Invited paper presented at the 6th African Conference of Agricultural Economists, September 23-26, 2019, Abuja, Nigeria

Determinants of inflation volatility in Nigeria, 1980-2010

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Abstract
The study analyzed the determinants of inflation volatility in Nigeria from 1980 to 2010 using the Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) approach. Variables for which data from secondary sources (Central Bank of Nigeria, National Bureau of Statistics, Food and Agriculture Organization etc.) were collected include annual inflation, government expenditure, exchange rate, GDP etc. Findings from the analysis shows that variables such as past inflation, Gross Domestic Product (GDP), government expenditure, government debt stock, import, export and exchange rates were found to favour inflation volatility within the study period. On the other hand, previous years' unemployment and interest rate were found to significantly reduce inflation volatility in Nigeria. In view of the foregoing results, the study recommends the need for effective harmonization of fiscal and monetary policies in order to maintain price stability; investment in agricultural research in order to provide farmers access to improved technologies and the need to strengthen current – based market regime.
Keywords: Inflation, Inflation volatility, GARCH, ARCH, Determinant.

I. Introduction

Lack of price stability exerts harmful effects on the economy not only through changes in the price level uncertainty. High volatility of inflation over time raises such price level uncertainty (Rother, 2004). According to Shesadri (2012) empirical regularities underline the fact that inflation volatility in developing countries is substantially higher than the developed countries. Moreover, existing studies on inflation volatility are done typically for the advanced countries and very few are available which critically analyze the same for the developing countries.

Inflation is undeniably one of the most leading and dynamic macroeconomic issues confronting almost all economies of the world especially in the African region. Its dynamism has made it the most imperative issue to be considered (Olatunji, et al., 2010). Among the harmful effects of food inflation, the negative consequences of inflation volatility are of particular concern. High variability of inflation over time makes expectation over the future price level more uncertain. In a world with nominal contracts this induces risk premia for long term arrangements, raises cost for hedging against inflation risk and leads to unanticipated distribution of wealth. Thus, inflation volatility can impede growth even if inflation on average remains restrained (Phillip, 2012). In addition, Nicholas (2015) in his work on inflation volatility and economic growth also opined that inflation volatility could reduce economic growth by reducing economic efficiency.

Inflation raises prices of farm inputs as well as farm products resulting in uncertain effects on the current net incomes of farmers. Therefore, input price inflation creates cash flow problem for farmers and increases the necessity for high level of operational management and conservative financial strategies. Several factors have been identified to enhance or retard growth in the agricultural sectors. These factors include education, infrastructure and inflation. Inflation and unemployment are issues that are central to the social and economic life of every country. Aminu and Anono (2012) in their study on the relationship between inflation and unemployment, refer to inflation and unemployment as constituting a vicious circle that explains the endemic nature of poverty in developing countries. Economic theories indicate many factors that influence inflation, yet it is complicated to figure out and distinguish the causes of inflation in reality. Therefore, it is crucial to study in depth and breadth about the determinants of inflation so that an effective policy can be designed to curb inflation (Chankreusna, 2017).

In Africa, inflation is the major problem faced by countries like Tanzania, Zimbabwe, Nigeria, and most importantly, Ghana. In the Zimbabwean economy, inflationary periods are highly characterized by nominal monetary growth (money supply), foreign prices, exchange and interest rates, unit labour costs and real income (Chibber et al, 1991). Inflation in Egypt is primarily affected by the rate of growth of money supply, interest rate, depreciation of the exchange rate and trade deficit (Helmy, 2010). In the West African sub-region, inflation has been one of the macroeconomic concerns, in the Nigerian economy, inflation has been one of the macroeconomic issues surrounding policy making on how to control its occurrence. It can also be said that inflation in the Nigerian economy is characterized by increase in money supply, huge government spending (budget deficits), external shocks, growth in domestic credit (bank credits), among other fiscal policies.

