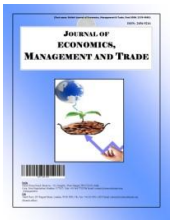

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Inflation Dynamics in Nigeria

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Authors' contributions

This work was carried out in collaboration among all authors. Author OIA designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NCCU and NOJ managed the analyses of the study. Author NOJ managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Inflation remains a central issue to policy makers and analysts. High inflation induces uncertainty, adversely affects financial sector development and it is the goal of monetary authorities to achieve price stability in consonance with the general consensus that price stability aids growth of the economy. Despite the goal of single-digit inflation rate by monetary authority (CBN), the Nigerian economy is still practically characterized by high cost of living, increased variability of relative prices of goods and services; therefore the reliability of the monetary aggregates as the main signal for the conduct of monetary policy for control of inflation has become increasingly questionable. Against this backdrop, this research examined the determinants of dynamics of inflation in Nigeria over a period of 36 years (1982-2016); using New Keynesian Philips Curve theoretical framework, Ordinary Least Square estimation techniques (OLS), ARDL bounds testing approach to cointegration and Vector Autoregressive (VAR) econometric techniques to ascertain if inflation is only a monetary phenomenon in Nigeria having inflation as dependent variable and exchange rate (Ex), interest rate (Ir), Unemployment (U), Real Gross Domestic Product (RGDP) as independent variable. The result of the estimation shows that inflation is not only a monetary phenomenon by the statistical significance of EX and RGDP at short and long-run, U and IR at long-run. Therefore, it was thus

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recommended that exchange rate and inflation targeting monetary policy framework that will revalue the naira should be implemented to reduce inflation while expansionary fiscal policy that will increase RGDP is also recommended for reduction of inflation.

Keywords: Inflation; exchange rate; unemployment and real gross domestic product.

ABBREVIATIONS

ARDL : Autoregressive Distributed Lag
CRR : Cash Reserve Requirement
CNB : Central Bank of Nigeria
CPI : Consumer Price Index
ECM : Error Correction Mechanism
ECT : Error Correction Term
EX : Exchange Rate
INF : Inflation
IR : Interest rate
LR : Liquidity Ratio
NBS : National Bureau of Statistics
OLS : Ordinary Least Square
QTM : Quantity Theory of Money
RGDP : Real Gross Domestic Product
U : Unemployment
VAR : Vector Auto regression

1. INTRODUCTION

Inflation remains a central issue to policy makers and analysts. Its importance is premised on the distortions that high inflation rate can exert on domestic macroeconomic conditions with the potential to derail the economy from the path of sustainable economic growth and development. For a developing economy like Nigeria, which is characterized by significant structural imbalances and uncertainties, an insight into the dynamics of inflation is very pertinent and specifying the major determining factors to the changes in the level of prices over time cannot be overemphasized.

Anyanwu [1] opined that Nigeria started to experience high inflationary trend as a result of government policies to stimulate a fast rate of economic growth or labor productivity and development. In spite of this, continued depreciation of the Naira has continued to aggravate the inflationary situation in the country. The sole dependency of import whose cost has risen as a result of devaluation of Nigerian domestic currency has encouraged local scarcity and high price of goods and services thereby negating the country's policy to achieve economic stability specifically price stability.

The objective of economic stabilization inclusively price control led the researcher to the specification of the statement of problem for this study in other to properly guide the researcher to producing a consistent and unbiased result that will be of importance to policy makers and other relevant agencies in Nigerian economy. Therefore the study examined the dynamics of inflation in Nigeria with a view of establishing determinant factors that can cause inflation dynamics or changes which will help in price stabilization.

1.1 Statement of Problem

The inflationary forces that led to the collapse of the Bretton Woods system in the 1960s and 1970s greatly refocused the monetary policy from its primary function of providing finance for government, stabilizing the financial system to the stabilization of price and currency. Therefore the Central Bank of Nigeria (CBN) 2007 Act requires the bank to achieve monetary and price stability objective in consonance with the general consensus that price stability (low and stable inflation) aids growth of the economy. Prior to this mandate, the Central Bank of Nigeria in 2014 campaigned for a single-digit inflation rate between six percent (6%) and nine percent (9%). But despite the reflection of single-digit goal achieved in 2014 (9.3 percent) inflation rate via monetary policy, inflation still remains a major threat to the Nigerian economy thereby causing high cost of living, increased variability of relative prices of goods and services.

Friedman and Schwartz [2] argued that "inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output".

Extensive research to address inflationary problem in Nigeria by investigating its main determinants were conducted with varying results, depending on the methodology applied and objectives set to achieve, among others. Mordi et al. [3], in their study on the dynamics of inflation used autoregressive integrated moving

average (ARIMA), popularly known as the Box-Jenkins methodology considering consumer price index as a measure of inflation. Gujarati and Dawn [4] stated that the concept of autoregressive integrated moving average is a theoretic model because they are not derived from any economic theory [5,6]. Thus, this study added to the body of empirical literature by varying on the methodology adopted by Mordi et al. [3], thereby used the New Keynesian Philips Curve framework, Autoregressive Distributed Lag (ARDL) and Vector Autoregressive (VAR) methodology to determine inflation dynamics model for inflation control in Nigeria covering a scope of 1982 to 2018.

1.2 Objectives of the Study

The broad objective of this study is to examine inflation in Nigeria with the view of ascertaining its determinants, while the specific objectives of this study are:

1. To examine the relationship of inflation dynamics and its determinant in Nigeria.
2. To examine if inflation is only a monetary process in Nigeria.

1.3 Significance of the Study

This study has been considered significant in the following ways.

1. The findings of this research will help Federal Government of Nigeria and its agencies to formulate policy for control of inflation.
2. This study will be relevant for researchers who intend to have an empirical base for other research works needed to be embarked upon in Nigeria and the world in general.

2. LITERATURE REVIEW

In this section, viewpoint of eminent scholars and researchers was reviewed and the analytical literature framework organized under the following sub-headings:

2.1 Theoretical Literature Review

The theoretical review of this study focused on the determinants of dynamics of inflation in a given economy in both short-run and long-run analysis with economic theories that will effectively put into consideration the economic criteria of a good research.

2.1.1 Conceptual framework

Inflation has been defined as a situation of persistent rise in the rate of change of the general price level. The mechanisms or processes of inflation are quite diverse. The process of inflation has therefore been explained differently to reflect the various sources of price change.

Dynamics in economics means changes in economic system over time. Therefore inflation dynamics are interpreted as resulting from an anchoring of inflation determining factor or expectations as a result of better monetary policy. Monetary policy is the process by which monetary authority of a country controls supply of money often targeting inflation or interest rate to ensure price stability, while fiscal policy is the use of government revenue collection and expenditure to influence the economy (CBN 2014).

