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Inflation Dynamics in Nigeria: Implications for Monetary Policy Response

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Abstract
This study is an investigation into the appropriate price index that the monetary authority in Nigeria should monitor to ensure stable price level. It employed univariate autoregressive model to determine the persistence of headline, food (noncore) and nonfood (core) inflation and impulse response function to determine the transmission effects between food and nonfood inflation. The results showed that headline, food and nonfood inflation are persistent but headline inflation was shown to have highest level of persistence, followed by food inflation. The fact that food inflation shows more persistence than nonfood is an indication that it transmits more shock to nonfood inflation than nonfood to food inflation. The impulse response function results showed that shocks from food inflation to nonfood are not only larger than shocks from nonfood to food but are also contemporaneous and as well have longer memory. This is an indication that food inflation is a vital component of price index in Nigeria. Therefore using headline inflation as the underlying inflation by the CBN is appropriate.
Keywords: Inflation Dynamics, univariate autoregressive, impulse response, headline inflation

1. Introduction

Over the years, the Central Bank of Nigeria (CBN) stabilization policy which hinges on the performance of monetary aggregates has been trailed by unending debate on the transmission mechanism. Blejer (1998) pointed out that, generally central banks by their statutes are meant to pursue not just a single goal but multiple macroeconomic goals, and sometimes even microeconomic goals. In Nigeria, the goals of the central bank have been to ensure the achievement of full employment equilibrium, rapid economic growth, maintaining price stability and external balance (Folawewo and Osinubi, 2006). The idea to single out price stability as a dominant macroeconomic objective is simply to avoid conflicts, and for the desire to improve the credibility of the monetary authorities in stabilizing prices (Blejer, 1998). However, despite the fact that price stability has become the central issue of monetary policy for most central banks, inflation still remains a policy challenge to both the policy makers and analysts in most developing countries (Mordi et al, 2007). In Nigeria specifically, the quest for price stability seems to have eluded the monetary authority. Evidence shows that among the emerging market economies, Nigeria has shown to have the highest inflation and exchange rates variability (Batini, 2004). This has been attributed mainly to high degree of openness, high exchange rate pass-through, fiscal dominance and volatile macroeconomic environment; all which undermined the credibility of the monetary authority. Thus, price instability still remains a challenging policy issue in Nigeria not necessarily that monetary authority does not have the potentials to effectively combat price instability but because to fight inflation, it is necessary to know its cause, and this is usually difficult. Inflation is known to be either supply or demand induced. To determine correctly whether inflation is caused either by supply shocks or the demand shocks is not an easy task because of the diverse effects of food prices on inflation. The understanding of the actual cause of inflation and hence inflation dynamics has implication for the monetary authority's response to inflation.

Most of the empirical works on inflation dynamics in Nigeria have paid closer attention to monetary policy response to changes in headline inflation despite the criticsms of monetary authority response to headline inflation. Most of these studies have tried to estimate the impact of monetary policy variables on inflation (headline inflation). For instance, the work of Asuquo (2012), Nenbee and Madume (2011), Mbutor (2014) and Tule, Obioma, Okpanachi and Olaoye (2015) among others. .

Many studies have criticized the use of the headline inflation when used as the underlying inflation trend. For instance, headline inflation is volatile because of the substantial movements in the commodity or food prices that make up its components, and this makes it difficult for policy makers to accurately judge the underlying trend (OECD, 2005). It has also been argued that measuring inflation as a monetary phenomenon has proved difficult because some non-monetary events such as sector specific shocks that produce noise in the data are included in the measurement of aggregate price and this makes it difficult for central banks to track accurately the movement in price level. These necessitated Bryan and Cecchetti (1994) to call for the removal of certain prices that have

high frequency noise components such as food and energy prices in the computation of inflation to arrive at the underlying inflation which is indispensible in monetary policy. Brian (1997) further raised two arguments for the use of core inflation instead of the headline inflation. Firstly, he argued that though ignoring the changes in food and energy prices has significant effects on the overall index, he emphasized that they are often reversed, such that they need no policy response. He argued further that changes in the energy and food prices are due to supply shocks which affect price levels but not their growth rates, therefore the major role of monetary policy which is to fight inflation should ignore this one-time changes in the price level.