Several empirical studies over the years have factored out the determinants of inflation volatility. These studies largely focused on factors like currency depreciation, changes in consumer price index (CPI), producer price index (PPI), external shock in the world commodity market, input cost of production, among other factors, as core determinants of inflation volatility. However, these

factors are not the only macroeconomic determinants of inflation volatility in the world and probably Nigeria. There are several other factors which might characterize inflationary conditions in Nigeria. These other macro factors which will be considered in this study include unemployment rate, government expenditure, Gross Domestic Product (GDP), export, import, money supply among others. Apart from the few studies that provide evidential reports on the analysis of inflation volatility determinants, Rother (2004) finds that fiscal policies importantly affect inflation volatility, and that the discretionary fiscal policies' volatility itself has positive impact on inflation volatility. Browdler and Malik (2005) reveal that inflation volatility is reduced through openness. Also, Asien and Veiga (2008) explain how inflation volatility highly responds to intense degree of political factors, such as political fragmentation and instability (Ismail and Oluwasegun, 2017).

The main purpose of this study is to analyze the determinants of inflation volatility in Nigeria from 1980-2010 using the ARCH and GARCH approach. The study covering a total of 31 years investigates the contribution of unemployment, government expenditure, GDP, exchange rate, interest rate, import, export, government debt stock and money supply to inflation volatility in Nigeria within the period studied. The choice of this period is because it marks the sharp decline in agricultural contribution to Gross Domestic Products (GDP) of the nation due to the oil boom of the 1970s. Therefore, agricultural commodity prices assumed a rising trend during this period in parallel with increases in the rate of inflation.

II. Literature Review

There are many theories of inflation, namely, demand – pull, cost – push, structural, monetary and imported inflations. The demand – pull paradigm suggests that inflation occurs when aggregate demands for goods and services is greater than the aggregate supply and such that, the resultant excess cannot be satisfied by running down the existing stocks, diverting supply from the export market to the domestic market, increasing import or postponing demand (Olatunji, *et al.,* 2010). According to Chankreusna (2017) demand pull theory is concerned with aggregate demand as the determinant of inflation. Aggregate demand includes consumption, investment and government expenditure. If aggregate demand is higher than aggregate supply, it generates output gap which fuels inflationary pressure

The cost – push school attributes inflation to a host of non – monetary supply – oriented influences of shock that raise cost and consequently price. Cost push theory occurs when labor union puts pressure on employers to increase wage. Consequently, labor becomes more expensive, so does the cost of production (Chankreusna ,2017). In recent time, this school of thought has attributed inflation to some random monetary shocks such as crop failure, commodity shortages and increase in the price of oil (Onwioduokit, 2002). Jhingan (2010) also noted that cost – push inflation is caused by wage increases enforced by employers. The Structuralists have propounded a theory of explaining the relationship between inflation and agricultural production; they agree that inflation is caused by lack of balance between supply and demand in different sectors of the economy.

Onwioduokit (2002) also added that the Structuralists explain the long – run inflationary trend in developing countries in terms of structural rigidities, market imperfections, hoarding, import sub-station, industrialization and political instabilities. The reasoning of the Structuralists starts from a premise of a total sectoral incompressibility of prices, so that any upward price pressure would result in rise in the general price level.

Monetarists opined that inflation is always and everywhere hence, prices tend to rise when the rate of increase in money supply is greater than the rate of increase in real output of goods and services (Olatunji, *et al.,* 2010). The controversy over causes of inflation has generated vast empirical literatures in Nigeria and abroad. A number of studies have identified structural factors as important in Nigerian inflation. For example, Ojo (1985) carried out a study to ascertain the relative contribution of monetary and structural factors to the pace, rate and dimension of inflation in Nigeria. The results show that export instability, foreign exchange scarcity and agricultural bottleneck are important factors in Nigerian inflation. Similarly, Asogu (1991), in his study, discovered increases in real domestic products, or supply situation, especially food and low cost of production of consumables tend to ameliorate inflation. Also, in their study, Afolabi and Efunwoye (1995) obtained a result which showed that structural rigidities such as foreign exchange constraints and inadequate food supply are indeed relevant in the process of inflation in Nigeria. In another finding, Olatunji *et al.,* (2010) noted that inflation is usually the result of the interplay of many factors. In most developing countries like Nigeria, poor and inadequate tax programme makes government unable to generate enough revenue; hence, the pursuance of the policy of financing the government expenditure by creation of money becomes inevitable (Onwioduokit, 2002). More recently, the drought that hit most part of the world has created a supply crisis, aggravating the upward trend in agricultural commodity prices. On the demand side, a huge jump in energy prices and rising environmental and political concerns force many countries to seek alternative sources. The high inflation rate has become not only a concern in the industry and emerging market economies, but to the general economies of the world (Olatunji,*et al.,* 2010).

