing countries spend more on food relative to overall spending and therefore, food price inflation had played a bigger role in overall inflation.

Despite the critical position of inflation in the macroeconomic environment of Nigeria, research efforts have not hitherto addressed the links between the direction of inflation, agricultural productivity and economic growth over the years in Nigeria and therefore, this study was carried out to fill the identified gap in research by providing empirical information on the links between the inflationary trend, agricultural productivity and economic growth in Nigeria and draw up relevant policy implications.

## 2.0 Literature Review and Theoretical Framework

According to Keynesian theory, inflation can be caused by increase in demand and/or increase in cost (Jhingan, 2010). Demand-pull inflation is a situation where aggregate demand persistently exceeds aggregate supply when the economy is near or at full employment. Keynesian theory of cost-push inflation attributes the basic cause of inflation to supply side factors. This means that according to Keynesian, rising production costs will lead to inflation

Akpan and Udoh (2009) in a study on estimating grain relative price variability and inflation rate movement in different agricultural policy regimes in Nigeria, found out that inflation had a positive significant effect on relative price variability of grains and that the SAP and civilian post SAP agricultural policy regimes in Nigeria brought about a positive significant shift in the coefficient of inflation which implies an increase in the relative price variability of grains. Mesike *et al.* (2010) also found out that inflation has a significant positive impact on relative price variability in the short-run and long-run and that those policies that would protect the agricultural sector from the impact of inflation in the short-run should be encouraged.

Murtala (2010) posited that the coefficient of inflation was negative and significant in influencing economic performance in Nigeria and noted that both supply-side policies and demand management policies such as a reduction in real broad money supply should be adopted to reduce inflation in the short-run and in the long-run. Ukoha (2007) found out that the effect of inflation on relative price variability is non-neutral for both food crops and cash crops, and that there is a significant positive impact of inflation on price variability in both the short run and the long run.

The role of agribusiness has become important in the context of the challenges that global economy faces in enhancing food production to cater for increasing demand for food, fuel and feed. The impact of agribusiness on inflation is also both direct and indirect (Khan, 2012). The direct impact of agribusiness is visible in the form of food inflation. The indirect impact of agribusiness on inflation is reflected in the rise in cost of living arising from high food inflation leading to higher wages, which, in turn, contributes to generalised inflation through higher cost of production.

From a policy point of view; both global and domestic, one of the channels through which inflation affect fiscal balances is that the overall cost of living increases as food prices increase, more so for low income countries where food constitutes a substantive part of the consumption basket (Canuto, 2011).

The theoretical framework for this study is adapted from Leoning *et al.* (2009) who modelled inflation in an agricultural economy by presenting an empirical inflation model that embeds different models of inflation which makes it possible to test various hypotheses rather than imposing restrictions on the models and account for the specific circumstances of developing economies with a large agricultural sector. They were of the view that inflation originates either from price adjustments in markets with excess demand or supply or from price adjustments due to import costs. The focus is on markets in three main sectors: the monetary sector; the external sector, including the markets for tradable food and non-food products; and the domestic market for agricultural goods.

Specifically, they postulated that changes in the domestic price level are affected by deviations from the long-run equilibrium in the money market and the external sector, represented by food and non-food products. The domestic market for agricultural goods affects food inflation in the short to medium run through supply shocks with several other factors such as money growth, exchange rate changes, imported inflation, oil-price inflation and world fertilizer-price inflation which might affect inflation as well but shocks in the domestic agricultural market are likely to be the most important.

### **3.0 Methodology**

#### **3.1 Description of Data**

This study employed time series data on inflationary trend given by inflation rate (1970 – 2011), agricultural productivity given by index of the aggregate of agricultural production (1970 – 2011) and economic growth given by real gross domestic product (1970 – 2011). The data were collected from various issues of Central Bank of Nigeria statistical bulletin and annual reports (CBN, 2008; 2011) and National Bureau of Statistics (NBS, 2010).

### 3.2 Analytical Procedure

Descriptive and inferential statistics were utilized to achieve the objective of this study. Descriptive statistics was used to summarize the features of the variables under study. Inferential statistics such as Augmented Dickey Fuller (ADF) test, unrestricted vector autoregression (VAR) and pairwise granger causality test were employed. The ADF test was used to ascertain the time series properties of all the variables so as to avoid spurious regression which results from the regression of two or more non-stationary time series data.