The essential feature of the core inflation is that it is devoid of temporary changes inherent in the headline inflation and can accurately determine the trend of inflation which serves as useful guide to monetary policy (Armour,2006). Mishkin(2007) added that if monetary authorities react to headline inflation, they may run the risk of responding to mere temporary shock to inflation. Rich and Steindel (2007) and Šoškić(2015) further added that overreacting to these shocks by monetary authority might even lead the economy to the path of slow economic growth.

However, some also argued against the use of core inflation. It was pointed out that the use of core inflation as a guide for monetary policy only works in the developed countries. It was argued by Anand and Prasad (2010) that in both low and middle income countries and as well emerging market economies the use of core does not work. In these economies, food expenditure constitutes larger proportion of their expenditure and removing them from inflation measure will underestimate inflation trend. Apart from the fact that food prices have larger weight in the consumer price index in the developing countries, Walsh (2011) argued that they are most often found to be more persistent than the nonfood (core) inflation and shocks from food inflation are often being transmitted into the nonfood inflation. Thus, in this case it becomes inappropriate to remove food price as that will lead to misspecification of inflation. Following Anand and Prasad and Walsh, food prices will be relevant in inflation dynamics when the following conditions are met; food inflation must be more persistent than nonfood inflation and shocks to food inflation are strongly propagated into the nonfood inflation. Based on these arguments, it is evident that the removal of food and energy prices is not a matter of choice but rather statistical. In Nigeria, the monetary authority has over the years been responding to headline inflation in the monetary policy process. The question is whether the components of inflation in Nigeria possesses these characteristics as stated by Walsh (2011). If no, why does the monetary authority still monitor headline inflation instead of core inflation even when the relationship between headline inflation and monetary policy has appeared to be weak (Tule, Obioma, Okpanachi and Olaoye, 2015).

Following this, the question which this study intend to address is not whether monetary policy can be used to stabilize price level, but about the appropriate price index the monetary authority in Nigeria respond to.
In other to address the broad research question, the following specific questions will be answered;

a. Are headline, food and nonfood inflation persistent in Nigeria?
b. What is the transmission effect between food and nonfood inflation in Nigeria?

With the need for stability in the aggregate price level in Nigeria, this study intends to determine the appropriate price index that the monetary authority should respond to in addressing price instability.
In specific terms the objectives of the study are;

a. To determine the persistence of headline, food and nonfood inflation in Nigeria

b. To determine the transmission effects between food and nonfood inflation

The remaining parts of this paper are as follows: sections 2 reviews related literature, sections 3 discusses data features and methodology, section 4 analyzes the empirical results and discussions and section 5 is the conclusion.

2.0 Literature Review

Atuk and Ozmen (2009) noted that inflation can be decomposed into persistent and transitory components. The transitory component is described as volatile and hence does not matter for monetary policy because it comprises of supply shocks which are beyond the control of the monetary authorities. These are direct price effect such as the effect of drought on food prices which the monetary authority cannot control. However, the persistent components are the real inflation trend which are demand induced inflation and inflation expectation (Pedersen, 2015). These components can to a large extent be controlled by the monetary authority and can reasonable serve as guide in monetary policy making. Thus there are considerable arguments in literature and by monetary authorities on whether headline or core inflation should be the focus of monetary policy. Those that argue in

favour of core inflation believe that core inflation is more predictable than the headline inflation which contains some noise components. Ross (2012) noted that monetary policy influences price stability and the choice of the underlying inflation should be based on price index capable of furnishing the monetary authority with the best information about the trend of inflation in the medium term. Such underlying inflation should be relatively stable and should exclude volatile items. Silver (2006) argued that countries practising inflation targeting monetary policy should focus on inflation that is devoid of noise inherent in food and energy component of the consumer price index. Aoki (as cited in Stevens, 2015) emphasized that monetary policy should be concerned with that part of the price index that does not fluctuate.

Various arguments have also been put forward against the use of core inflation. For instance, Anand and Prasad (2010) argued that economies with high level of financial development should focus on core inflation in their monetary policy processes while countries with low financial development should respond to the headline inflation. This idea according them is because in the developing countries, there is low access to financial institution and hence most households spend their incomes of food and fuel. They further argued that food prices have larger weight in the consumer price index in developing countries than the industrialized ones. Hanif (2012) explained that more attention should be giving to food inflation because it takes a larger proportion of the income of the poor and hence hurt the poor more than the rich. This implies that poor countries as well should monitor the movement in headline inflation which contains the food component of inflation. Walsh (2011) noted that what determines what the monetary authority should respond to depends on the persistence of food inflation visa-vis nonfood inflation and transmission effects between food inflation nonfood inflation.

