Rural Economics and Development

MACROECONOMIC VARIABLES AND FOOD PRICE INFLATION IN NIGERIA (*1980-2018*)

S. O. AKINBODE[1]*, J. OLABISI[2], C. P. ADEKUNLE[3] and O. M. JIMOH[1]

[1]Department of Economics, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.
[2]Department of Accounting, Federal University of Agriculture, P.M.B. 2240, Abeokuta, Nigeria.
[3]Department of Agricultural Economics and Farm Management, Federal University of Agriculture, P.M.B 2240, Abeokuta, Nigeria.

*Corresponding Author: E-mail: akinbodeso@funaab.edu.ng, deleakinbode@yahoo.com

Abstract

Despite the abundance of literature on general inflation, there is limited knowledge on the specific effects of macroeconomic variables on food inflation in Nigeria. The study examined the effects of key macroeconomic variables on food price inflation in Nigeria using data from 1980 to 2018 obtained from the World Bank and the Central Bank of Nigeria (CBN).Stationary tests revealed that some of the series were stationary at level i.e. I(0) while others were stationary at first difference i.e. I(1). Therefore, the data were analyzed within the ARDL framework. The bound test revealed the presence of long run relationship among the variables. Food production, exchange rate, money supply and crude oil prices were significant in the short run while all of these except food production were significant in long run. It takes about 1.1 years for the system to restore back to the long run equilibrium path in case of an external shock. Post estimation tests confirmed the validity of the model estimated. Measures aimed at ensuring increased food production such as provision of loan through guided increase in money supply and effective protection of the Naira against excessive depreciation are recommended.

Keywords: Inflation, food prices, money supply, exchange rate

1.0 Introduction

Inflation is a major economic problem in developing and emerging economies, therefore, ensuring stable prices is always one of the main objectives of monetary authorities, and in fact, that of government. Adverse effects of inflation include reduction in the purchasing power of a country's currency which may lead to the lowering of living standard and general welfare. Unstable and especially galloping prices are usually accompanied with uncertainty which discourages both local and foreign investor. This is in addition to the worsening of the country's term of trade and making the domestic goods more expensive relative to its peers in regional and world markets (Adams *et al*, 2014).

The Gross Domestic Product (GDP) annual growth rate in Nigeria averaged 3.82 percent from 1982 until 2019, though; there have been few cases of negative growth. The country's economy grew 1.94 percent year-on-year in the second quarter of 2019. Similarly, the agricultural share of the country's GDP has also witnessed significant growth over time. For instance, the agricultural sector of the GDP grew by 7.2 percent in the second quarter of 2019 (Trading Economics, 2019). This is expected to ensure abundance of agricultural product at affordable prices and keep food price inflation as low as possible. It is worthy of note that Nigeria is the largest territorial unit in West Africa with a land area of about 923 Million square kilometer and the country's population estimated as at 2018 to be around 195 million (World meter, 2019). It has been evaluated that 82 million hectares of the country's total land area of about 91 million hectares were arable. However, only 42 percent of the cultivable land is being put to use for various farming activities. While some parts of the remaining are forests, others are pasturelands which have agricultural potentials (FAO, 2018). About 30 percent of the population is engaged in the agricultural sector. Therefore, food production is expected to progress steadily in the country, *ceteris paribus*. In the 1960s and the 70s, it is a country with abundant food supply as farming was the leading and the most important occupation thereby ensuring stability in food

supply and food prices, therefore, the country did not face noticeable food price inflation. However, few years after oil discovery in commercial quantity in the country, farming and agriculture as a whole began to lose its integrity and witnessed setbacks which brought issues like food price inflation (references).

According to Ambachew *et al*. (2012), high inflationary pressure especially on food price has been a top agenda in many developing countries since the last decade as it has been hindering their socio-economic development. Meanwhile, inflation, or specifically, food inflation is not peculiar to any particular country, but a global phenomenon, though, with varying intensity. For instance, according to Financial Times (2019), the United Kingdom (UK) inflation rose marginally in February 2019 as increases in the cost of food weighed more than decrease in the prices of clothes and other commodities resulting in an inflation rate of 1.9 percent on year-on-year basis. Globally, food inflation after the turn of the millennium posed a challenging task to policy makers in the world as food and energy prices were increasing substantially.

According to FAO (2018), annual global food price inflation fell from 6.3 percent in 2013 to 3.6 percent in 2017 with divergent trends at regional levels. The lowest food price inflation rate in recent time was in 2017, when it decreased to 3.6 percent. It is pathetic to note that from 2013 to 2017, most regions in the world witnessed decline in food price inflation except Africa where it increased from 6 percent to 14 percent from 2013 to 2017 respectively. During the same period being considered, Asia recorded significant reduction in food price inflation as food inflation on annual basis fell by 7 percent to 2 percent in 2017. Annual food price index in Nigeria was at the high rate of 168.5 percent in 2017 (FAO, 2018). One of the core economic objectives of governments around the world is attaining the highest level of welfare for the masses and thus works towards stabilizing the rate of all forms of inflation or reduces it. In Nigeria however, this objective seems to prove difficult to achieve as the prices of food has been on an increase relative to previous years in the country. For example, a kilogram of polished rice (a staple food consumed across socioeconomic strata of the economy) which was around ₦130 in 2009 is presently around ₦300 per kilogram and this trend can be observed across various food commodities in the country.