Unrestricted VAR was employed to generate the criteria (likelihood ratio, final prediction error, Akaike information criterion and Schwarz information criterion) which formed the basis for selecting the optimal lag length used in the granger causality test and finally, the pairwise granger causality test was used to determine the causal links between inflationary trend, agricultural productivity and economic growth in Nigeria exchange rate and agricultural share of gross domestic product over the period of exchange rate deregulation. The model of the Augmented Dickey Fuller (ADF) with the constant term and trend is as follows:

$$\Delta Y_t = a_1 + a_2t + \beta Y_{t-1} \sum_{i=1}^n \gamma_i \Delta Y_{t-1} + \varepsilon_t \quad (1)$$

The null hypothesis ( $H_0: \beta = 0$ ) of the ADF test indicates that the series is not stationary and the alternative hypothesis ( $H_1: \beta < 0$ ) indicates that the series is stationary. If the absolute value of calculated ADF statistic ( $\tau$ ) is higher than the absolute value of the critical values, we reject the hypothesis which states that the series is stationary. However, if this value is lower than the critical values, the time series is not stationary (Gujarati, 2004). The Granger causality test assumes that the information relevant to the prediction of the respective variables, X and Y, is contained solely in the time series data on these variables. The test involves estimating the following pair of regressions:

$$X_t = \beta_0 + \sum_{i=1}^p \beta_i X_{t-i} + \sum_{j=1}^p \alpha_j Y_{t-j} + \mu_{1t} \quad (2)$$

$$Y_t = \gamma_0 + \sum_{i=1}^p \gamma_i Y_{t-i} + \sum_{j=1}^p \delta_j X_{t-j} + \mu_{2t} \quad (3)$$

It is assumed that the disturbances  $\mu_{1t}$  and  $\mu_{2t}$  are uncorrelated. Thus there is unidirectional causality from  $X$  to  $Y$  if  $\alpha_i = 0$  and  $\delta_i \neq 0$ . Similarly, there is unidirectional causality from  $Y$  to  $X$  if  $\delta_i = 0$  and  $\alpha_i \neq 0$ . The causality is considered as mutual if  $\delta_i \neq 0$  and  $\alpha_i \neq 0$ . Finally, there is no link between  $X$  and  $Y$  (independence) if  $\delta_i = 0$  and  $\alpha_i = 0$ .

### 3.3 Empirical Model Specification

To determine the causal links between inflationary trend, agricultural productivity and economic growth in Nigeria, the pairwise granger causality test was modelled as a multivariate vector autoregressive (VAR) model as follows:

$$IFT_t = \alpha_0 + \sum_{i=1}^p \alpha_i IFT_{t-i} + \sum_{j=1}^p \omega_j AGP_{t-j} + \epsilon_{1t} \quad (4)$$

$$AGP_t = \beta_0 + \sum_{i=1}^p \beta_i AGP_{t-i} + \sum_{j=1}^p \varphi_j IFT_{t-j} + \epsilon_{2t} \quad (5)$$

$$IFT_t = \alpha_0 + \sum_{i=1}^p \alpha_i IFT_{t-i} + \sum_{j=1}^p \omega_j ECG_{t-j} + \epsilon_{1t} \quad (6)$$

$$ECG_t = \beta_0 + \sum_{i=1}^p \beta_i ECG_{t-i} + \sum_{j=1}^p \varphi_j IFT_{t-j} + \epsilon_{2t} \quad (7)$$

$$AGP_t = \alpha_0 + \sum_{i=1}^p \alpha_i AGP_{t-i} + \sum_{j=1}^p \omega_j ECG_{t-j} + \epsilon_{1t} \quad (8)$$

$$ECG_t = \beta_0 + \sum_{i=1}^p \beta_i ECG_{t-i} + \sum_{j=1}^p \varphi_j AGP_{t-j} + \epsilon_{2t} \quad (9)$$

where:

$IFT_t$  = Inflationary trend given by inflation rate (%);

$AGP_t$  = Agricultural productivity given by index of aggregate agricultural production;

$ECG_t$  = Economic growth given by real gross domestic product (1990 = 100) in ₦ million;

$\epsilon_{1t}, \epsilon_{2t}$  = Gaussian white noise error terms;

$p$  = optimal lag length.

$\alpha_0$  and  $\beta_0$  are constants, while  $\alpha_i, \beta_i, \omega_i, \varphi_i, i = 1, 2, \dots, p$  are parameter coefficients to be estimated.

## 4.0 Results and Discussion

### 4.1 Descriptive Statistics of Variables

The summary of the descriptive statistics of the variables of this study are presented in Table 1. The skewness is an indicator of the asymmetry or deviation of the variables from a normal distribution with an expected value of zero. The kurtosis defines the degree of flattening or peakedness of a distribution with an expected value of three. Jarque-Bera statistic determines the normally or otherwise of a distribution.

Table 1: Descriptive statistics of Inflationary Trend, Agricultural Productivity and Economic Growth (1970 – 2011)

Statistic	<i>IFT</i>	<i>AGP</i>	<i>ECG</i>
Mean	19.300	116.235	281607.462
Median	13.850	105.770	266464.565
Maximum	72.800	270.600	833400.000
Minimum	3.200	55.160	4219.000
Std. Dev.	15.984	62.057	228451.229
Skewness	1.740	0.898	0.754
Kurtosis	2.658	-0.056	-0.100
Jarque – Bera	21.398	21.988	67.668
Sum	810.500	4881.890	11827513.380
Observations	42	42	42

IFT has a skewness greater than zero (positively skewness), kurtosis approximately three (mesokurtic) and its Jarque-Bera statistic (21.398) denotes that its errors are normally distributed. AGP is negatively skewed, leptokurtic and its errors are normally distributed based on the Jarque-Bera statistic (21.988). ECG is also negatively skewed, leptokurtic and has a



Jarque-Bera statistic of 67.668 which implies that ECG is normally distributed.