Bodenstein, Aerceg and Guerrieri (2008) used DSGE in their analysis and found that monetary policy that responds to headline inflation generate different macroeconomic effects compared to the one that responds to core inflation. The study further revealed that monetary policy that uses the core inflation as the underlying inflation performed better than the one using headline inflation as the underlying inflation

Shrestha (2006) used various statistics to compare the core and headline inflation. The descriptive statistics shows that core inflation exhibit less variability compared to the headline inflation and is more correlated with both narrow money supply and the broad money supply compared to the latter. The granger causality test conducted in the work also indicated that both narrow money and broad money granger cause some measures of core inflation but does not granger headline inflation. The work further estimated the impact of narrow money and broad money on inflation. The result showed that all types of narrow money has significant impact on all types of core inflation at 5 per cent level of significant while it has significant impact on headline inflation at 20 per cent level. The result of regressing inflation on broad money showed that broad money has significant impact on all types of core inflation but does not have significant impact on headline inflation.

Peedersen (2015) found evidence that shock to food inflation propagate to core inflation in 45 out of 46 countries used for the study and that such transmission from food to core inflation is more pronounced in the developing countries compared with the industrialized ones. Selliah & Applanaidu (2015) found that in Sri Lanka food inflation is highly persistence and hence, monetary policy should focus on headline inflation as the inflation trend.

3.0 Methodology

Measuring the persistence of Inflation

Inflation persistence refers to the speed at which inflation converge to its long- run mean or equilibrium after a shock (Kota& Lazaretou, 2011). If the speed at which inflation responds to shock is low, inflation is considered persistent while if the speed is high, inflation is not persistent. Knowing the degree of persistence helps the central banks in the conduct of the monetary policy. This is because the higher the inflation persistence the earlier and the stronger a central bank will react to disturbances to inflation in order to maintain price stability. In literature, some measures have been used to measure the persistence of inflation. The study intend to uses univariate autoregressive process proposed by Andrews and Chen(as cited in Levin & Piger, 2004). A univariate autoregressive (AR) process is given below;

$$\Pi_t = \mu + \sum_{j=1}^{K} \alpha_j \Pi_{t-j} + \varepsilon_t \quad \text{..... (1)}$$

where Π is a list of variables which includes headline inflation, core inflation and non-core inflation, ε_t is the stochastic disturbance term which is serially uncorrelated . To avoid bias, equation (1) can be reparametized as below

$$\Pi_t = \mu + \rho \Pi_{t-1} + \sum_{j=1}^{k-1} \phi_j \Delta \Pi_{t-j} + \varepsilon_t \quad \text{.....(2)}$$

To measure persistence, the sum of AR process coefficients, $\rho \equiv \sum \alpha_j$ will be used, and ϕ_j are the transformation of α_j shown in equation (1). The lag of AR of order K will be obtained using Akaike information criterion.

The Impulse Response Model

The impulse response function will measure the transmission effects between food and nonfood inflation. To model this, we proceed as follows,

Let $Y_t = (Y_{1,t}, Y_{2,t}, ..., Y_{n,t})'$ denote an kX1 vector of time series variable. The basic autoregressive model of order p, VAR(p), is

$$Y_t = c + \Pi_1 Y_{t-1} + \Pi Y_{t-2} + ... + \Pi_p Y_{t-p} + \mu_t \quad t=1,...,T \qquad (3)$$

where Π, are kx1 vector of constant and μ_t is an KX1 unobservable zero mean white noise.

Since we will consider only food and nonfood inflation, we modeled a VAR that consists of two equations, hence bivariate VAR

$$Y_t = \begin{pmatrix} Y_{1,t} \\ Y_{2,t} \end{pmatrix} = \begin{pmatrix} c_1 \\ c_2 \end{pmatrix} + \begin{pmatrix} \pi_{11}^1 & \pi_{12}^1 \\ \pi_{21}^1 & \pi_{22}^2 \end{pmatrix} \begin{pmatrix} Y_{1,t-1} \\ Y_{2,t-1} \end{pmatrix} + \begin{pmatrix} \pi_{11}^2 & \pi_{12}^2 \\ \pi_{21}^2 & \pi_{22}^2 \end{pmatrix} \begin{pmatrix} Y_{1,t-2} \\ Y_{2,t-2} \end{pmatrix} + \begin{pmatrix} \mu_{1,t} \\ \mu_{2,t} \end{pmatrix} \qquad (4)$$