In statistical terms, volatility is usually referred to as variance and it is a measure of the dispersion of a random variable from its mean value. Thus, inflation volatility relates to the fluctuation or instability in a chosen measure of inflation (Omotosho and Doguwa, 2013). Literatures suggest that volatile inflation creates uncertainty in the economy. Often, inflation volatility is treated synonymously with inflation uncertainty (Shesadri, 2012). Lucas (1973) argued that increased inflation uncertainty accentuates firm's real responses to observed price variation and worsens the trade-off between output and inflation. According to Friedman (1977), inflation volatility leaves the economy in a less efficient state by adding friction in the markets. It produces a wedge between prices prevailing in the economy and those which would have been determined solely by market forces in the absence of inflation volatility. Moreover, if nominal rigidities are in place, volatile inflation can generate greater uncertainty about the relative price of final goods and input costs. This leads to allocation of resources and finally impairs the economic growth (Shesadri, 2012).

Internationally, the evidence for ARCH effects in inflation series is mixed, but there is strong evidence that countries with high inflation have significantly high levels of volatility on average and such volatilities ultimately impacts on growth negatively (Omotosho and Doguwa, 2013). The GARCH model and its extension have been recognized lately in analyzing volatility of financial time series. The limited studies that embrace GARCH models are based only on the analysis of headline inflation to determine its effect on other macroeconomic variables, while others only check for symmetric headline inflation volatility, neglecting the two sides asymmetric responses (Ismail and Oluwasegun, 2017). Apergis (2004) employed GARCH model with panel data to reveal the positive relationship between inflation, output growth and volatility. Arize and Malindretos (2000), on the other hand used the ARCH model to establish that inflation volatility imparts short run and long run negative effect on real money while Ismail and Oluwasegun (2017) modeled inflation rate volatility with structural breaks in Nigeria using GARCH-Type models. Omotosho and Doguwa (2013) also applied the GARCH model in understanding the dynamics of inflation volatility in Nigeria.

III. Theoretical Framework

One of the fundamental hypotheses of the classical regression model is the homoskedasticity or the hypothesis of constant error variance: $Var\ (e_t) = \sigma^2\ (e_t\ )$, where t $e_t \sim N\ (0,\sigma^2\ )$. The opposite case is known as Heteroskedasticity. In the case of financial time series it is unlikely that the variance of the errors will be constant over time and hence it is preferred to consider a model that does not assume constant variance and which can describe how the variance of the errors evolves. As we mentioned earlier another important feature of financial series is known as volatility clustering or volatility pooling. This characteristic shows that the current level of volatility tends to be positively correlated with its level during the immediately preceding periods. Using the ARCH model (Engle, 1982) represents one of the modalities through which a phenomenon of this nature can be parameterized. In order to understand how this model works, a definition of the conditional variance of a random variable e_t is necessary. Thus, the conditional variance of e_t, denoted σ_t^2 has the following form:

$$\sigma_t^2 = Var\left(\frac{e_t}{e_{t-1}, e_{t-2,\dots}}\right) = \frac{E}{\overline{[(e_t - E(e_t))^2}}{e_{t-1}, e_{t-2,\dots}} \quad (1)$$

Since $E(e_t) = 0$, equation (1) becomes

$$\sigma_t^2 = Var\left(\frac{e_t}{e_{t-1}, e_{t-2,\dots}}\right) = E[\frac{e_t^2}{e_{t-1}, e_{t-2,\dots}}] \quad (2)$$

Equation (2) states that the conditional variance of a zero mean normally distributed random variable e_t is equal to the conditional expected value of the square of e_t. In the case of the ARCH model, the autocorrelation in volatility is modeled by:

$$e_t^2 = \alpha_0 + \alpha_1 . e_{t-1}^2 \quad (3)$$

The above model is known as ARCH (1) and it shows that the conditional variance of the error term σ_t^2 depends on the immediately previous value of the squared error. Equation (3) represents only a part of the model, since nothing has been specified about the conditional mean.