According to Trading Economics (2019), "cost of food in Nigeria increased 13.56 percent in June of 2019 over the same month in 2018. Food Inflation on yearly basis in Nigeria averaged 11.62 percent from 1996 to 2019, reaching an all-time high of 39.54 percent in September of 2001 and a record low of -17.50 percent in January of 2000".According to NBS (2019), the average consumer price index increased by three basis points from 11.37 per cent year-on-year in April to 11.40 per cent year-on-year in May 2019, while the price of volatile agricultural produce increased to 13.79 per cent from 13.70 per cent year-on-year in April same year. Interestingly, the causes of food price inflation and the significance of some macroeconomic variables such as broad money supply, interest rate, crude oil prices, and exchange rate among several related variables have not been extensively researched in Nigeria. This study is therefore conceptualized with a view to examining the effect of selected macroeconomic variables on food price inflation in Nigeria. Specifically, the study described the trend and statistical properties of the food price inflation and selected macroeconomic variables in Nigeria and determined the effect of the macroeconomic variables on food inflation in the country. Section 2 reviewed some of the existing related literature. The study methodology was presented in section 3 while results and discussions were presented in the fourth section. Section 5 summarized and concluded the paper.

2.0 Literature Review

2.1 Review of Empirical Literature

Studies have been carried out on the determinants of food inflation in both developed and developing economies. Such studies have been able to identify different determinants of food price inflation and have arrived at different opinions as regards the significance of some of the determinant variables. Sasmal (2015) stated that India was experiencing high rate of economic growth but the growth has been occurring with high rate of food price inflation. The study reported that increase in per capita income has caused increased in demand for food which agricultural production has been unable to keep pace with the increased demand. Furthermore, Ahmed and Singla (2015) reported that the major determinants of food inflation in India were rainfall, broad money, effective exchange rate, interest rate and crude oil prices. Sthanumoorthy (2008) reported that manufactured food products were the leading factors responsible for increasing food prices due to the high importation of edible oil between 2006 and 2007 in India. Chand (2010) attributed the rise of food price inflation to drought, which resulted in the slow growth of production of food items and a rise in the cost of the production. Davidson *et al*. (2011) found that retail food price movement is accounted only in a small degree by world raw commodity prices while the remaining is explained by changes in manufacturing cost of food. This was similar to Vavra and Godwin (2005) assertion

that raw agriculture commodity prices account for only around 20-30 percent of the final good price in the developed countries. Abbott *et al.* (2009) reported that depreciation of the exchange rate in the United State lead to higher prices in the United States, but a lower price to the rest of the world and vice versa. This was corroborated by Davidson *et al.* (2011) who affirmed that changes in Dollar exchange rate may decrease or increase the effects of Dollar denominated price of agricultural commodities in the world market.

Hasan and Mashi (2018) investigated the determinants of food price inflation in Malaysia by employing Nonlinear ARDL technique to determine the linearity and symmetry of the focused variables. The study reported the presence of long run co-integration among the study variables. The vector error correction model (VECM) and the Variance Decompositions analysis reported that the exchange rate is the most exogenous variable. In addition, NARDL found that the relationship between the food price and exchange rate to be symmetric in the long run but asymmetric in the short run. Since the exchange rate is the most exogenous variable in the study and the fact that Malaysia adopts the flexible exchange regime makes it hard for the policy makers to control the fluctuations of the Malaysian exchange rate to control food price. The study concluded that adjustment and control of food price should be made through the reduction of the food import in order to minimize the exchange rate pass through effect on the food price inflation.

China has witnessed low and stable consumer price inflation alongside high and volatile food price inflation over the past decade. Therefore, Zhang *et al.* (2014) examined the link between consumer price inflation and food price inflation and the determinants of consumer price inflation using co-integration and error correction model and suggested that the link between consumer price inflation and food prices has not been weakened. It was further reported that food price inflation, especially cereal price inflation, remains a significant driving force for overall consumer price inflation, and that international food prices also play a significant role in determining China's inflation dynamics. Ismaya and Anugrah (2018) investigated the determinants of food inflation in Indonesia using quarterly data from 2008Q1 to 2017Q4 with GMM estimator. It was reported that backward-looking and forward-looking expectations have a strong impact on food inflation. Furthermore, food production, agriculture sector output, infrastructure, food import, agriculture sector credit, demand level (M1/consumption), and seasonal event (Eid Mubarak), were significant determinant of food inflation in Indonesia. Backward-looking and forward-looking expectations, domestic oil price, and level of demand actually contributed to high food price.