2.1.2 Review of basic theories

In recent times, there have been three dominant schools of thought on the causes of inflation; the neo-classical or monetarist, neo-Keynesian and structuralist.

(a) The Quantity Theory of Money

The monetarist, following from the Quantity Theory of Money (QTM), have propounded that the quantity of money is the main determinant of the price level, or the value of money, such that any change in the quantity of money produces an exactly direct and proportionate change in the price level. The QTM is traceable to Irving Fisher's famous equation of exchange:

$$MV = PQ \quad (1)$$

where M stands for the stock of money; V for the velocity of circulation of money; Q is the volume of transactions which take place within the given period; while P stands for the general price level in the economy. Transforming the equation by substituting Y (total amount of goods and services exchanged for money) for Q, the equation of exchange becomes:

$$MV = PY \quad (2)$$

The introduction of Y provides the linkage between the monetary and the real side of the economy. In this framework, however, P, V and

Y are endogenously determined within the system. The variable M is the policy variable, which is exogenously determined by the monetary authorities. Nevertheless, the model's general weakness is found in its inadequacy to explain general price movement. The truism of direct proportion between change in the quantity of money and change in the price level cannot be accepted in today's world (as there are other factors involved such as infrastructural and structural factors).

(b) The Phillips Curve

Two major goals of interest to economic policy makers are low inflation and low unemployment, but quite often, these goals conflict. The adoption of monetary and/or fiscal policy moves the economy along the short-run aggregate supply curve to a point of higher output and a higher price level. As higher output is recorded, this is followed by lower unemployment, as firms need more workers when they produce more and vice-versa. This trade-off between inflation and unemployment is described as the Phillips curve. This was an empirical discovery by Phillips [7], which showed an inverse relationship between wage and unemployment rates, using United Kingdom data plotted over the period 1862-1957. The discovery is strengthened by the fact that movement in the money wages could be explained by the level and changes of unemployment.

A major criticism of the Phillips curve is that it does not take into account the interactions in the underlying or structural behavior of consumers and firms in the economy, but rather captures empirical regularities between unemployment and inflation rates based purely on correlations in historical data.

2.1.3 Review of other related theoretical issues

Other related theories reviewed to further explain the determinants of inflation are state as follows:

(a) Keynesian Theory

The Keynesians opposed the monetarists' view of a direct and proportional relationship between the quantity of money and prices. According to this school, the relationship between changes in the quantity of money and prices is non-proportional and is indirect, through the rate of interest. The strength of the Keynesian theory is its integration of monetary theory and value theory on the one hand and the theory of output and employment through the rate of interest on the other hand. Thus, when the quantity of money increase, the rate of interest falls, leading to an increase in the volume of investment and aggregate demand, thereby raising output and employment. In other words, the Keynesians see a link between the real and monetary sectors of the economy an economic phenomenon that describes equilibrium in the goods and money market (IS-LM). Several weaknesses of the Keynesian postulation have been documented. For instance, Keynesians assume prices as fixed, so that the effect of money appears in terms of quantity of goods traded rather than their average prices. Keynesians also assume that monetary changes are largely absorbed by changes in the demand for money. They fail to appreciate the true nature of money and assume that money could be exchanged for bonds only. However, it is known that money can be exchanged for many different types of assets like, securities, physical assets, human wealth, etc.

(b) New Keynesian Philips Curve

The economists no longer use the Phillips curve in its original form because it was shown to be too simplistic. This can be seen in a cursory analysis of US inflation and unemployment data from 1953–92. There is no single curve that will fit the data [8]. Modified forms of the Phillips Curve that take inflationary expectations into account remain influential. The theory goes under several names, with some variation in its details, but all modern versions distinguish between short-run and long-run effects on unemployment. This is because in the short run, there is generally an inverse relationship between inflation and the unemployment rate; as illustrated in the downward sloping short-run Phillips curve. In the long run, that relationship breaks down and the economy eventually returns to the natural rate of unemployment regardless of the inflation rate. The "short-run Phillips curve" is also called the "expectations-augmented Phillips curve", since it shifts up when inflationary expectations rises.

The New Keynesians Philips Curve recognizes the fact that most economic decisions are made under conditions of uncertainty. However, given their preoccupation with the dynamics of growth and long-run considerations, it is logical to expect that they cannot successfully, abstract from the reality of uncertainties surrounding dynamic analysis.

(c) Monetary policy framework and implementation in Nigeria

Since inception, CBN has used two monetary policy frameworks for the implementation of monetary policy namely: exchange rate targeting and monetary targeting. Exchange rate targeting framework was used between 1959 and 1973 while monetary targeting has been in use from 1974 to date. The shift to monetary targeting was largely informed by the collapse of the Breton Woods system of fixed exchange rates in 1974 and change in strategy to demand management as a means of containing inflationary pressures and balance of payments imbalances.

2.2 Empirical Literature Review

A review of the empirical literature on inflation in industrialized emerging market and developing economies is the focus of the researcher which will help to reveal the dominant theoretical underpinning for assessing the dynamics of inflation and the methodology for forecasting its future trajectory.

Asogu [9] focused on the econometric investigation of the nature and causes of inflation in Nigeria. The study found that increase in real GDP or supply situation, especially food, and low cost of production of consumables tended to ameliorate inflation. He added that increase in government expenditures – deficits financing, tend to increase the money supply and worsen the depreciation of the exchange rate, which in turns intensify the inflationary pressure. The author noted that the monetary model does not adequately explain the inflation process in Nigeria.

Khan and Schimmelpfennig [10] examined the relative importance of monetary factors and structuralist supply-side factors for inflation in Pakistan. Their study showed that monetary factors were the main drivers of inflation, while "wheat support price" affects inflation in the short-run. Using monthly data from 1998 to June 2005, a monetary perspective was considered by specifying a stylized inflation model that include monetary variables such as money supply, credit to private sector, the exchange rate, as well the "wheat support price" as a supply-side factor. A vector- error correction model (VECM) was estimated in growth rates as well as in log levels. The choice of sample periods reflected a trade-off between having sufficient observations and avoiding structural breaks that would complicate the empirical analysis. The findings indicated that monetary factors played a dominant role in recent inflation, affecting inflation with a lag of about one year and increases in the wheat support price influence inflation in the short-run. The conclusion of the study was that wheat support price mattered for inflation over the medium term only if accommodated by monetary policy. The study confirmed that a long-run relationship existed between the CPI and private sector credit.