A natural extension of the ARCH (*q*) model is the GARCH model. The GARCH model has been developed independently by Bollerslev (1986). This model allows the conditional variance to be dependent upon previous own lags, so that the simplest equation form of the conditional variance is:

$$\sigma^2 = \alpha_0 + \alpha_1 + e_{t-1}^2 + \beta . \sigma_{t-1}^2 \quad (4)$$

This is a GARCH (1, 1) model and the conditional variance can be interpreted as a weighted function of a long term average value (dependent on α_0), of the information related to the volatility during the previous period ($\alpha_1 . e_{t-1}^2$) and of the variance during the previous period ($\beta . e_{t-1}^2$). The general form of the GARCH (*q, p*) model, where the conditional variance depends on q lags of the squared error and *p* lags of the conditional variance is:

$$e_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i . e_{t-1}^2 + \sum_{j=1}^{p} \beta_j . \sigma_{t-j}^2 \quad (5)$$

In academic literature a GARCH (1, 1) model is considered to be sufficient in capturing the evolution of the volatility. A GARCH (1, 1) model is equivalent to an ARCH (2) model and a GARCH (*q, p*) model is equivalent to an ARCH ($q + p$) model (Gujarati, 2004). The unconditional variance of the error term t e is constant and given by the following equation:

$$Var\,(e_t) = \frac{\alpha_0}{1-(\alpha_1+\beta)} \quad (6)$$

As long as $\alpha_1 + \beta < 1$. For $\alpha_1 + \beta \geq 1$, the unconditional variance of the error e_t is not defined (non-stationarity in variance), and $\alpha_1 + \beta = 1$ represents Integrated GARCH or IGARCH (unit root in variance) (Prdescu and Stancu, 2010).

IV. Method and Empirical Model

This research made use of secondary data which were obtained from Central Bank of Nigeria (CBN) Publications and Annual Reports, National Bureau of Statistics (NBS), Federal Ministry of Agriculture and Water Resources, Food and Agriculture Organization (FAO), World Bank and International Monetary Fund (IMF). Variables for which data were obtained include annual inflation rates, interest rate, government expenditure, exchange rate, unemployment rate, government debt stock, GDP, money supply, total import and total export. Data for all variables cover a period of 31 years (1980 – 2010). The choice of this period is because it marks the sharp

decline in agricultural contribution to Gross Domestic Products (GDP) of the nation due to the oil boom of the 1970s. Therefore, agricultural commodity prices assumed a rising trend during this period in parallel with increases in the rate of inflation.

Inferential statistics was employed in order to achieve the objective of this study. Inferential statistics such as Augmented Dickey Fuller test (ADF) 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. Furthermore, the Autoregressive Conditional Heteroskedasticity (ARCH) and the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) test were employed to analyze the objective of the study and test for the degree of inflation volatility in Nigeria.

The ARCH model is a symmetric model introduced by Engel (1982) to estimate the time-varying volatility of a series by expressing the conditional variance of the prediction error term as a function of the recent past values of the square error as follows:

$$\sigma_t^2 = c_0 + \sum_{i=1}^{q} \alpha_i \ \varepsilon_{t-1}^2 \quad (7)$$

Such that $c_0 \geq 0$ and $\alpha_t \geq 0$ for *i = 0, 1, 2, 3…,q.* σ_t^2 denotes the conditional variance at time t, c_1 is a constant, α_i are the parameters of the ARCH terms of order *q* and ε_{t-1}^2 represent the lagged values of the squared prediction error for *i = 1, 2, 3,..., q.* In order to provide solution to the problem of how many lags of the squared innovations should be included in the ARCH model, Bollerslev (1986) introduced a generalized version of the ARCH model known as GARCH, by modeling the conditional variance as a function of its own lagged values as well as the lagged values of the squared innovations as follows:

$$\sigma_t^2 = c_0 + \alpha\varepsilon_{t-1}^2 + \beta\sigma_{t-1}^2 \quad (8)$$

Whereσ_t^2 , c_0, α and ε_{t-1}^2 are as previously defined in equation (7), β is the GARCH coefficient and σ_{t-1}^2 represents the one period lag of the fitted variance from the model. To guarantee a well defined GARCH (1, 1) model, it is required that $\alpha \geq 0$ and$\beta \geq 0$, while $\alpha + \beta < 1$ suffices for covariance stationarity.