Qayyum and Sultana (2018) analyzed factors affecting the food price inflation in Pakistan covering the period from 1970 to 2017. The study reported that GDP, food exports, food imports and taxes significantly increased food inflation while money supply reduced food inflation. Rehman and Khan (2015) sought to identify the factors affecting food price inflation in Pakistan using data for the period 1990 to 2013 within a VECM framework. Results of the study revealed that indirect taxes and food exports have positive and significant impact on food price inflation while government subsidy and GDP are negatively correlated with food price inflation in Pakistan. Consequently, the study recommended that government should give attention to the agricultural sector and also reduce the taxes on food items.

Ambachew *et al.* (2012) assessed the general and intermediate factors driving food price dynamics in Ethiopia. The study specifically focused on Dire Dawa administration and Harari regional state using monthly data from January, 2001 to September 2012. The VECM analysis revealed that real income, money supply and international food and oil price hikes increase domestic food inflation while it was found that depreciation in the value of the country's currency decrease inflation in the long run. In the short run however, smuggling, inflation expectation, exchange rate and increase in world oil price and exchange rate significantly affected food price inflation in the study area. The study consequently recommended that conservative monetary policy, creation of enabling environment for competition in the market and lowering the cost of doing business would go a long way in reducing food inflation in the study area.

Udoh and Isaiah (2018) concluded that previous values of inflation rate and money supply are significant in predicting future inflation rates in Nigeria. However, Egwuma *et al.* (2017) examined the intrinsic relationship between key demand and supply variables, GDP, price of crude oil, food import and food price inflation in Nigeria covering the period 1988 to 2017 in a co-integration and error correction modeling framework. The study reported that price of crude oil; food import and real GDP have long run positive relationship with food price inflation. However, real GDP and food import were the key determinants of food price inflation. The ECM suggested a slow adjustment process and the study recommended increased domestic agricultural production through the supply of agricultural inputs rather than cash as policy incentive. It should be noted that the scope of the study can be

expanded to give a more representative picture. Ayinde *et al.* (2010) assessed the determinants of inflation using the co-integration approach and it was reported that the previous total export and import (with opposite signs) and food price index significantly affected inflation in Nigeria. The study suggested that policies that will set the interest rate to a moderate level which will encourage investment and increase in production level, reduction in importation, efficient and effective exchange rate system and the domestic consumption of petroleum product in order to curb inflation in Nigeria should be put in place.

2.2 Review of Theories Relating to Inflation

A number of the theories have been developed to provide explanation on the causes of inflation in the macroeconomic context. These include:

The demand-pull theory: This theory posits that inflation occurs due to a rise in aggregate demand. Under the theory, determinants of inflation are increase in government spending, increase in money supply and the changes in the price levels in other countries.

Cost-push theory: Here, inflation is seen as a phenomenon which arises perhaps due increase in wages and cost of other raw materials in the production process thereby leading to decreases in aggregate supply.

The Keynesians and the monetarists' views of inflation: The Keynesians believe that inflation is a result of disturbances in income and shocks to the economy such as increase in oil price while monetarists believe that inflation is caused by excessive demand and incorrect monetary responses to conditions of the economy. That is, few goods being chased by too much money. The monetarist model of the factors affecting inflation is derived from the money demand function and is based on the hypothesis that inflation varies directly with the rate of change of money supply and negatively with the rate of change of real income, *ceteris paribus*.

The Structural list Theory: Proponents of this theory cite the presence of structural bottlenecks, especially in developing countries as key causes of inflation. Structural factors such as policies which were designed to protect some industries including trade policies, weather conditions among others may affect the rate of inflation. For instance, if massive flood occurs which destroys farms and disrupts food supply, then, prices of commodities will surely go up. In addition, in a bid to protecting some domestic industries, good and services which are obviously cheaper may be denied importation which results in higher prices for certain goods and services in the country.

The Purchasing Power Parity Theory: This tried to explain the changes in exchange rates in terms of differentials between countries. Proponents of this theory are of the view that for countries which adopt the flexible exchange rate, changes in exchange rate impacts on inflation. This is most likely in small and open developing economies. Agenor and Montiel (1996) posited that worsening exchange rate affects prices in domestic currency of tradable goods, but may also indirectly affect the general price level if pricing decisions are affected by the cost of imported input.