Odusanya and Atanda [11] critically analyzed the dynamic and simultaneous interrelationship between inflation and its determinants in Nigeria between 1970 and 2007. The time series variables properties were examined using the Augmented Dickey Fuller (ADF) unit root test and the result reveals that inflation rate, growth rate of real output and money supply, and real share of Fiscal deficit are stationary at levels, while other incorporated variables in the empirical analysis- real share of Import, Exchange rate and Interest rate-are stationary at first difference. The long-run and short-run mechanism of interaction between inflation and its determinants were examined using the Augmented Engle-Granger (AEG) cointegration test and Error Correction Mechanism (ECM) model respectively.

Moses and Tule [12] examined the key relationship between money supply, inflation and underpinning the conduct of monetary policy in Nigeria. The motivation for the study is derived from the perceived weakening relationship between money supply and inflation in recent times. The methodology was a Vector Auto regressive (VAR) model. Three variants of OLS - ordinary least square, fully modify OLS, and dynamic OLS – techniques were used in estimating the data. Results from these estimates showed that the coefficients of money supply were positive and significant at 1, 5, and 10 per cent, respectively in the inflation equation for the full sample period, suggesting that money supply bears a long run positive relationship with inflation. Based on the coefficient stability results obtained from the Chow test, the entire sample was divided into two sub samples with the first one covering the period 1982 q1 to 1996 q4 while the second sub sample covered the period 1996 q1 to 2012 q4. The equation was re-estimated for the two sub-samples. The coefficient of money supply was significant in the first sub sample but insignificant in the second sub sample, buttressing the point made earlier in

their trend analysis that the relationship between inflation and money supply might have weakened in recent years. Overall, the study confirms the existence of some relationship between growth in monetary aggregates and inflation, but this relationship has weakened in recent years. The diminishing strength of the relationship between money and prices could be explained in part by recent developments in the Nigerian Financial System including new products and assets classes which may affect demand for money.

Amassoma et al. [13], empirically investigated the influence of money supply on inflation in Nigeria. The study was borne out of the curiosity to reexamine the immediate cause of the alarming rate of inflation in Nigeria which is adversely affecting the general welfare of Nigerian populace. Design/ methodology/ approach – The study employed co-integration test and error correction approach on annual time series data spanning from 1970 to 2016 to ascertain both the long run and short run dynamics relationship among the variables under consideration. Findings – The results showed that money supply does not considerably influence inflation both in the long and short run possibly because the country is in recession. The error correction model has the correct sign of negative and it is significant meaning that about 21% of the errors are corrected yearly. The Granger causality outcome demonstrates that, there is no causality between money supply and inflation in Nigeria within the study period and vice-versa. Research implications/limitations – The implication of this is often that there are different economic conditions which are key determinant of inflation in Nigeria. The study recommends that the government should diversify the economy, minimize importation by encouraging local production of products and services.

2.3 Justification of the Study

Quite a number of theoretical and empirical literatures have been reviewed but it was observed that issues in relation to inflation dynamics or determinant remains unsettled in the literature so that any new attempt to address them is likely to be an added knowledge to old arguments. This is true of inflation in Nigeria. The literature abounds on the causes, consequences and remedies of inflation in Nigeria. Despite this, the problem has continued to be here. Yet to undertake another study in this area requires justification. Inflation itself is a highly dynamic process, which means that the process of inflation within the last 10 years may not be the same as it was perhaps 25-30 years ago. This study departs from previous studies via change in methodology by employing Perron [14] to determine the break points/dates as well as further investigate the properties of the time series data employed. The structural breaks test becomes necessary, especially following the introduction of Structural Adjustment Program (SAP) in 1986 and the Wholesale Dutch Auction System (WDAS) in 2006 and the occurrence of the 2007/2009 global financial crisis. The consideration of effect of expected rate of inflation in inflation policy control is still a contribution to knowledge by using Autoregressive Distributed Lag and New Keynesian Philip Curve framework in other to identify if inflation is only a monetary process in Nigeria.

3. RESEARCH METHODOLOGY

This chapter deals with the methods and procedures adopted in the conduct and advancement of the study. They include theoretical framework, model specification, estimation technique and procedure.

3.1 Theoretical Framework

The New Keynesian Philips Curve (NKPC) methodology has been widely used in the empirical literature to depict relationship between inflation, inflation expectations and the real marginal cost of production. It indicates that the rate of inflation will increase when real marginal costs increase and there are expectations for higher prices by economic agents in the future. Calvo [15] described the basic NKPC in the standard form as:

$$\pi_t = \beta E_t \pi_{t+1} + K(y_t - y_t^*) \quad (3)$$

Where yt represent actual output, $yt*$ is the potential output.

3.2 Model Specification

In line with the work of Cevik and Teksoz [16], we used the past values of inflation and monetary aggregates as a proxy for inflation expectations, as agents tend to formulate inflation expectations in a backward-looking manner. The hybrid model of consumer price inflation can now be formulated as follows:

$$\pi_t = \alpha\pi_{t+1} + \beta m_{t-1}\gamma(y_t - y_t^*) + \varphi ex + \xi u + \mu_t \quad (4)$$

Where ex is the official exchange rate as a control variable that also represents monetary policy and u is unemployment rate. For the necessity of uniformed scale of measurement and consistent interpretation of results, all variables were transformed to the natural logarithms. The log transformation of all the variables allows us to interpret the coefficients as elasticities.

3.2.1 Economic apriori expectation

This refers to the supposed relationship between the dependent and independent variables of the model as determined by the postulations of economic theory. The result or parameter estimates of the models will be interpreted on the basis of the supposed signs of the parameters as established by economic theory. Put differently, the parameter estimates of the model will be checked to find out whether they conform to the postulations of economic theory or not.