Model Specification

The models specified for the analysis of the determinants are given below:

Conditional Variance /Volatility Equation

$$\sigma^2_t = \Theta_1 + \lambda_1 \epsilon^2_{t-1} + \lambda_2 \sigma^2_{t-1} + \lambda_3 INF_{t-1} + \lambda_4 MS_{t-2} \quad (9)$$

Mean Equation

$$INF_t = \alpha_o+\alpha_1 INF_{t-1}+\alpha_2 EX_{t-1}+\alpha_3 GEX_{t-1}+\alpha_4 IMP_{t-1}+\alpha_5 DS_{t-1}+\alpha_6 MS_{t-1}+\alpha_7 INR_{t-1}+\alpha_8 EXR_{t-1}+\alpha_9 UNEM_{t-1} +e_t \quad (10)$$

Where
INF = Inflation rate (%)
EX = Annual export (N)
GEX = Annual government expenditure (N)
IMP = Annual import (N)
DS = Annual debt stock (N)
MS= Annual money supply (N)
INR=Interest rate (N)
EXR= Exchange rate (N=$1)
U= Unemployment rate (%)
α_o and Θ_1 = Constants
α_1,.., α_9 = Coefficients
Θ_1 = Constants
λ_1, λ_2, λ_3 and λ_4 = ARCH and GARCH coefficients
σ^2_t = Conditional Variance
ε^2_{t-1} = ARCH term
σ^2_{t-1} = GARCH term
e = Error term

IV. Results and Discussion

Unit Root Test for all Variables

Due to the time series nature of data for this study, there was need to test for the presence of unit roots. This is because series with unit roots could give spurious results. Therefore, Table 1 gives the unit test results for inflation, import (IMP), export (EXP), debt stock (DST), money supply (MS), interest rate (INR), exchange rate (EXR), government expenditure (GEX) and unemployment rate (UNEM). The result of the Augmented Dickey Fuller test indicates that all the series were found to become stationary at differencing. This implies that all the variables contain non-stationary time trend or unit roots which necessitated the application of the Error Correction Model.

Table 1: Unit Root Tests for All Variables

Variables	ADF		Critical Value (5%)	
	Level	1st Difference	Level	1st Difference
Inflation	-3.0847	-5.2735*	3.5731	-1.9535
IMP	10.0048	-6.3908*	-2.9665	-2.9705
EXP	2.8813	-2.6319*	-2.9665	-1.9535
DST	-2.6412	-3.5747*	-2.9665	-2.9705
MS	2.6691	-3.1118*	-2.9665	-2.9750
INR	-2.3525	-5.2816*	-2.9665	-2.9705
EXP	0.0089	-3.3191*	-2.9665	-2.9705
GEX	0.5980	-2.7684*	-2.9665	-1.9535
UNEM	-0.3025	-4.0912*	-2.9665	-2.9705

Source: Field Survey 2018. * indicates significance at 5% level. IMP=Import; EXP=Export; DST=Debt stock; MS=Money supply; INR=Interest rate; EXT=Exchange rate; GEX=Government expenditure; UNEM=Unemployment rate.

ARCH Analysis for Determinants of Inflation Volatility in Nigeria.

The result of the Autoregressive Conditional Heteroskedasticity (ARCH) given in Table 2 reveals that a unit increase in previous year's Gross Domestic Product (GDP) will significantly increase inflation by 5.3E-07. This may be as a result of the fact that as GDP increases more money is available for budgeting, thereby leading to increase in money supply. The result also shows that interest rate (INTR) significantly affect INF at 1 % level of significance. This means that a unit increase in interest rate will result in 4.4E-16decrease in inflation. This implies that, the higher the interest rate, the less the inflation rate due to less amount of money in circulation because investors are not encouraged to borrow from financial institutions. This finding is in line with results obtained by Olatunji *et al.,* (2010). Also, a unit increase in exchange rate increases inflation by 7.8E-16 at 1 % significant level as shown by the Table 2. This is because whenever the dollar appreciates against the naira, more amount of money in naira is required to purchase the same quantity of goods which was once purchased with a less amount of money in naira. This result agrees with that obtained by Olatunji *et al., (*2010) and Omotosho and Doguwa (2013).