2.3Theoretical Framework

The quantity theory of money is one of the oldest surviving economic doctrines. The theory relates level of an economy's commodity prices to the quantity of money in the economy and the level of its commodity production. The quantity theory of money relates inflation with increase in the stock of money in the economy. There are two similar formulations of the theory which are the equation of exchange and the cash-balances formulation. The transaction version which is linked to names Newcomb and Fisher is given as:

$$MV = PY \qquad (i)$$

Where M is the stock of money in circulation

V is the velocity of circulation

P is the general price level

Y is the total income (output)

Relating equation (1) to inflation, the equation can be re-written as percentage change as

$$\%\Delta M + \%\Delta V = \%\Delta P + \%\Delta Y (ii)$$

Subtracting $\%\Delta Y$ from both sides

$$\%\Delta M + \%\Delta V - \%\Delta Y = \%\Delta P (iii)$$

Velocity of circulation V is assumed to be constant.

Therefore, $\%\Delta V$ is zero (0).

It should also be noted that $\%\Delta P$is simply inflation.

Thus, equation (3) can be re-written as

$$\delta = \%\Delta M - \%\Delta Y$$

Where $\delta represents inflation$

%Δ implies growth rate

The equation (iv) above implies that the quantity theory of money suggests that inflation rate is the difference between growth rate of money supply and the growth rate of aggregate output. It can therefore be deduced that money supply and output in the economy are likely macroeconomic variables capable of exerting significant effects on inflation rate in an economy.

3.0 Methodology

3.1 Data Sources and Variable measurement

The study covered the period from 1980-2018 and used data from World Bank Commodity Prices (WBCP) statistical database, Central Bank of Nigeria (CBN) database and the World Development Indicators (WDI). The variables used were; food price inflation rate, exchange rate, interest rate, world crude oil prices, food production index, broad money supply and annual rainfall in Nigeria (Table 1).

Table 1: Data sources and Measurement

Variable	Source	Measurement
Food Price Inflation (FPI)	WBCP	Index
Broad money supply (M2)	CBN	In Naira
Food Production index (FPR)	WDI	Index
Rainfall	CBN	Millimeters
Crude oil prices(OIL)	WBCP	Per barrel
Exchange Rate(EXCH)	CBN	Naira per Dollar
Interest Rate(INT)	WDI	In Percentage

Source: Authors' compilation, 2019.

3.2 Model specification

The effect of macroeconomic variables on food price inflation is specified following the theoretical exposition of the quantity theory of money which suggested money supply and output as possible determinants of inflation alongside other macroeconomic variables suggested in empirical literature such as exchange rate, interest rate, oil price and rainfall in equation *(v)* as:

$$fpi = (exch, int, m2, oil, fpr, rainfall)$$

Where: *fpi* = Food Price Inflation index
int = interest rate
exch = exchange rate
m2 = broad money supply
fpr = food production index
oil = world crude oil price per barrel
rainfall = annual rainfall

Equation (v) can be written in explicit format as equation (vi) below:

$$fpi_t = \alpha + \beta_1 exch_t + \beta_2 int_t + \beta_3 m2_t + \beta_4 oil_t + \beta_5 fpr_t + \beta_6 rainfall_t + \mu_t \quad (vi)$$

From the linear model (Equation vi), it is expected that β_1, β_2, β_3 and β_4 are positive while β_5 and$\beta_6$are negative on food price inflation.

3.3. Model Estimation

Pre-estimation Analyses

Preliminary tests were carried out to examine the nature of the data for each of the series and their statistical properties. A descriptive analysis was used to describe the data for the variables while the graphical analysis gave an insight into the likely movement of each of the variable overtime. The Augmented Dickey Fuller unit root test was employed to ascertain the stationary level of the variables and they were found to be stationary at different order of integration which necessitated the use of the ARDL estimation method. Furthermore, the correlation analysis was carried out to prevent the problem of multicollinearity among variables to be included in the econometric model estimated. The ARDL bound test was carried out to affirm if there was a long run relationship between food price inflation and the selected macroeconomic variables and the Akaike information criterion was used to select the best lag length for the model estimation.

Estimation Procedure

The model estimation procedure adopted is the Autoregressive Distributed Lag (ARDL), thus the model was expressed in a time series form as

$$\Delta fpi_t = \alpha + \mu \text{TREND} + \sum_{m=1}^{M} \theta_m \Delta fpi_{t-m} + \sum_{j=0}^{J} \vartheta_j \Delta Inexch_{t-j} + \sum_{r=0}^{R} \theta_r \Delta int_{t-r} + \sum_{p=0}^{k3} \varphi_p \Delta InM2_{t-p} + \sum_{q=0}^{Q} \delta_q \Delta Inoil_{t-q} + \sum_{l=1}^{L} \epsilon_l \Delta fpr_{t-1} + \sum_{p=1}^{P} \gamma_p \Delta In\, rainfall_{t-p} + \beta_1 fpi_{t-1} + \beta_2 Inexch_{t-1} + \beta_3 int_{t-1} + \beta_4 InM2_{t-1} + \beta_5 INoil_{t-1} + \beta_6 Infpr_{t-1} + \beta_7 Inrainfall_{t-1} + \varepsilon_t \quad (v)$$

Where α is the error correction term which shows the speed of adjustment to the long run equilibrium after a short run shock and terms with β_1 corresponds to the long run relationship between the dependent variable

and the independent variable. The summation signs represent the error correction dynamics, showing the short run relationship between dependent variable and the independent variables, the superscripts on summation signs represents the lag order while ε represents the white noise or the error term.