Table 1. Summary of the apriori expectation

Regressand	Relationship	Regressors
INF	+	EX
INF	+ OR -	IR
INF	+ OR-	RGDP
INF	-	U

4. RESULTS AND DISCUSSION

4.1 Data Presentation

The data set used in analyzing this research work is shown in appendix I. However, a graphical trend of the variables used in the model is presented below:

Graphical Presentation of Data used in the Analysis

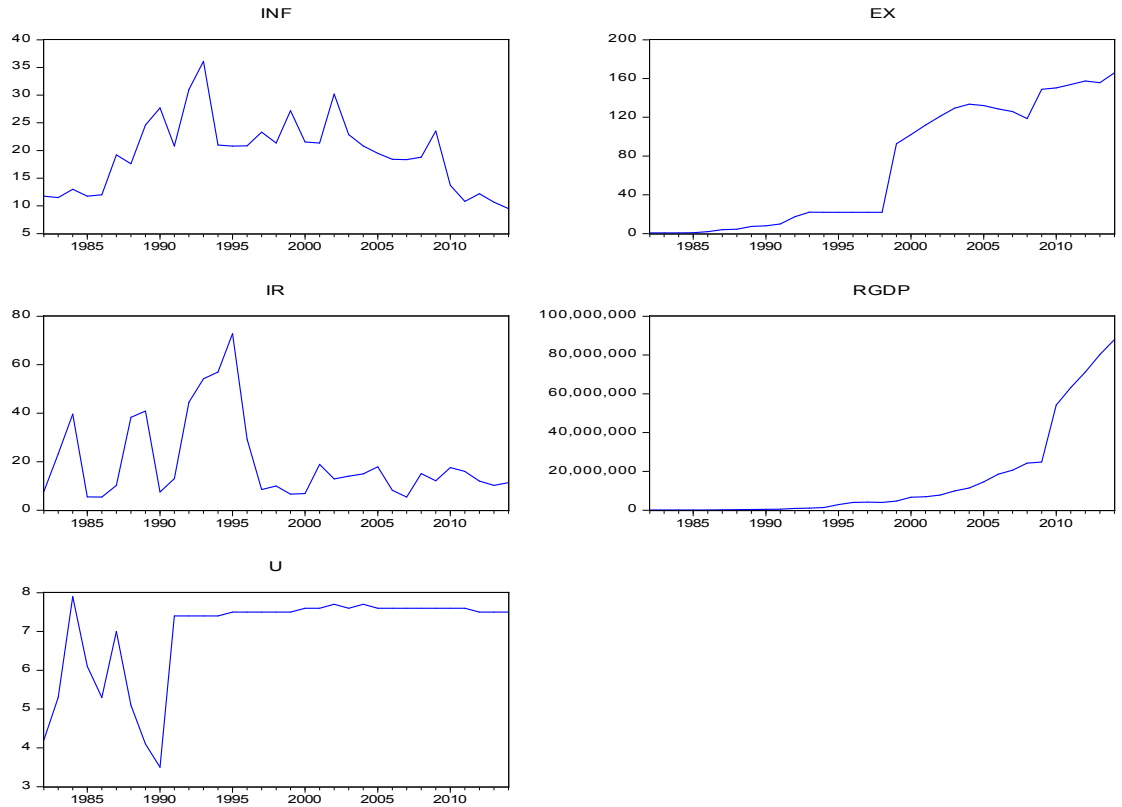

Fig. 1. Graphical Presentation of Data
Source: Researcher Plot 2018

Fig. 1 provides a glimpse to the data set used for the research analysis. The above graphical representation depicts wide variations in the data particularly interest rate and inflation rate that are very volatile. But real gross domestic product and exchange rate are upward trending, while unemployment rate is very unstable. Generally, the above fluctuations in the data set may be attributed to policy summersaults that characterized different administration in Nigeria over time.

4.1.1 Preliminary analysis

The empirical section will begin by analyzing the summary statistics of all the variables in order to determine their inter relationships. The summary statistics is presented in Table 2.

Table 2 shows the summary of descriptive statistics of the variables included in the model. It shows the existence of wide variations in the variables as depicted by the mean values during the study period. For instance, INF, EX, IR, RGDP and U were 19.50667%, 70.17232%, 20.23667%, 16001091% and 6.954545% respectively with RGDP and EX having the highest mean values during the study period. This is a clear indication that exchange rate and real gross domestic product are among the major determining factors of inflationary trend in Nigeria.

4.2 Data Analysis

The goal of the study is to examine the inflation dynamics determinants and its impact both at short term and long run in Nigeria, which makes the analysis more comprehensive. In recognition of this, the study begins by examining the time series properties of the variables.

4.2.1 Time series properties of the variables

Econometric studies have shown that most financial and macro-economic time series variables are non-stationary and using non-stationary variables leads to spurious regression (Engel & Granger, 1987). Thus, the variables were investigated for their stochastic properties, using two traditional and one modern unit roots tests. The traditional tests deployed are the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP). The two tests were used to test for consistency and where conflicts exist, to decide on the most appropriate option [17]. The results are shown in Table 3.

The result of the PP unit root test suggests that all the variables were non-stationary with the exception of U that was stationary at level. They however became stationary after the first difference was taken. Also, the result of the ADF unit root test suggests that all the variables were non-stationary with the exception of RGDP and U that was stationary at level. They however became stationary after the first difference was taken.

However, traditional tests for unit-roots (e.g. ADF and PP) have low power in the presence of structural breaks, and have a tendency to "detect" non-stationarity which does not exist in the data. It is crucial to have knowledge of break point because accurately evaluating any programme intended to engender structural changes [18]. To avoid invalid inferences, the study employ unit root test with structural break by Perron [14] to determine the break points/dates as well as to further investigate the properties of the time series employed. The author provides the framework for the implementation of the general structure of the structural break with unit root [14,19]. The generalized test regression can be expressed as:

$$y_t = \mu + \theta DU_t + \beta_t + \gamma DT_t^* + \delta D(T_1)_t + \alpha y_{t-1} + \sum_{i=1}^{k} c_i \Delta y_{t-1} + e_t; e_t \square iid.(0, \sigma_e^2) \quad (5)$$

Where $DU_t = 1; DT_t^* = t - T_1 = t - T_1$ if $t > T_1$ and 0 otherwise. The T_1 represents the significant break point. The test considered is the minimal value of the t-statistic for testing that $\alpha = 1$ versus the alternative hypothesis that $|\alpha| < 1$ over all possible break dates in some pre-specified range for the break fraction $(\varepsilon, 1-\varepsilon)$. The implementation of the test regression follows the Innovational Outlier (IO) framework as it allows the change to the new trend function to be gradual rather than being instantaneous as assumed by the Additive Outlier (AO) framework. The results of unit root tests are presented in Table 4.

