Effect of Exchange Rate Volatility on Food Prices in Nigeria (1999-2023)

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ABSTRACT

The drive objective of this paper is to examine the effect of exchange rate volatility (ERV) on food prices (FPI) in Nigeria with quarterly time series data from 1999Q1 to 2023Q4 using Structural Vector Autoregressive (SVAR) approach and modeled food prices based on food prices index (FPI) against policy instruments of exchange rate volatility (ERV), monetary policy rate (MPR), imported food prices (IFP), transportation costs (TPC) and dummy variable (DUM). The findings of structural impulse response functions of the food prices index increased steadily to itself and to ERV, but a downward movement to MPR and IFP, while the respond to TPC and DUM a decrease and turned to negative. The result of the Structural Variance Decomposition revealed that ERV is the only principal variable that affects the food prices in Nigeria. Other variables do not significantly affect the variation of food prices. The paper therefore, recommended that monetary authorities should diversify the holding of US dollar as the main exchange rate currency and spreads it across multiple currencies. More so, to initiate a programme that will reduce dependency on food supply imports, like Community-Supported Agriculture (CSA).

Key words: Food prices, exchange rate volatility, SVAR model

JEL Codes: C1, Q11, E31, F31, Q46.

1. Introduction

In Nigeria, many households in low-income families have continued to battle with poverty, because of the persistent increase in food prices that affect their livelihood drastically. National Bureau of Statistics (2023) confirm that "Consumer Price Index (CPI) for food inflation rate in January 2023 was 24.32% on a year-on-year basis; which was 7.19% points higher compared to the rate recorded in January 2022 (17.13%)". The average annual rate is increased to 21.53% in 2023, which was a 1.44% points increase from the average annual rate of change recorded in 2022 (20.09%), and over the previous years. For instance, food prices increased to 33.93% in December, 2023; and to 40% in the first two months of 2024. It recorded the average of 11.30%

from 1999 until 2023, reaching all time high of 28.89% in December 2001, and recorded low of -14.07% in December, 2000 (NBS, 2024). Figure 1 shows the rate of inflation for the period of study.



Source: Researcher's Computation (2024), data from CBN (2022), NBS (2023).

Figure 1: Average Rate of Food Prices Inflation in Nigeria (1999Q1 – 2023Q4)

Figure 1 depicts the average rate of food prices inflation in Nigeria covered the periods from 1999 to 2023, each period marked by different domestic and global factors. It showed that the average point of 41.81% between 1999 and 2003; it stood at 71.58% between 2004 and 2008; it increased to 128.53% from 2009 to 2013; and also raised to 226.11% between 2014 and 2018; and stood at 520.79% from 2019 to 2023 respectively.

The factors behind higher food prices is week Naira boots demand for US dollar (depreciation), that when the exchange rate rises or when the Naira depreciates, it is anticipated that general prices will rise including the food prices. Moreover, the ongoing Russia-Ukraine crisis roots low supply of some global food commodities like wheat; the implementation of monetary and fiscal control measures of structural reforms of removing fuel subsidies, unifying the various official foreign exchange window, and poor agricultural production, and energy costs have both raised and kept food prices high in the last eight months rapidly. IMF (2024) notices that the "long-term Boko-Haram insurgent crisis; kidnapping and banditry activities; crisis of herdsmen and farmers and land boarder closure that are persistently in the northern part of Nigeria". The effect of COVID-19 pandemic was unable farmers and food producing companies to cultivate and produce food in

sufficient quantities (Owan, Sunday, Iwara & Asu, 2022, p. 10).

The impact of food prices distorts the consumption pattern of the low-income households, led them to malnutrition, food insecurity, low saving and investment, and possible social unrest among others. The recent report by the International Monetary Fund (IMF, 2024) estimates that "about 25 million or 13% of Nigerians are food insecure" (p. 12). Fasanya and Olawepo (2018) have notice that "many households in Nigeria are net consumers of food, and spend more than 60% of their income on food items" (p. 166).

With the above ascertaining, one may ask weather food prices inflation is caused by the exchange rate volatility or not. Therefore, the prime objective of this paper is to examine the effect of exchange rate volatility on food prices inflation in Nigeria for the period 1999Q1 to 2023Q4, guided by the research question of what aspects of policy strategies help to ensure food prices stability for sustainable economic growth. The remaining of the paper is structured as follows: Section two contains literature review on the relationship between exchange rate volatility and food prices. Section three presents a description of data and methodology. Section four covers empirical results and discussion. Section five comprehends conclusion and policy recommendations.