Post-Estimation Analyses

After estimating the model and obtaining the coefficients of the variables, the study proceeded to post-estimation tests to establish the validity of the estimated model in order to be sure that the underlying assumptions were not violated and to guarantee the authenticity of the estimation technique adopted and conclusion drawn therein. Tests which were very relevant and carried out in this regard included the test for linearity using the Ramsey RESET test, test for normality using Jarque-Bera test, heteroskedasticity using the ARCH-LM test and test for serial correlation using the Breusch-Godfrey Test.

4.0. Results and Discussion

4.1 Preliminary Estimations

Table 2 presents a summary of major statistical properties of each of the variables. The mean value for Food Price Inflation (FPI) index with 39 observations was 132.42% per year. This represents an increase of about 32 percent yearly. The standard deviation shows how the each of the data series clusters around their mean. The smaller the value of the standard deviation the more clustered the data set. Interest rate, exchange rate, broad money supply, crude oil prices and volume of annual rainfall all cluster around their averages while food price inflation and food production index widely dispersed around their means. The skewness shows the symmetry of the distribution of a series. Food price inflation, interest rate and crude oil prices were positively skewed implying that these series had the long tail of each of their distributions lying to the right i.e. majority of the observations have relatively lower values. Broad money supply, exchange rate and annual rainfall were negatively skewed i.e. the long tails lie to the left of the distributions while food production index was approximately symmetrical (near normal distribution). The kurtosis is the degree of peakedness (pointedness of the peak) of a distribution, and food price inflation, interest rate and annual rainfall were leptokurtic, that is, they were highly peaked while the other variables were platykurtic (a bit flat peak). The Jarque-Bera test is a more comprehensive test as it combines the properties of both skewness and kurtosis to assess the normality of the distribution of series. The test revealed that food price inflation and annual rainfall were not normally distributed since their Jarque-Bera probability values were less than 0.05 thereby rejecting the null hypotheses that the series were normally distributed while food production, interest rate, exchange rate, broad money supply and crude oil price were all normally distributed (Table 2).

Table 2 Descriptive Statistics

	Fpi	*Fpr*	*Int*	*Inexch*	*Inm2*	*Inoil*	*In Rainfall*
Mean	132.423	76.081	17.514	3.246	6.412	3.493	10.917
Median	116.649	79.065	17.321	3.809	6.408	3.358	10.933
Maximum	230.701	133.786	31.650	5.535	10.007	4.654	11.098
Minimum	89.467	29.970	8.432	-0.604	2.667	2.569	10.531
Std. Dev.	38.208	31.561	5.065	2.036	2.564	0.642	0.122
Skewness	1.235	0.019	0.159	-0.701	-0.045	0.501	-1.033
Kurtosis	3.356	1.831	3.418	2.095	1.583	2.033	3.981
Jarque-Bera	9.854	2.165	0.437	4.411	3.191	3.070	8.289
Probability	0.007	0.339	0.804	0.110	0.203	0.215	0.015
Observations	39	39	39	39	39	39	39

Source: Authors' Computation, 2019

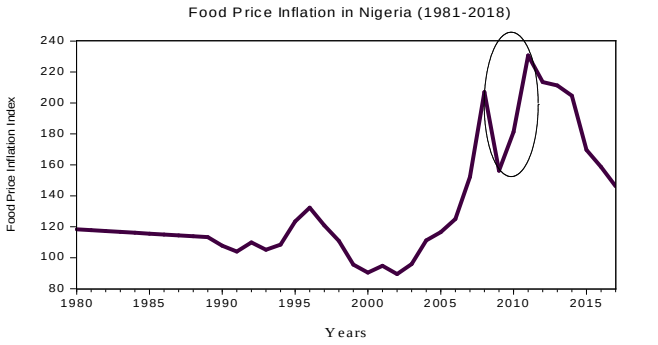
Graphical Analysis

Figure 1 and Figure 2 present the graphical illustration of the study variables. Food price inflation index was almost constant (though, falling slightly) between 1980 and 1993. The distinction between food price inflation and food price should be noted. Therefore, a constant, near constant or falling inflation rate does not mean falling prices but the rate at which the prices are rising is only decreasing, though, prices are rising. The index fell between 1996 and 2000 after which it rose up sharply fluctuating and reaching an all-time highest between 2008 and 2010, perhaps, reflecting the period of the global financial melt-down. The trend fell afterwards.