In Table 4, the null hypothesis of a unit root is accepted for M2 (in the innovational outlier model). The null hypothesis of a unit root is

Table 2. Summary statistics results

	INF	EX	IR	RGDP	U
Mean	19.50667	70.17232	20.23667	16001091	6.954545
Std. Dev.	6.533533	63.88376	17.18319	25233941	1.207552
Skewness	0.402048	0.174763	1.518684	1.791316	-1.719938
Kurtosis	2.787220	1.240864	4.410111	4.850221	4.512811
Jarque-Bera	0.951290	4.423002	15.41927	22.35553	19.41684
Probability	0.621484	0.109536	0.000448	0.000014	0.000061
Observations	33	33	33	33	33

Source: Researcher Computation, 2018

Table 3. Traditional unit root test results (Trend and Intercept)

Variables	PP	Critical values	Order of integration	ADF	Critical values	Order of integration
EX	-5.306	-4.285*	I(1)	-5.306	-4.285*	I(1)
INF	-9.824	-4.285*	I(1)	-6.804	-4.297*	I(1)
IR	-9.217	-4.285*	I(1)	-5.216	-4.285*	I(1)
RGDP	-5.227	-4.285*	I(1)	4.961	-4.323*	I(0)
U	-3.882	-3.558**	I(0)	-29.819	-4.394*	I(0)

*NB: * Indicates stationary at the 1% level and ** stationary at 5% level*
Source: Researcher Computation, 2018

Table 4. Unit root tests with a structural break

	Innovational outlier model			Additive outlier model		
Variable	t-statistics	Break date	Lag	t-statistics	Break date	Lag
INF	-16.88215*	1985	0	-5.805667*	1989	0
EX	-7.084329*	1998	1	-1.862468	1999	0
IR	-5.591662**	1995	1	-6.398135*	1994	1
RGDP	-1.116794	2008	0	-4.988462*	2001	8
U	-55.12500*	2011	8	-38.81953*	2000	8
∆INF	-12.35765*	1987	0	-12.29993*	1987	0
∆EX	-10.58956**	1999	0	-7.638544**	1997	8
∆IR	-6.249826*	1996	1	-6.564003**	1995	1
∆RGDP	-15.15812**	2010	0	-5.240846**	2000	8
∆U	-6.179480*	1994	0	-13.12462*	2001	8

*Note: *, ** and *** denote significant at the 1, 5 and 10 percent level.*
Source: Researcher's Computation Using E-views 9.5

accepted for two variables (TLF and REXR) (in the additive outlier model). In first difference however, all the series tend to be stationary. The results confirm previous studies [20] that in the presence of structural break, the standard ADF test or PP tests are biased towards acceptance of the null hypothesis of unit root in the data. Ben-David, Lumsdaine, and Papell [21] argue that not allowing for multiple structural breaks can cause acceptance of the unit root null by tests which incorporate only one break. In general the results from multiple structural breaks clearly contradict those obtained from unit root tests without breaks. Both the IO and AO approach reveals that all the variables have quite diverse structural breaks that depend on key policy changes. The results reveal that majority of the variables have unit root at level but found to be stationary at 1st difference in the presence of various structural breaks.

The purpose of testing for the stationarity properties of the variables in bounds approach to cointegration is because the (ARDL) bounds testing approach becomes applicable only in the presence of I(1) and I(0) variables or a mixture of both. This means that the assumption of bounds testing will collapse in the presence of I(2) variable.

4.2.2 Lag order selection criteria

The lag order selection criteria were adopted to obtain optimal lag length for the model. All information criteria suggested a lag of one except the Log likelihood criteria (See Table 5).

Table 5. Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-993.0460	NA	6.34e+21	64.39006	64.62135	64.46546
1	-887.7397	169.8489*	3.65e+19*	59.20901*	60.59674*	59.66138*
2	-862.7936	32.18844	4.20e+19	59.21249	61.75666	60.04183

Source: E-views Output. Note: LR is the modified LR test statistic; FPE is the Final Predictor Error; AIC is Akaike Information Criterion; SC is the Schwarz Information Criterion; HQ is the Hannan-Quinn Criterion

Therefore, a lag length of one (1) was used in building the short-run model.

4.2.3 Co-integration test

To determine the appropriate lag order of the differenced variables in the model, the study choose Akaike Information Criterion (AIC) which is a framework within the Vector Autoregressive (VAR) structure.Thereafter, the ADRL-bounds testing approach was used to determine whether a long-run co-integration relationship exists between inflation and its dynamic determinants in Nigeria. Haven chosen the optimal lag length, the long-run equilibrium condition for the models was built. The different order of integration of the variables necessitates the choice of the ARDL-Bounds testing approach to co-integration which is suitable for testing long-run relationship among variables that are of mixed order of integration. The result of the co-integration test is presented in Table 6.

Table 6. ARDL bounds test for co-integration relationship

Null Hypothesis: No Long-run relationships exist		
Test statistic	**Value**	**K**
F-Statistic	2.399078	4
Critical value bounds		
Significance	**Lower bound**	**Upper bound**
10%	2.2	3.09

Source: Researcher's Computation Using E-views 9.5

From Table 6, the F-statistics is greater than the lowerbound critical value at 10%. Hence the null hypothesis of no co-integration is rejected and long-run co-integration relationship is established among the variables in this study period. It can therefore be inferred that the variables are co-integrated.

4.2.4 Estimated error correction and long-run models

In view of the cointregration relationship between the dependent variable and the regressors, we proceed to estimate the error correction and long-run models. The results of the estimations are presented in Table 7.

Result of Error Correction Model is given in Table 7. The coefficient of error correction is significant at 1 percent with correct negative sign. The coefficient of ECM is (-0.62) which shows high speed of adjustment from short run fluctuations to long run equilibrium (62% discrepancy is corrected each year) approximately 62 percent of disequilibrium from the previous year's shock convergence back to the long run equilibrium in the current year. This is a further indication of the existence of long-run relationship between the dependent variable and the regressors. Bannerjee, Dolado and Mestre [22] asserted that a highly significant lagged error correction terms further prove the existence of long-run relationship between the variables. Shahbaz, Lean and Kalim, [23] corroborated this view when they opined that the existence of negative and significant ECM in the model connotes that a change in the dependent variable depends on changes in both the dependent variables and level of disequilibrium in the cointegration relationship.

Currency depreciation is observed to be positively related to inflation at the 5% significance level in the short-run. This implies that a one percent increase in exchange rate will lead to an increase in inflation rate by 9.3 percent. Similarly, the long run effect of currency depreciation on inflation is also positive and in conformity with theoretical prediction.

Interest rate is observed to be positively related to inflation both in the short-run and in the long-run though the relationships are not statistically significant. This means that one percent increase in IR will cause 0.28 and 0.19 percent increase in inflation rate both in the short and long run. This indicated that inflation in Nigeria is a monetary phenomenon consistent with the traditional quantity theory of money, and can be moderated through the adoption of sufficiently tight monetary policy actions overtime.