Annual import was also found to significantly affect inflation positively, that is, a unit increase in annual import (IMP) increases inflation by 2.3084 units as obtained by Olatunji *et al.,* (2010). This result may be due to the imported inflation, that is, the price rise in industrial countries spread to almost every country with which they have trade relations. In the same vein, export (EXP), though not significant, but has a negative relationship with inflation. A unit increase in EXP will reduce

inflation rate by 1.5E-05, which implies that increase in demands for domestically produced goods in foreign countries, which thus, raises the earnings of industries producing export commodities, expanding their production capacity, thereby reducing prices. This finding agrees with the result of Olatunji *et al.,* (2010). The result also revealed that a unit increase in Government expenditure (GEX) will increase inflation by 1.0E-06 which corresponds with findings by Nwachukwu *et al.,* (2014). This could be due to much money in circulation as a result of higher funds released for government projects. The result also revealed that two years lag of money supply (MS_{t-2}) has a significant positive relationship with current inflation. This implies that, a unit increase in money supply in the last two years will increase current inflation by 1720.7 units. This is in line with findings by Moser (1995) and Omotosho and Doguwa (2013) which confirms the demand-pull theory of inflation that the more money in circulation, the higher the demand for goods and services, therefore, the higher the prices paid by consumers for such commodities. Results obtained from this research also indicated that a unit increase in government's debt stock (DS) results in 1.4E-05 increase in the rate of inflation, though not significant. This result signifies that the more the amount of money borrowed by the government for developmental projects, the more money is available for spending which is capable of forcing up prices.

Furthermore, the lag of unemployment ($UNEM_{t-4}$) significantly affects inflation at 5% probability level. This implies that a unit increase in unemployment rate in the past four years leads to 0.3245 decrease in the current rate of inflation. This is expected because the more the number of unemployed people, the less the money available for spending. This result also agrees with results obtained by Aminu and Anono (2010).

In testing for inflation volatility in Nigeria, the volatility equation result reveals that the lag of inflation has significant positive effect on inflation volatility in the current year at 1% level of significance. The result shows that a unit increase in inflation rate in the previous year, will lead to 8.8044 increase in current inflation volatility rate. The finding also indicates that lag of interest rate (INR_{t-3}) has significant negative effect on inflation volatility in the current year. Government expenditure in the past two years was found to have a positive relationship with inflation volatility, though not significant. Three years lag of export significantly increases inflation volatility by 5.0132 units. A unit increase in the coefficient of last year's government debt stock will lead to 2.5553 increase in inflation volatility. Also, a unit increase in money supply in the past two years significantly increases inflation volatility by 0.0005 units. Furthermore, two years lag of GDP affects inflation volatility positively, although, not significant. This implies that, a unit increase in past two years GDP will result in 4.9E-06 increase in inflation volatility.

The lags of unemployment rate both at the last two and four years ($UNEM_{t-2}$ and $UNEM_{t-4}$) were both significant in affecting inflation volatility in the current year at 1% and 10% probability levels respectively. The result shows that a unit increase in unemployment in the past two years reduces inflation volatility by 26.1150. On the contrary, a unit increase in unemployment in the past four

years increases inflation volatility by 8.3349. The coefficients of ARCH (1) and GARCH (1) are statistically significant at 1 % significant level. This implies that the coefficients are statistically different from zero; therefore, the null hypothesis of no volatility is rejected. The sum of the ARCH (1) and GARCH (1) term is -0.0763, which indicates low volatility clustering among the series. The Durbin-Watson statistics of 1.8022 indicates that ARCH model provides a good fit for the determinant of inflation in Nigeria. The Coefficient of Determination (R^2) shows that the independent variables explain 93.3 % of the movement in the dependent variable.