Exchange rate was almost stable between 1980 and 1985 before it started trending upwards with some fluctuations. Food production index also showed a more consistent upward movement from 1980 to 2018. Interest rate also showed upward movement with very sharp rise between 1985 and 1990. This may be due to the stringent economic policies of Structural Adjustment Programme (SAP) at the time. Interest rate reached the highest between 1993 and 1994, perhaps, due to the unstable political situation in the country at that time. The interest rate declined afterwards and keeps fluctuating between 16 percent and 24 percent, stabilizing around 18 percent in recent years. Broad money supply was stable from 1980 up to 1992 before it started rising steadily. Crude oil prices fell between 1980 and 1985 before it started its upward movement with noticeable fluctuation and an all-time highest between 2013 and 2014 after which it fell drastically. In

the same vein, rainfall has been trending upwards overtime, though, also showing some level of fluctuations.

Fig 1: Food Price Inflation Index Trend in Nigeria.



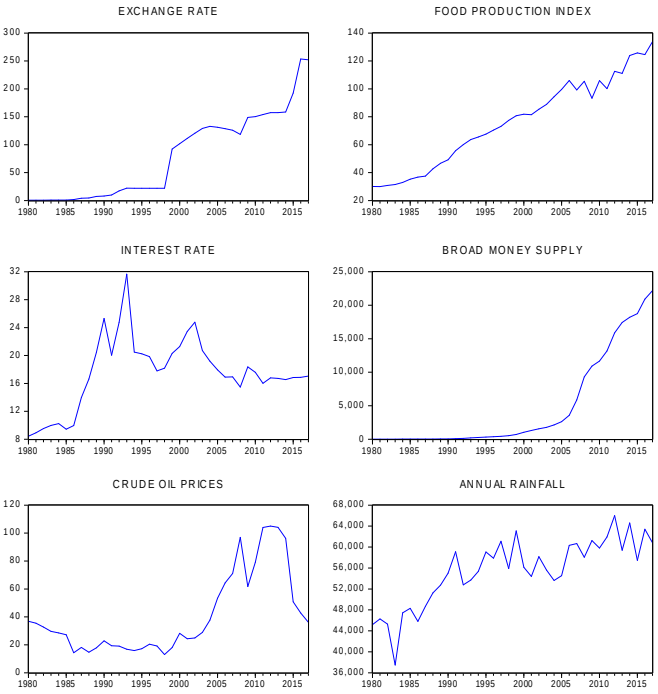


Fig 2: Trends of the independent variables from 1981 to 2018

Source: Source author's compilation

Correlation Analysis

Correlation refers to degree of linear relationship between two variables. The multivariate correlation analysis was conducted in this study as part of pre-estimation analysis in order to avoid multicollinearity problem among explanatory variables in the study. According to Iyoha (2004), two variables having correlation coefficient more than 0.95 must not exist together in a model in order to avoid multi-collinearity. No pair of variables has up to the said threshold in the present study (Table 3).

Table 3: Correlation Matrix

	Fpi	*Fpr*	*Int*	*m2*	*oil*	*rain*	*exc*
FPI	1						
FPR	0.5926	1					
INT	-0.2091	0.3087	1				
M2	0.7991	0.8140	-0.0535	1			
OIL	0.7096	0.6297	-0.1790	0.7111	1		
RAIN	0.4871	0.8183	0.4742	0.5949	0.4771	1	
EXC	0.5568	0.9361	0.1571	0.6587	0.6178	0.6800	1

Source: Authors' Computation 2019

Test for Stationarity and Lag Length Selection

Augmented Dickey-Fuller (ADF) test was employed in the study as shown in Table 4 to examine the stationarity or otherwise of the study series. Results showed that the alternative hypothesis of no unit root was acceptable at the 5% significance level for Food Production Index (*fpr*) and Rainfall (Log of *rainfall*) implying that they were integrated of order zero i.e. I(0) or stationary at levels. However, Food Price Inflation (*fpi*), Interest rate (*int*), log of Exchange rate (*exch*), Log of Money Supply (*m2*) and log Crude Oil Prices (*oil*) were differenced stationary i.e. they were integrated of order one I(1). In the light of the fact that the series were integrated of different orders, the Autoregressive Distributed Lag model (ARDL) framework is therefore most appropriate for their analyses. Table 5 presents the Lag selection criteria test and the majority of the criteria suggested the lag length of 2 as appropriate for the analysis.

Table 4: Augmented Dickey-Fuller (ADF) Unit Root Result

Variable	Level			First Difference			I(d)
	Intercept	Trend and Intercept	None	Intercept	Trend and Intercept	None	
FPI	-1.473	-1.943	-0.167	-6.095***	-6.000***	-6.172***	I(1)
FPR	0.002	-3.856**	2.430				I(0)
INT	-2.372	-2.146	-0.713	-5.298***	-5.520***	-5.322***	I(1)
EXCH	-1.874	-1.068	1.751	-5.188***	-5.510***	-4.420***	I(1)
M2	-0.905	-1.547	1.113	-3.289**	-3.284*	-0.843	I(1)
OIL	-1.188	-1.861	-0.223	-5.653***	-5.571***	-5.736***	I(1)
RAIN	-1.624	-3.995**	0.980				I(0)

Source: Authors' computation (2019). ***Note: *, **, *** represents significant at 10%, 5% and 1% respectively***.