Table 7. Results of estimation of error correction and long-run models

Dependent Variable is LOG(INF)			
Cointegrating Form (ECM)			
Variable	**Coefficient**	**t-Statisitc**	**Prob**
DLOG(EX)	9.264394**	4.112976	0.0005
DLOG(IR)	0.275085	0.271768	0.7883
DLOG(RGDP)	-8.472253**	-2.890778	0.0085
DLOG(U)	-0.390648	-0.093407	0.9264
ECT(-1)	-0.627809	-6.326469	0.0000
Long-run Coefficients			
LOG(EX)	0.508208*	5.372803	0.0000
LOG(IR)	0.196002	1.885555	0.0726
LOG(RGDP)	-0.416302**	-4.918156	0.0001
LOG(U)	0.019837	0.052277	0.9588
C	6.919547	6.239489	0.0000

R^2 = 0.79, Adj. R^2 = 0.71, F. Statistic = 9.36, and DW = 1.8
*Note: *, ** and *** represent 1%, 5% and 10% level of significance respectively.*
Source: Researcher Computation, 2018

The results of short run coefficient show that change in RGDP, shows a negative significant relationship with inflationary process in the short run and in the long run. By implication, GDP growth has not been an important contributor to inflation process in Nigeria. This implies that a percentage increase in real gross domestic product will lead to a decrease in inflation rate by -8.5% in the short run and -0.42% in the long run.

The coefficient of unemployment rate shows a negative relationship with inflation in the short-run. This implies that a percentage increase in unemployment rate will lead decrease in inflation rate 0.39% in the short run. This indirect relationship between inflation rate and unemployment rate is in line with the Phillips [10] postulation of inverse relationship between inflation and unemployment. However, the long run effect of unemployment rate on inflationary process in Nigeria is positive and not in conformity with theoretical prediction invariably there is no trade off in long run Philips Curve.

Further examination of the estimated result in Table 7 above shows that the overall fit is satisfactory at the value of R^2 = 0.79. This shows that the independent variables used in our model jointly accounted for 79 percent of the total variation and 79 percent explanatory power in inflation dynamics in Nigeria during the study period. All the variables are correctly signed except U that is directly related to inflation rate in Nigeria.

The estimated short run result in Table 7 shows that at 5% level of significance the variables collectively influence the variation of inflation rate as show by the F-statistic (9.36), and F. Prob (0.0001). Additionally, it can be observed that the Durbin-Watson statistic (from Table 9) is greater that the R- squared value. This is a sign that the model is a non-spurious regression.

Durbin – Watson Statistic indicates whether there is serial correlation in the model. If there is serial correlation in the model it therefore implies that the model has lost its predictive power. Durbin – Watson Statistic is given as 1.843741and this suggests that the model is free of autocorrelation. Consequently, the estimated model can be confidently relied upon for making inferences and for prediction purposes.

The analysis is complemented by an examination of impulse responses and variance decomposition from a VAR model. As stated by De and Neogi [24], VAR is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. The VAR approach treats every endogenous variable in the system as a function of the lagged values of all the endogenous variables in the system, thereby bypassing the need for structural modelling. The approach is, therefore used to identify leading or lagging relationships among the data.

4.2.5 Presentation and interpretation of VAR estimation results

VAR analysis is employed to reinforce the findings in the previous section.

The impulse response: The impulse response graph obtained after the VAR estimations is presented in this section as shown in Fig. 2. One of the researchers focus in this study is the responses of inflation rate to the shocks from other four variables, we therefore present only the four relevant responses shocks from exchange rate, interest rate, the growth rate of real gross domestic product (RGDP), and unemployment rate.

Fig. 2 shows that the growth rate of inflation (INF) temporarily responds positively to the growth rate of exchange rate (EX) shock in the first year as it is usually the case in real life. However, the growth rate of inflation (INF) shows a very sharp contraction showing a negative response to the shock from the growth rate of exchange rate (EX) in year 4 to year 5. Also, the growth rate of inflation (INF) responds positively to the growth rate of exchange rate (EX) shock in the in year 6 to 7 and start rising again between year 9 and 10 but at a very slow pace.

Fig. 2 shows that the growth rate of inflation (INF) temporarily responds positively to the growth rate of interest rate (IR) shock in the first year as it is usually the case in real life. However, the growth rate of inflation (INF) shows a very sharp contraction showing a negative response to the shock from the growth rate of interest rate (IR) in year 5 to year 5.5. From year 1, there is a fluctuation between positive and negative responses of the growth rate of inflation (INF) to the shocks from the growth rate of interest rate (IR) up till year 7.5 and then tapers off. This result shows the real life experience of people or nations that take interest rate. That is, there is usually a rise in the output of borrowers in the first year or in the very short run, but the problem of the interest start to show its ugly head when the borrowers start to repay the loan obtained with interest. There is no rest of mind for taker of interest based loan because there is no permanent positive or permanent negative response. They usually see the positive aspect when they are taking the loan but later discover the negative aspect after taking it. This is clearly shown by the sharp negative and positive fluctuations in the growth rate of inflation (INF) to the growth rate of interest rate (IR).

Fig. 2 also shows that the response of the growth rate of inflation rate (INF) to the shocks from the growth rate of unemployment (U) is positive from year two to three and negative from year 3.5 to 5.5 but however fluctuates between being positive and negative thereafter. Finally, Fig. 3