Generally, VAR model is represented thus,

$$Y_t = \Pi_1 Y_{t-1} + \Pi Y_{t-2} + ... + \Pi_p Y_{t-p} + \Gamma X_t + \mu_t \qquad (5)$$

Where X_t represents an mx1 matrix of exogenous or deterministic variables, and Γ is the matrix of parameters

To model the impulse response function, we transformed VAR (p) into the form of vector moving average (VMA) process

The ψ_s measures the effects of μ_{t-s} shocks on Yt and is represented by the equation below;

$$\frac{\partial Y_{i,t+s}}{\partial \mu_{j,t}} = \frac{\partial Y_{i,t}}{\partial \mu_{j,t-s}} = \psi_{ij}(s) \qquad i, j = 1,...,T \qquad (6)$$

The set of coefficient $\psi_{ij}(s)$ $\quad i, j = 1,...,T$ are called the impulse response function.

4.0 Results and Interpretation

Test for Persistence of Inflation

The data for the analysis are monthly data from 1996 to 2014 obtained from the Central Bank of Nigeria (CBN) statistical bulletin. Table1 below is the result of the test for the persistence of inflation. An Akaike information criterion (AIC) was used in the determination of the number of lags included in the AR model. Following AIC, AR6 lags was used for food inflation, AR7 was use employed for each of nonfood and headline inflation.

Table 1: Estimates of the Persistence of Nonfood, Food and Headline inflation

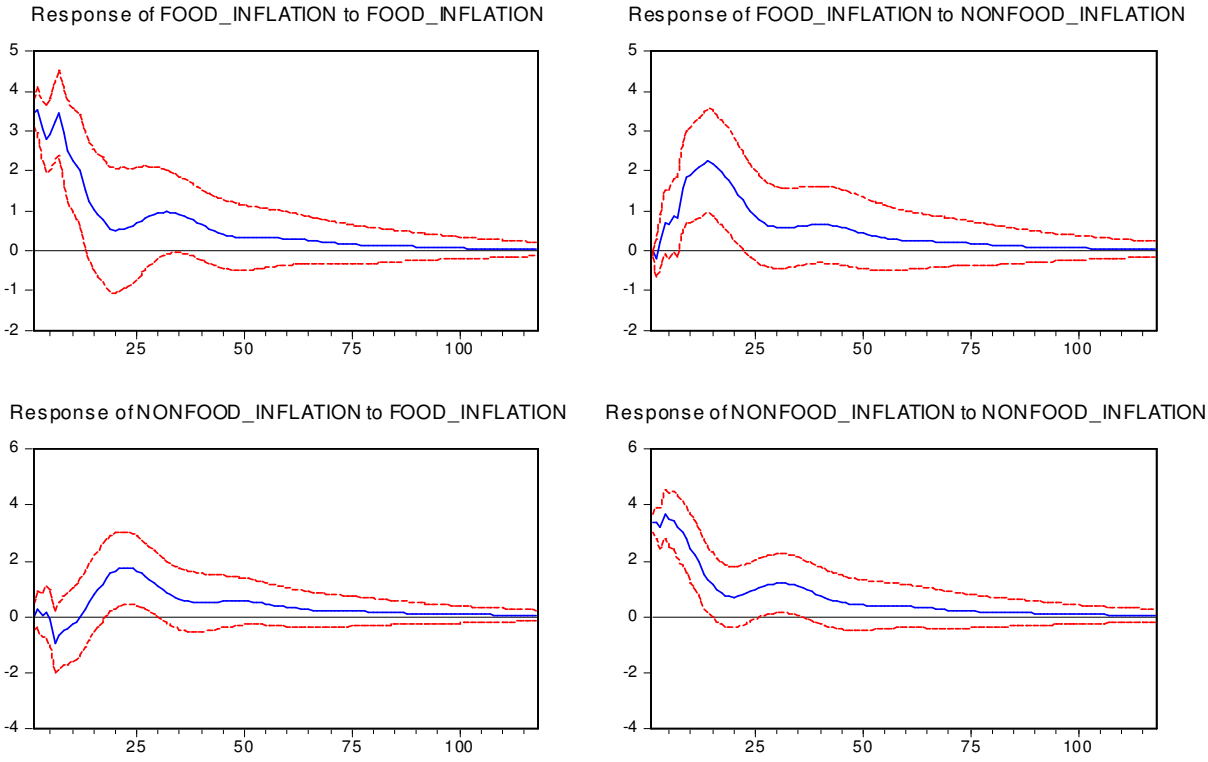
Variable	Lags	Sum of coefficient of the lags
Nonfood inflation	7	0.83
Food inflation	6	0.86
Headline inflation	7	0.87