2. Literature Review

2.1 Conceptual Clarification

Food prices can be defined as the sustained increase in the general price level of food items in an economy over a period of time. It is a crucial component of the cost of living, and can significantly affect household budgets and overall inflation rates. Anidiobu, Okolie and Oleka (2018) describes it as "a recurrent rise in the overall level of prices for food items that measured the annual percentage increase of Naira owns to purchases one a smaller percentage of food products" (p. 29). That is, the value of Naira decreases persistently in relation to the quantity of foods can fetch.

The unifying of various official foreign exchange window, fuel subsidy removal, hoarding of food products by traders in anticipation of future price increases are considered to be the major causes behind the driving up of food prices recently. Sylvester el al (2023) views that "exchange rates fluctuations and trade policies affect local food prices" (p. 503). The depreciation of Nigerian naira to dollar led to a large increase in food price due to the fact that Nigeria is a net food importer. A weakening Naira currency can make imported foods more expensive.

Exchange rate volatility refers to the degree of fluctuation in the value of an economy's currency relative to other currencies over a specific period of time. It is a measure of how much and how quickly exchange rates change, reflecting the uncertainty and risk associated with currency movements in global markets**.** It leads to variations in the cost of imported food products, and influence the costs of inputs for domestic food production, such as fertilizers, pesticides, and machinery that may be imported. Victor (2016) argues that "exchange rate between an exporting and an importing country affects the importing economy's import prices" (p. 51). A depreciation of the real exchange rate increases food prices inflation by expanding the cost of importing petroleum products, fertilizer, and other finished products relating to agricultural commodities, thereby leading to rising domestic market prices (Asharani, Mallesh & Phanindra, 2022 p. 13). A depreciation of Nigerian Naira to dollar led to a greater increase in food prices in Nigeria due to the fact that Nigeria is a net food importer. NBS (2021) confirms that "Nigeria imported wheat from Russia and Ukraine worth over N128.1 billion in the nine-month period of 2021". Thus, Exchange rate volatility can therefore have significant impacts for food prices in Nigeria, because it is heavily relying on importing a significant portion of its food products and inputs.

However, the invasion of Russia on Ukraine affects Nigeria's import of some agricultural products like wheat; conspicuous insecurity issues have led to a severe rise in food prices due to the substantial reduction in food production; and impact of COVID-19 Pandemic. Fasanya and Olawepo (2018) state that "this category is caused by weather conditions, crop yields, and shifts in consumer preferences that disrupts agricultural production and supply chains"

Food commodities have become so expensive that Nigerians now buy raw food in much smaller quantities. Owan et al (2022) observe that the "effects of inflation have been felt badly by Nigerians who use social media to speak out on the rising food prices which is affecting the purchasing power of households" (p. 10). High and volatile food prices may have various effects on households, farmers, businessmen, governments, and other stakeholders in different ways. For example, higher food prices directly influence the cost of living for households which is reduces the purchasing power of consumers, leading to decreased affordability of essential food items. Farmers may face increase in costs for inputs such as fertilizers, pesticides, fuel and labour. The consequence may extent to the food supply chain, such as retailers, distributors, and processors. It can lead also to social unrest and political instability, which can increase demands for government intervention in form of subsidy programs to mitigate the impact on vulnerable households.

2.2 Theoretical Review

Different theoretical underpinnings are grounded in economic principles and models channels through which currency fluctuations influence food prices. Some of these theories include:

Classical Theories: were developed by Adam Smith (1723-1790) and David Ricardo (1772-1823) in the late 18th and early 19th centuries. Modern groundwork and contemporary analyses were laid down by the Keynesian, monetarism, and international trade theories. They all emphasized on the principle of demand and supply which states that, an increase in demand or a decrease in supply of food items can lead to higher prices, contributing to food prices rise.

International Trade Theory: was introduced by David Ricardo in the early 19th century. Ricardo's work laid the foundation for understanding the benefits of specialization and trade among nations. The theory holds that changes in exchange rates affect trade patterns and prices of traded food items, including agricultural products.