Table 5 Lag Length Selection for Dependent Variable (FPI)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1414.09	NA	4.57E+25	78.9492	79.2571	79.0566
1	-1186.63	353.8146	2.38E+21	69.03513	71.4984*	69.8948*
2	-1124.71	72.2473*	1.61e+21*	68.3170*	72.9356	69.9290

Source: Authors' computation, (2019).*indicates lag order selected the criterion

LR: Sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error.

AIC: Akaike information criterion. SC: Schwarz information HQ: Hanna-Quinn information criterion.

Co-integration test results and model selection

Following the mixed order of integration of the series as reported in the stationarity test results the ARDL Bound co-integration test proved most appropriate to determine if there was long-run relationship between food price inflation and the selected macroeconomic variables. The test provides two critical values to be checked against the F-statistic value in order to make conclusion on either the rejection of the null hypothesis of "no co-integration" among the series, or otherwise. Table .6 presents the ARDL bounds test results, the F-statistic value which is approximately 3.74 was greater than the I(1) critical bound at 5 percent risk level, hence, there was long-run relationship among the variables. Following this co-integration result, the study presents both the short run and long run estimates of the ARDL models.

Table 6: ARDL Bounds Cointegration Test

Dependent variable	Critical value	F-statistic = 3.7366 Lower bound	Upper bound
FPI	10%	2.12	3.23
	5%	2.45	3.61
	1%	3.15	4.43

Source: Authors' Computation, (2019).

4.2 Macroeconomic Factors Affecting Food Price Inflation

The result of the short run (dynamic) model is presented in Table 7. Food production index (P<0.01), exchange rate (P<0.05) and money supply (P<0.1) were the significant macroeconomic variables affecting food price inflation in Nigeria in the short run. In line with *a priori* expectation, food production index and its lag reduced food price inflation. This is a supply side issue because as production improves it is expected that the increase in supply will exert downward pressure on equilibrium prices and reduce inflation. A percent increase in production decreased food price inflation by 1.34 percent while its lag reduced food price inflation by 1.29 percent. Exchange rate and its one year lag exerted positive effect on food price index. This corroborates the report of Moser (1995) and that of Njoku and Nwaimo (2019) in Nigeria. According to Oyejide (1989), exchange rate depreciation often lead to increased local currency cost of imported inputs (raw materials and intermediate capital goods) and final goods via the cost-push inflation channel. Since non-tradable goods cannot be imported, excess demand for them would translate into increased prices given the fixed nature of domestic supply in the short run. The increase in price feeds directly into domestic inflation via demand-pull route. The phenomena of direct relationship between currency depreciation and food price inflation is in line with the reports of Bada *et al.* (2016), Fatukasi (2011), Ayinde *et al.* (2010) all in Nigeria and that of Ambachew *et al.* (2012) in Ethiopia. One year lag of money supply had a negative effect on food price inflation. The explanation for this may be that more money supply in the in form of credit (which includes credits for the agricultural sector) for instance might have led to improvement in food production and other food related activities such as processing, packaging, preservation/warehousing, marketing etc. Improvement in this sector might have resulted in increased supply which is capable of reducing inflation. The finding corroborates those of Qayyum and Sultana (2018) in Pakistan and Ambachew *et al.* (2012) in Ethiopia for short run models. It however contradicted that of Inimole and Enoma (2011) who reported a positive relationship.

World price of crude oil was positive and significant at 1 percent level. This implies that a percent increase in the price of crude oil in the international market caused a 1.336 percent increase in food price inflation in Nigeria. The positive relationship may be due to the use of some cereal crops for the production of ethanol or for other energy use which may be substitutes for crude oil. Therefore, increases in the price of crude oil may force companies to seek for alternatives in cereal crops which impart on food availability and food prices. The error correction coefficient satisfied the three (3) main conditions for the existence of long run co-integrating relationship among the variables in the model. These include being significant, less than one and being negative. The coefficient value of -0.9193 implies that 91.93 percent of the total disequilibrium which may occur due to an external shock to the food price inflation system in the previous year is corrected in the present year. Therefore, it will take 1.09 years (about 13 months) before the system is restored back to its long run equilibrium path.