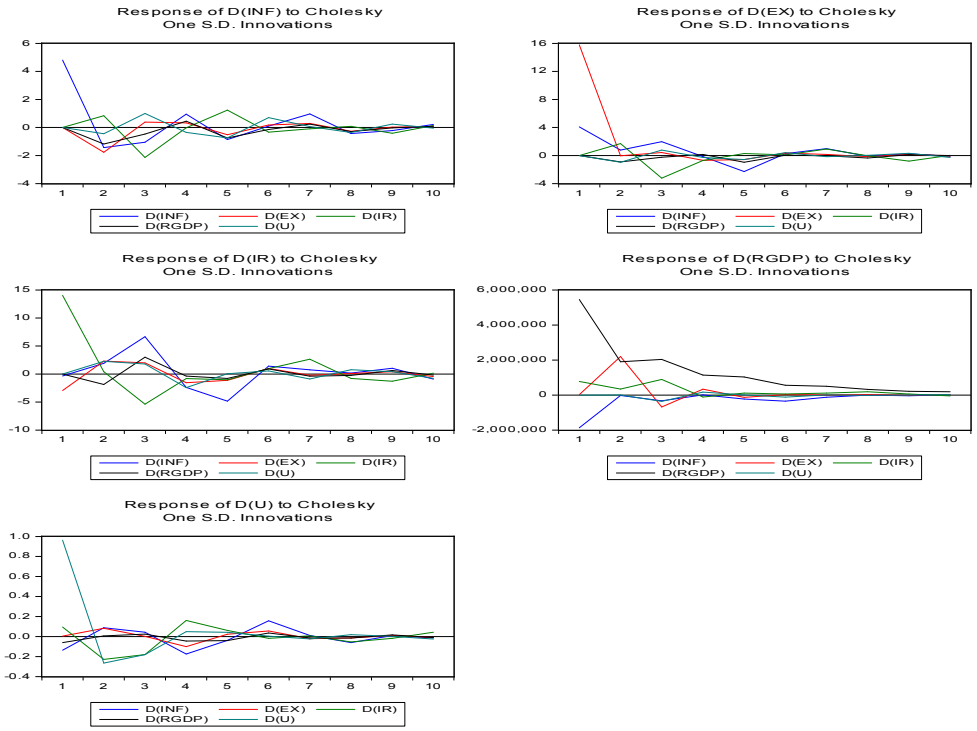

Fig. 2. Impulse response functions
Source: Researcher Computation, 2018

Table 8. Variance decomposition of INF

Period	S.E.	INF	EX	IR	RGDP	U
1	4.803186	100.0000	0.000000	0.000000	0.000000	0.000000
2	5.528080	82.23936	10.25224	2.328386	4.543513	0.636496
3	6.131861	69.77050	8.728836	14.05244	4.268099	3.180121
4	6.240330	69.68626	8.712812	13.56970	4.643962	3.387263
5	6.525885	65.47001	8.598355	15.99908	5.557944	4.374615
6	6.576666	64.48565	8.536951	16.01319	5.516073	5.448133
7	6.658959	65.00773	8.517659	15.63856	5.511129	5.324929
8	6.694715	64.72618	8.593114	15.48725	5.640356	5.553096
9	6.715662	64.43290	8.541180	15.77366	5.606691	5.645571
10	6.721671	64.42056	8.536713	15.78699	5.615131	5.640610

Source: Researcher Computation, 2018

shows a weak negative response of the growth rate inflation (INF) to the shocks from the growth rate of RGDP (RGDP) and thereafter weakly fluctuates being negative.

Variance decomposition: After impulse response the researcher used variance decomposition to examine the quantitative and magnitude effect of impulse of the variables in the model to growth rate of inflation in Nigeria by focusing on the share of variance of exchange rate (EX), interest rate (IR), real gross domestic product (RGDP), and unemployment rate (U) in the forecast variance decomposition of growth rate of inflation (INF) in Nigeria.

As shown in Table 8, in the first period, none of growth rate of exchange rate (EX), interest rate (IR), growth rate of real gross domestic product (RGDP) and growth rate of unemployment (U) accounted for the variation in the growth rate of inflation (INF). However in year 2, the growth rate of interest rate (IR) shock accounted for about 2.3% variation in the growth rate of inflation (INF). Interest rate growth rate shock explanation of variation in the growth rate of inflation (INF) drastically increased to approximately 14% each in year two and 16% in year 6. On the average therefore, interest rate shock accounts for approximately 14% variability in the growth rate of inflation (INF). Though appreciable, it is still below what Nelson & Prilleltensky [25] obtained in his study on the role of interest rates in the Brazilian business cycle where he predicted that interest rate shocks can explain about one third (i.e. 33.3%) of output fluctuations and generations in business cycle.

This result also shows that apart from the shock from the growth rate of inflation (INF) to itself, the growth rate of interest rate (IR) shock accounts for the highest variability in the growth rate of inflation (INF). This is obvious as each of the growth rate of the exchange rate (EX), growth rate of real gross domestic product (RGDP) and growth rate of unemployment (U) respectively account for an average of approximately 8%, 5% and 4% variations in the growth rate of inflation (INF).

In the long run, the shock togrowth rate of inflation (INF) to its self contributes 64.4% variation. The shocks of growth rate of exchange rate (EX), interest rate (IR), growth rate of real gross domestic product (RGDP) and growth rate of unemployment (U) accounts for 8.5%, 15.8%, 5.6% and 5.6% fluctuation in the variance of the growth rate of inflation (INF) respectively.

Measurement of Degree of Co-movement: Measurement of degree of co-movement of a growth rate of each variable with another one is done using the value of correlation coefficients. The use of correlation coefficients to measure degree of co-movement follows Agenor, Dermort and Prasad [26] and the degree of co-movement between two variables can be determined as follows:

1. If $\delta_j \succ 0$, it is pro-cyclical.
2. If $\delta_j \prec 0$, it is counter-cyclical.
3. Lastly, if $\delta_j = 0$, it is acyclical[1].

Where δ_j = the correlation coefficients and j=1, 2, 3…

Table 10 shows the correlation coefficients matrix of the growth rates of the variables under study.

From Table 9, it can be seen that the degree of co-movement between growth rate of inflation (INF) and growth rate of the exchange rate (EX)

[1] *Acyclical is also referred to as noncyclical. This is any economic quantity/variable that moves independently of the overall state of an economy.*

Table 9. Correlation analysis of the variables

	INF	EX	IR	RGDP	U
INF	1.000000				
EX	0.250552	1.000000			
IR	-0.024317	-0.204316	1.000000		
RGDP	-0.321785	-0.076557	0.137428	1.000000	
U	-0.139445	-0.031284	0.097723	0.000160	1.000000

Note: Pearson correlation coefficients are reported; Source: Computed by the Researcher

Table 10. Diagnostic checks results

Test	Null Hypothesis	T-Statistic	Prob
Jarque-Bera	There is a normal distribution	0.117	0.943
Breusch-Godfrey LM	No serial correlation	0.729	0.494
Heteroskedasticity: Breusch-Pagan-Godfrey	No conditional heteroscedasticity	1.128	0.385

Source: Researcher's Computation (2016)

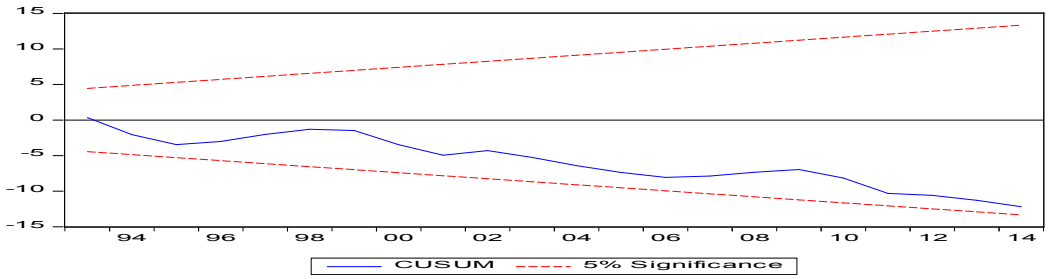

Fig. 3. Stability test
Source: E-views Output

which is 0.250552 is pro-cyclical. The degree of co-movement between growth rate of inflation (INF) and growth rate of interest rate (IR) which is -0.024317 is counter-cyclical and the degree of co-movement between growth rate of inflation (INF) and growth rate of RGDP which is -0.321785 is counter-cyclical. Also, the degree of co-movement between growth rate of unemployment (U) and growth rate of growth inflation rate (INF) which is -0.139445 is counter-cyclical.