Purchasing Power Parity (PPP) Theory: was first formalized in the 16th century with scholars like Thomas Gresham, who observed the impact of currency values on trade. Modern formulations of the theory emerged in the 20th century, with notable contributions from economists such as Gustav Cassel, Irving Fisher and Robert Mundell, who see exchange rate volatility as playing a pivotal role in influencing the relative prices of imported and domestically produced food items.

Monetary Policy Transmission Mechanisms: has been advanced by numerous economist John Maynard Keynes, who emphasized the role of interest rates and aggregate demand in macroeconomic stabilization. Milton Friedman, Franco Modigliani and others developed modern theories that emphasizes the role of monetary policy in influencing currency values. Exchange rate volatility can reflect changes in interest rates, money supply, and inflation expectations, which in turn affect household prices, including food prices.

2.3 Review of Empirical Studies

Several related empirical studies have been conducted on the effect of exchange rate volatility on food prices in Nigeria. For instance, Ikechukwu, Rauf and Biose (2022) examine the impact of COVID-19 pandemic on food prices in Nigeria using Food Price Index (FPI), the number of confirmed cases of COVID-19, the number of confirmed deaths related to COVID-19 illnesses, exchange rate, broad money supply, and agricultural output, using Autoregressive Distributed Lag (ARDL) Model. The results revealed a positive relationship between food prices and COVID-19 pandemic in long-run dynamics, while negatively related in the current period, hence recommended continuous vaccination of the populace and implementation of price

control mechanisms as the food price stability.

Moreover, Asharani, Mallesh and Phanindra (2022) investigate the impact of macroeconomic factors on food price inflation in India utilizing the monthly time series from January 2006 to March 2019, using ARDL bounds testing approach. The long-run estimates showed that per capita income, money supply, global food prices and agricultural wages are positively and significantly impacted food price inflation in both the short and long-run; while the short-run estimates revealed that real exchange rate positively impacts food price inflation.

Fasanya and Olawepo (2018) examine the determinants of food price volatility in Nigeria using multivariate GARCH approach of the Baba-Engle-Kraft-Kroner (BEKK) model and the Dynamic Conditional Correlation (DCC) model were used for estimation. The findings showed that information shocks originating in Consumer Price Indices (CPI), lending rate, exchange rate and oil market have a direct effect on the current conditional volatility in food market Hence, the government should encourage the use of alternative sources of energy to reduce the effect of high oil prices on food prices and provide soft agricultural credit scheme to farmers with a low lending rate through specialized banks.

In addition, Chidinma, Simon and Emilia (2022) examine the effect of agricultural productivity on food price and inflation in Nigeria using time series data between 1981 and 2021. The study applied structural vector autoregressive model (SVAR) model on three variables. The results indicated that increase in agricultural productivity induces a positive change in food prices, while an increase in food prices is accompanied by fall in inflation in the long run. Hence, recommended policy measures like subsidization of agricultural inputs will prevent the food prices increase.

These studies have examined the impact of macroeconomic factors on food prices rise across the world. They make significant contribution to existing knowledge, but only a few studies have been empirically investigated the effect of exchange rate volatility on food prices, hence this paper is attempts to fill this gap by incorporating the energy cost variable, imported food prices variable and dummy Variable in the model.

2.4 Theoretical Framework

The theoretical frameworks for understanding the effect of exchange rate volatility on food prices inflation involve various economic theories and models that explain the relationship between currency fluctuations and changes in domestic prices. The theoretical framework for

this research includes the Purchasing Power Parity (PPP), International Trade and Comparative Advantage and Monetary Policy theories, because they looked most in the food markets, costs of imported inputs for food production and food industries, and central bank interventions.

3. Methodology

3.1 Source and Description of Data

This paper is based on quarterly time series data of 100 observations covering the periods between 1999Q1 and 2024Q4. The data is sourced from the Central Bank of Nigeria (CBN) Statistical Bulletins of various editions, National Bureau of Statistics (NBS) of different years, Food and Agriculture Organization (FAO), Academic Journals, Unpublished Works and Web sites & Pages (internets).