Table 2: Arch Analysis for Determinants of Inflation in Nigeria

	Coefficient	**Std. Error**	**z-statistics**	**Probability**
GDP_{t-1}	3.5E-06	5.3E-07	1.9589	0.0501
INTR	-4.4E-16	3.5E-07	-4.7E-09	1.0000
EXR	7.8E-16	7.1E-06	14129	1.0000
IMP	2.3084	1.3167	1.7532	0.0796
EXP	-1.5E-05	2.5E-05	-0.5979	0.5499
GEX	1.0E-06	3.4E-05	0.0567	0.9547
MS_{t-2}	1720.7	679.56	2.5319	0.0113
DS	1.4E-05	2.6E-05	0.5397	0.5894
$UNEM_{t-4}$	-0.3245	0.1519	-2.1351	0.0328
INF	1.0000	1.8E-05	55117	0.0000
		Volatility Equation		
C	351.64	105.48	3.3337	0.0009
α-ARCH (1)	-1.1027	0.3250	-3.3927	0.0007
β- GARCH (1)	1.0264	0.2080	4.9341	0.0000
INF_{t-1}	8.8044	2.8423	3.0976	0.0020
INR_{t-3}	-9.5103	3.5605	-2.6711	0.0076
GEX_{t-2}	4.6E-05	6.3E-07	0.0637	0.9492
EXP_{t-3}	5.0132	11784	4.3E-05	1.0000
DS_{t-1}	2.5553	15458	1.7E-05	1.0000
MS_{t-2}	0.0005	2.5E+08	2.2E-12	1.0000
GDP_{t-2}	4.9E-06	0.0006	-0.0086	0.9931
$UNEM_{t-2}$	-26.1150	9.1056	-2.8680	0.0041
$UNEM_{t-4}$	8.3349	4.4929	1.8551	0.0636
α + β	-0.0763	-	-	-
R-squared		0.9330	Mean dependent var.	21.433
Adjusted R-square		0.8870	S. D. dependent var.	18.975
S.E. of regression		18.458	Akaike Inf. Criterion	8.2923
Sum squared residual		5791.7	Schwarz criterion	8.7723
Log likelihood		-101.95	Durbin-Watson stat	1.8022

Source: Data Analysis, 2018.

V. Conclusion and Recommendations

Findings for inflation determinants shows that one year's past value of GDP, interest rate, exchange rate, annual import, money supply in the past two years and unemployment in the past four years all have significant effects on current inflation rate. On the other hand, annual export rate, government expenditure and government debt stock had no significant effect on current inflation rate. Also, the ARCH and GARCH test for inflation volatility indicates that inflation is weakly volatile in Nigeria within the research period. The result also indicates that past inflation, government debt, government expenditure, GDP, export and import were all found to increase inflation volatility. On the other hand, past unemployment rate and interest rate were found to reduce inflation volatility within the period under study.

In view of the foregoing findings, the study recommends the following:

1. There should be effective harmony between fiscal and monetary policies in order to maintain price stability in the country.
2. The need for new fiscal measures and strategies in the massive creation of jobs and income generation especially in the agricultural sector.
3. Improvement in resource and development investment in agricultural research in order to provide farmers with access to improved technologies, thereby, boosting production.
4. The need to strengthen current market – based interest regime

References

Afolabi, A. J. & Efunwoye, B. 1995. Causes of high inflation in Nigeria. *NDIC Quarterly report,*5: 14 – 31.

Asien, A. & Veiga, F. J. 2008. Political instability and inflation volatility. *Public Choice,* 135(3): 207-223

Aminu, U. & Anono, A. Z. 2012. An empirical analysis of the relationship between unemployment and inflation in Nigeria: 1977 – 2009. *Economic and Financial Review* Vol. 1 (12) 42 – 61.

Apergis, N. 2004. Inflation, output growth, volatility and causality: Evidence from panel data and the G7 countries. *Economic Letters*, Elsevier Publications., 83(2): 185-191.

Apergis, N. & Rezitis, A. 2002. Mean spillover effects in agricultural prices: Evidence from changes in policy regime. Paper presented at the fifty-third *International Atlantic Economic Conference, Paris, France*. 69 – 72.

Arize, A.C., & Melindetros, J. 2000. Does inflation variability affect the demand for money in China? Evidence from Error Correction Models. *International Economics,* 14(1): 47-60.