4.2.6 Post-diagnostic result and sensitivity (or stability) analysis

The study conducted various diagnostic tests to ascertain the appropriateness and stability of the models as well as the robustness of the results. Thus, for reliability of estimates, we obtained series of residual and stability tests such as the serial correlation LM test, the heteroscedasticity test, and normality test. The test as presented in Table 10 revealed that there were no evidence of serial correlation and heteroskedasticity in the model during the study period. Also, the p-value of the normality test exceeds 0.05 during the study period implying that the residues are normally distributed.

The stability tests in Fig. 3 revealed that the model is stable and the regression equation is correctly specified as the plots of the charts lie within the critical bounds at 5% significant level.

4.4 Evaluation of Research Hypotheses

The results from the data analyzed were used to test the research hypotheses as follows:

Ho: There is no significant relationship between inflation dynamics and its determinants in Nigeria.
H1: There is significant relationship between inflation dynamics and its determinants in Nigeria.

In testing the above hypothesis which partly satisfies the objective of this study, the study adopt 5% level of significance and our conclusion would however be taken based on the probability values.

Rule:

i. If the probability (Sig) > 0.05, we accept the null hypothesis and reject the alternative hypothesis.
ii. If the probability (Sig) < 0.05, we accept the alternative hypothesis and reject the null hypothesis.

Decision:

Using Table 7 results of Error Correction and Long-run Model, the researcher found exchange rate and real GDP to be significant both at short and long run. This is shown by the p-values of, 0.0005, 0.0000 and 0.0085, 0.0001 respectively. This implies that exchange (EX) rate and real gross domestic product (RGDP) are variables that significantly determine or influence inflationary process in Nigeria within the period of study. Therefore alternative hypothesis accepted, meaning that there is a significant relationship between inflation dynamics and its determinants in Nigeria.

To further validate the decision above, the researcher used Table 6 which revealed that a long-run cointegration relationship exists between the dependent variable and explanatory variables since the F-statistics is greater than the lowerbound critical value at 10%. Hence the null hypothesis of no co-integration is rejected and long-run co-integration relationship is established among the variables in this study period. It can therefore be inferred that the variables are co-integrated and there is a significant relationship between inflation dynamics and its determinants in Nigeria.

Ho: Inflation is significantly only a monetary phenomenon.
H2: Inflation is not significantly only a monetary phenomenon.

In testing the above hypothesis, which will give answer to one of the research questions, the study adopt t-statistic test.

Rule:

i. If the absolute t-value coefficient of a variable (Sig) > 1.96, the variable possessing the coefficient is accepted as statistically significant and fit to be used for inferences and possibly for forecasting.

Decision:

Using Table 7 results of Error Correction and Long-run Model, the researcher found exchange rate and real GDP to be statistically significant. This is shown by the absolute t-value coefficients of 4.112976, 5.372803 and 2.890778, 4.918156 respectively being greater than 1.96. This implies that exchange rate (EX) which is a monetary policy variable and real gross domestic product (RGDP) a fiscal related process, are variables that significantly determine or influence inflationary process in Nigeria within the period of study. Therefore alternative hypothesis is accepted and it means that inflation is not only a monetary process thereby deviating from the Quantity Theory of Money.

5. CONCLUSIONS

High inflation induces uncertainty, adversely affects financial sector development and the vulnerable poor segment of the population; and consequently, poses serious threats to macroeconomic stability resulting to high social costs. This study examines the dynamics of inflationary process in Nigeria using the ARDL bounds testing approach to cointegration and further complemented by the examination of impulse responses and variance decomposition from a VAR model. The empirical model relates inflationary process to exchange rate, interest rate, real GDP and unemployment rate. The result reveals that the variables are co-integrated since the F-statistics is greater than the lower bound critical value at 10%. Hence the null hypothesis of no co-integration is rejected and long-run co-integration relationship is established among the variables in this study period. Further analysis reveals not all the variables were significant as shown by the p-values in influencing inflationary process in Nigeria but with the exception of exchange rate and real GDP that were found to be significant in influencing inflationary process in Nigeria. In addition, the coefficient of error correction is significant at 1 percent with correct negative sign. The coefficient of ECM is (-0.62) which shows high speed of adjustment from short run fluctuations to long run equilibrium (62% discrepancy is corrected each year) approximately 62 percent of disequilibrium from the previous year's shock convergence back to the long run equilibrium in the current year.

The study also found strong evidence of the importance of exchange rate, interest rate, unemployment and real GDP in the inflation process in Nigeria, lending evidence to the dominance of the monetarist proposition on inflation dynamics. But the statistical significant

nature of exchange rate (EX), unemployment and real gross domestic product (RGDP), shows a trace of monetary and fiscal process. By implication, both monetary and fiscal policy can contribute to inflation dynamics in Nigeria. This implies that inflation in Nigeria is not only a monetary phenomenon.

6. RECOMMENDATIONS

Based on the findings from this research, it is necessary to provide a set of policy recommendations that would be applicable to the Nigerian economy. The research therefore suggests the following policy options based on our empirical findings:

- The study recommends monetary policy framework that is on exchange rate and inflation targeting. A lower exchange rate targeting policy will help to revalue the Naira whose devaluation has raised domestic prices of import without significant impact on export. Low exchange rate will reduce inflation. This recommendation conforms to the remark made by analyst at Vetiva Capital Management following the announcement of flexible exchange rate by CBN on May 24th 2016. Vetiva Capital Management expect inflation to spike in the near term (Emeka Anaeto 2016, Forex: CBN throws Naira into open market, nullifies N197/$ exchange rate section, paragraph 3).
- Expansionary fiscal policy that will shift the labor supply curve downward (increase in labor supply) which invariably translate to downward shift in aggregate supply curve and downward pressure on price level.
- The Federal Government of Nigeria should embark on job creation policy that will reduce unemployment regarding that unemployment in Nigeria has a direct positive relationship to inflation. This means that reduction in unemployment will bring about decrease in inflation.
- Policies that will set the interest rate to single digit which will encourage investment and increase in RGDP level should be institutionalized such that the excesses produced could be exported if well monitored and which may thus lead to a reduction in inflation.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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