The result showed that the three inflation indices are persistent as the sum of coefficient of the lags for each index is close to unity. However, headline inflation has the highest persistence, followed by the food, while nonfood inflation is the least persistence. This implies that shocks to headline inflation seem to have longest impact compared to food inflation and nonfood inflation. Moreover, there will be tendency that both the food and nonfood inflation transmit shocks between themselves as both are persistent. This finding is in line with Wash (2011) that both the food and non food inflation are persistent The results also indicated that shocks to food inflation have more lasting effects on the food prices compared to the nonfood inflation. This result is similar to the finding by Thamae and Letsoela (2014) in Lesotho. The implication is that food inflation in Nigeria is a major component of underlying inflation in Nigeria and should play a dominant part in the monetary

policy process in Nigeria.

Transmission Effects between food and Nonfood Inflation

The figures below are the impulse response graphs of bivariate VAR model for food and nonfood inflation with an optimal lag length of 8 determined using Akaike information criteria (AIC). At the upper left and lower right are the response of food inflation to its own shock and the response of nonfood inflation to its own shock respectively.



As shown, shock to food inflation was immediately fed into food prices with value of shock approximately equal to 3.46 per cent. Also shocks to nonfood are transmitted into the nonfood prices by a value approximately equal to 3.37per cent. This shows that food inflation propagated larger shocks to itself than nonfood inflation to itself. This should not be surprising as food inflation is more persistence than nonfood as seen in the table 1 above.
On the other hand, the IRF graph at the upper right shows the transmission effect of shocks from nonfood inflation to food inflation while the lower left shows the transmission of shocks from food inflation to nonfood inflation. The following information can be inferred from the graphs. Shocks to food inflation had a contemporaneous effect on the nonfood inflation and this showed that a shock from food inflation was propagated immediately into the nonfood. However, shocks to nonfood did not have contemporaneous effect on food inflation but with a lag of one month. Therefore, it takes up to one month for the effect of shock from nonfood inflation to be transmitted into food inflation. The graphs shows that the transmission effects of shocks from food inflation to nonfood inflation were estimated to be 1.64 per cent, 0.55 per cent 0.195 per cent and 0.78 per cent for periods 25, 50, 75 and 100 months respectively while the shocks from nonfood to food inflation were estimated to be 0.87 per cent, 0.44 per cent 0.18 per cent and 0.70 per cent for periods 25, 50, 75 and 100 months respectively. The above analysis showed that shocks from food inflation to nonfood, apart from being contemporaneous, tapper off or decay slowly compared to shocks from nonfood which is not contemporaneous but decays faster. This suggests that shocks from food inflation are being propagated to food prices more quickly and the effects decay slowly over time implying that monetary policy should incorporate food prices into monetary policy processes. This shows that headline inflation still remains the appropriate price index for monetary policy purposes.

5.0 Conclusion

The price index that the monetary authority responds to is indispensible in the monetary policy process.

Responding to the wrong price index does not only lead to suboptimal results but jeopardizes the credibility of the monetary authority. The study employed univariate autoregressive (AR) process and impulse response function to determine the appropriate price index that the monetary authority in Nigeria should focus on tracking inflation dynamics. The univariate autoregressive (AR) process shows that food inflation has longer memory compared to nonfood inflation and this is an indication that the food component of consumer price index should not be excluded in measuring inflation trend in Nigeria. The impulse response function reveals that shocks to food inflation are being transmitted faster to the nonfood inflation than nonfood to food inflation. Both magnitude and the direction of shock from food to nonfood also appeared to be greater than nonfood to food inflation. Given that supply shocks which are the direct price effects are propagated to other prices, the monetary authority should design policies to control changes in other prices by influencing both the demand and inflation expectation.

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