Long Run: The long run (static) model result (Table 8) revealed that exchange rate, money supply and oil price were the significant macroeconomic variables affecting food price inflation in the long run in Nigeria. As in the short run model, exchange rate was negative in the long run model while crude oil price was similarly positive. Contrastingly, money supply alternated sign between the short and the long run. The variable came up with a positive sign in the long run. This corroborates the study of Inimole and Enoma (2011) for Nigeria. It may happen that initial money supply in the form of credit reduced food prices but in the long run the volume of money became more than available good and services or some are not channeled to productive ventures thereby causing demand-pull inflation. This is in line with the available theories on inflation such as demand-pull theory and the monetarists' views.

Table 7: Short Run Analysis Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(*fpi*(-1))	0.2164	0.1291	1.6761	0.1101
D*fpr*)	-1.3360***	0.4278	-3.1230	0.0056
D(*fpr*(-1))	-1.2943**	0.4590	-2.8204	0.0109
D(*exch*)	0.2719**	0.1028	2.6449	0.0160
D(*exch*(-1))	0.3555**	0.1346	2.6422	0.0161
D(*int*)	-0.3054	0.3580	-0.8530	0.4043
D(*M2*)	0.0005	0.0032	0.1442	0.8869
D(*m2*(-1))	-0.0051*	0.0028	-1.8093	0.0863
D(*oil*)	1.3361***	0.1485	8.9989	0.0000
D(*rainfall*)	-0.0005	0.0004	-1.2056	0.2428
CointEq(-1)	-0.9193***	0.2091	-4.3970	0.0003

Source: Authors' Computation, (2019).*, **, * represents significant at 10%, 5% and 1% respectively**

Table 8: Long Run Analysis Result

Independent Variable	Coefficient	t-Statistic	Prob.
Fpr	0.2893	1.0481	0.3077
Exch	-0.3797***	3.9404	0.0009
Int	-0.3322	-0.8770	0.3915
m2	0.0063***	9.3104	0.0000
Oil	0.5938***	4.7561	0.0001
Rainfall	0.0006	0.9922	0.3336
Constant	72.8701***	3.1035	0.0058

Source: Authors' Computation, (2019).*, **, * represents significant at 10%, 5% and 1% respectively**

4.3 Post estimation Diagnoses

Table 9 presents the result of the post estimation analyses. Linearity of the ARDL model estimated was assessed using the Ramsey RESET test and the result (given the probability level which was greater than 5 percent) confirmed the linearity of the estimated model implying that the model was well specified. The varying degree of the variance of error term across the changing value of regressors (heteroscedasticity) is a violation of the basic OLS assumption and this portends danger for econometric models. Therefore, the ARCH-LM test was used to test for the presence of heteroscedasticity in the estimated model. Given the probability level which was more than the acceptable level of 5 percent, the null hypothesis of "no heteroscedasticity" could not be rejected. It was therefore concluded that the estimated model was homoscedastic. The normality of the distribution of the model residuals was examined with Jaque-Berra test and the results showed that the residuals were normally distributed. Finally, serial correlation test was conducted on the model estimated and the Breusch-Godfrey test confirmed the absence of autocorrelation of the residuals (Table 9). The favourable outcomes of the post-estimation diagnoses tests revealed that the estimated model was free from fundamental econometric problems.

Table 9: Post Estimation Diagnoses Results

Econometric Problem	Test Procedure	Statistics (Probability)	Conclusion
Heteroscedasticity	ARCH-LM	0.3901 (0.4001)	No heteroscedasticity in the model
Normality	Jarque-Bera	1.8150 (0.2309)	Residuals are Normally Distributed
Autocorrelation	Breusch-Godfrey LM	51.03 (0.1906)	The is no autocorrelation in the model
Linearity Test	Ramsey Reset	0.051 (0.5491)	The model is well specified

Note: Figures in parenthesis are probability values
Source: Authors' computation, 2019

5.0 Summary and Conclusion

The study assessed key macroeconomic variables affecting food price inflation in Nigeria. Relevant data covering the period from 1980 to 2018 were obtained from World Bank and the CBN. Statistical properties of the study series were assessed and this included the descriptive statistics, graphical illustrations and stationarity tests. Only food price inflation and rainfall were not normally distributed while exchange rate money supply and rainfall were negatively skewed. In terms of kurtosis, analyses revealed that food price inflation, interest rate and rainfall were mesokurtic while others were platykurtic. The graphical analyses indicated that majority of the series showed upward trends over time while the correlation analyses showed moderate correlation among the study variables which did not raise any econometric concern for the model estimated. Food production index, exchange rate and money supply were the significant macroeconomic variables affecting food price inflation in Nigeria in the short run while exchange rate, money supply and crude oil prices were significant in the long run. Post estimation test involving the test of linearity, heteroscedasticity, autocorrelation and normality of distribution of residuals confirmed the validity of the models estimated. Measures aimed at ensuring increased food production such as provision of loan through guided increase in money supply, monitoring of agricultural loan utilization and effective protection of the Naira against excessive depreciation are recommended.

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