Asogu, J. O. 1991. An Econometric analysis of the nature and causes of inflation in Nigeria. *Economic Financial Review*; 2 (9): 138 – 155.

Bollerslev, T. 1986. Generalized Autoregressive Conditional Heteroskedasticity. *Journal of Econometrics*, 31:307-326.

Bowdler, C. & Malik, A. 2005. Openness and inflation volatility: cross country evidence. *CSAE Working Paper Series,* Centre for the Study of African Economies, University of Oxford. *http:www.nuffield.ox.ac.uk/economics/papers/2005/w14/Maydraft2pdf*

Chankreusna, I. 2017. Determinants of inflation in Cambodia. *Research paper*, Graduate School of Public Policy, University of Tokyo, Japan. 1-5

Chibber A, and Shaffik N 1991. *The Inflationary Consequences of Devaluation and Parallel Market: The Case of Ghana*. World Bank, Washington D.C.

Engel, R. 1982. Autoregressive Conditional Heteroskedasticity with estimates of the variance of United Kingdom Inflation. *Econometrica*, 50(1): 987 - 1007

Friedman, M., 1977. Discussion of 'The Monetarists Controversy. Federal Reserve Bank of San Francisco Economic Review Spring, 3(1, Suppl.), 12-26.

Gujarati, R.N. (2004). Basic Econometrics, Mc Graw-Hill, New York, pp. 856-867.

Helmy, H. E. 2010. Inflation Dynamics in Egypt: Does Egypt's Trade Deficit Play a Role? Middle Eastern Finance and Economics. *Euro Journals Publishing, Inc.* 2010.

Ismail, O. F. & Oluwasegun, B. A. 2017. Modeling inflation rate volatility in Nigeria with structural breaks. *CBN Journal of Applied Statistics*, 8(1): 177-178.

Jhingan, M. L. 2010. Principles of Economics (3rd Edition). Vrinda Publications (p) Ltd. 499-500.

Lucas, R.R. 1973. Some International Evidence of output-inflation trade off. *America Economic Review*, 63: 326-334.

Moser, G.G. 1995. The main determinants of inflation in Nigeria. *IMF Staff Papers, 42* (2): 270-280.

Nicholas, E. B. 2015. Inflation volatility and economic growth: A disaggregated analysis. *Research Paper*, Duke University, Durham, North Carolina. 5-9.

Nwachukwu, P. O., Dibie, A. C. & Ogudo, A. P. 2014. Effectiveness of Monetary Policy in Reducing Inflation in Nigeria: 1970-2013. *Journal of Economics and Sustainable Development*, 5(13): 73 – 77.

Ojo, O. 1982. "Causes of Inflation in Nigeria": Comments in Awosika, K. & Onitiri, H. M., Inflation in Nigeria, *Proceedings from Nigerian Institute of Social and Economic Research National Conference*, University of Ibadan Conference Center, Ibadan, Pp56 – 164.

Olatunji, G. B., Omotesho, O. A., Ayinde, O. E. & Ayinde, K. 2010. Determination of inflation in Nigeria: A co-integration approach. Paper presented at the 3rd*African Association of Agricultural Economists (AAAE),* Cape Town, South Africa, Pp. 1 – 5.

Onwioduokit, E. A. 2002. Fiscal deficit and inflation in Nigeria: An empirical investigation of causal relationships. *CBN Economic and Financial Review,* (37)2: 1 – 1.

Omotosho, B.S. & Doguwa, S.I. 2013. Understanding the dynamics of inflation volatility in Nigeria: A GARCH perspective. *CBN Journal of Applied Statistics*, 3 (2): 51-58.

Predescu, M.O. & Stancu, S. 2010. Portfolio Risk Analysis using ARCH and GARCH Models in the Context of the Global Financial Crisis. *Theoretical and Applied Economics,* 18 (555): 75 – 88.

Rother, P.C. 2004. Fiscal policy and inflation volatility. *European Central Bank Working Paper Series,* 317: 4 – 9.

Shesadri, B. 2012. Inflation volatility of advanced and developing economies: A new Keynesian perspective. *Research Paper*, Finance and Business, Durham Business School, University of Durham, Pp2-4.