#### 4.2 Augmented Dickey Fuller Unit root test

The result of the unit root test from the augmented dickey fuller test is presented in Table 2. lnIFT was found to be integrated of order zero and this implies that lnIFT was stationary at level form. lnAGP and lnECG were found to be integrated of order one at level form and therefore, became stationary after differencing once. Differencing was necessary so as to avoid the phenomenon of spurious regression when series are used in their non-stationary form.

Table 2: Result of Augmented Dickey Fuller Test

Variable	ADF Statistic	Test value (5%)	Critical	Inference
<b>Level</b>				
lnIFT	- 4.013819	-3.603202		Stationary
lnAGP	-1.336782	-3.603202		Non-stationary
lnECG	1.639852	-3.603202		Non-stationary
<b>First difference</b>				
$\Delta$ lnAGP	- 6.587732	-3.690814		Stationary
$\Delta$ lnECG	- 4.327546	-3.612199		Stationary

**NB:** ln = natural logarithm

$\Delta$  = difference operator

Lag length selection was automatic based on Schwarz information criterion (SIC).

Table 3: VAR Lag Order Selection Result

Lag	LR	FPE	AIC	SIC
0	NA	0.064459	2.933882	1.453467
1	84.62852*	0.000860*	-1.386750*	1.854632*
2	2.881067	0.001067	-1.185864	1.566986
3	4.347656	0.001185	-1.115459	1.426778
4	14.64704	0.000546	-1.955094	1.176634
5	3.039158	0.000660	-1.878057	1.573249

**NB:** \* indicates lag order selected by the criterion

LR: Likelihood ratio    FPE: Final prediction error

AIC: Akaike information criterion    Schwarz information criterion

### 4.3 Vector Autoregression (VAR) Lag Order Selection Criteria

VAR model was fitted to the time series data in order to find an appropriate lag structure for the granger causality test. This was necessitated by the sensitivity of granger causality to lag length structure (Foresti, 2006; Afzal, 2012; Oyinbo and Emmanuel, 2012). The result as shown in Table 3 indicates that the optimal lag length is one based on Likelihood ratio (LR), Final prediction error (FPE), Akaike information criterion (AIC) and Schwarz information criterion (SIC).

### 4.4 Granger Causality Test

The result of the granger causality carried out using an optimal lag length of one is given in Table 4. The result indicates that there is unidirectional causality from inflationary trend to agricultural productivity leading to the rejection of the hypothesis that inflation rate does not influence agricultural productivity and also, unidirectional causality from agricultural productivity to economic growth leading to the rejection of the hypothesis that agricultural productivity does not influence economic growth. The result also indicated there was no causality between inflationary trend and economic growth over the period of the study.

Table 4: Result of Pairwise Granger Causality Test

Null Hypothesis ( $H_0$ )	Obs.	F- statistic	Prob.	Decision
lnIFT does not granger cause lnAGP	41	24.4587*	0.0257	Reject $H_0$
lnAGP does not granger cause lnIFT	41	0.08745	0.9988	Accept $H_0$
lnIFT does not granger cause lnECG	41	0.1734	0.1856	Accept $H_0$
lnECG does not granger cause lnIFT	41	0.0231	0.7643	Accept $H_0$
lnAGP does not granger cause lnECG	41	14.5644**	0.0614	Reject $H_0$
lnECG does not granger cause lnAGP	41	1.4389	0.5791	Accept $H_0$

NB: \*  $P < 0.05$ , \*\* $P < 0.1$

The implication of the results is that the trend of inflation has been significant in influencing agricultural productivity and agricultural productivity has been significant in influencing economic growth over the study period. The observed influence of inflationary trend on agricultural production can be attributed to the persistent rise in the cost of farm inputs over the years leading

to an increase in the cost of agricultural production activities. This phenomenon is referred to as the cost push inflation. The inability of the agricultural sector to attain self-sufficiency in food production has led to a situation of aggregate demand for food exceeding aggregate supply leading to demand pull inflation in the economy.

Despite the inability of the agricultural sector to attain self-sufficiency in food production, it has been significant in influencing economic growth over the years. As noted by CBN (2011), the agricultural sector contributes the largest share of the gross domestic product of Nigeria.

## **5.0 Conclusion and Recommendation**

This study has been able to establish the nature of links between inflationary trend, agricultural productivity and economic growth over the period of 1970 to 2011 using pairwise granger causality test. The key findings of this study are the existence of unidirectional causality from inflationary trend to agricultural production, unidirectional causality from agricultural productivity to economic growth with no causality from inflationary trend and economic growth over the data period of the study. Based on these findings, it is recommended that the monetary authority of Nigeria should carefully monitor the trend of inflation and pursue policies that will ensure a single digit inflation rate as the inflationary pressure of the economy exerts significant influence on the level of agricultural production. This is necessary to ensure that the agricultural sector continues to play a major role in the Nigerian economy especially towards driving the economy to achieve the national transformation agenda.

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