3.2 Model Specification and Technique of Data Analysis

The Structural Vector Autoregressive (SVAR) model is specified for this study. The model is more relatively better in examining the effect of monetary policy actions and external shocks, because it avoids the problems of a dynamic simultaneous equation model which often leads to Sim's VAR criticism in 1980. It facilitates in handling problems concerning the identification of the contemporaneous and dynamic relationships between macroeconomic variables and the policy instruments (Nina, 2014). The model is estimated by using E-Views 10 econometric package from six variables VAR (p) model whose vector X_t = (FPI, ERV, MPR, IFP, TPC, DUM) (1)

Where FPI = CPI for food index, ERV = Exchange Rate Volatility, MPR = Monetary Policy Rate, IFP = Imported Food Prices, TPC = Transportation for energy costs and DUM = Dummy (high or low productivity) Variable. Following the initial approach of Sim (1980) as modified by Sanusi (2010) and previous studies have compressed the VAR model and written as: $Ay_t = \alpha_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots\ldots + \beta_k y_{t-k} + \ + \beta\varepsilon_t$ (2)

The prices shock can be represented in structural form: $Ay_t = \alpha_0 + C(L)y_{t-1} + \beta\varepsilon_t$ (3)

Then, SVAR model is estimated from the VAR in its reduced-form, because the coefficients in the matrices of equation (3.3) are unknown; it does by multiplying both sides of equation (3.3) by the inverse of matrix A: $Y_t = \Gamma_0 + D(L)y_{t-i} + e_t$ (4)

Hence, $\Gamma_0 = A^{-1}.\ \Gamma_0$, $D(L) = A^{-1}.\ C(L)$, $e_t = A^{-1}.\ \beta\varepsilon_t$

A random stochastic residual $[A^{-1}.\ \beta\varepsilon_t]$ can now be estimated from the residual unrestricted VAR as: $A^{-1}.\ \beta\varepsilon_t = e_t$ (5)

Amisano and Gianini (1997) in Kozluk and Mehrotra (2009), combine restrictions for A and B matrices, so the model become $Ay_t = B\varepsilon_{t,.}$ For simplicity, the variables are abbreviated as: FPI =

F, ERV = E, MPR = R, IFP = I, TPC = T and DUM = D, and specified as:

$$\begin{pmatrix} 1 & a12 & a13 & a14 & a15 & a16 \\ 0 & 1 & 0 & 0 & a25 & a26 \\ 0 & 0 & 1 & 0 & a35 & a36 \\ 0 & 0 & 1 & 0 & a45 & a46 \\ 0 & 0 & 0 & 0 & 1 & a56 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} et^F \\ et^E \\ et^R \\ et^I \\ et^T \\ et^D \end{pmatrix} = \begin{pmatrix} b11 & 0 & 0 & 0 & 0 & 0 \\ 0 & b22 & 0 & 0 & 0 & 0 \\ 0 & 0 & b33 & 0 & 0 & 0 \\ 0 & 0 & 0 & b44 & 0 & 0 \\ 0 & 0 & 0 & 0 & b55 & 0 \\ 0 & 0 & 0 & 0 & 0 & b66 \end{pmatrix} \begin{pmatrix} \varepsilon t^F \\ \varepsilon t^E \\ \varepsilon t^R \\ \varepsilon t^I \\ \varepsilon t^T \\ \varepsilon t^D \end{pmatrix} \quad (6)$$

Equation (6) restricts the system by recovering $\beta\varepsilon_t$ as $\beta\varepsilon_t = \beta e_t$ and assumed errors are independent of the various (ε_{it}) prices, and imposed theoretical restrictions to reduce the number of the unknown structural parameters of the variance-covariance matrix for the VAR residuals.

$$Ay_t = \begin{pmatrix} eFPI \\ eERV \\ eMPR \\ eIFP \\ eTPC \\ eDUM \end{pmatrix} = \begin{pmatrix} 1 & \alpha & \beta & \theta & \Phi & \psi \\ 0 & 1 & 0 & 0 & \lambda & \delta \\ 0 & 0 & 1 & 0 & \mu & \Delta \\ 0 & 0 & 0 & 1 & \tau & \eta \\ 0 & 0 & 0 & 0 & 1 & \omega \\ 0 & 0 & 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \varepsilon FPI \\ \varepsilon ERV \\ \varepsilon MPR \\ \varepsilon IFP \\ \varepsilon TPC \\ \varepsilon DUM \end{pmatrix} \quad (7)$$

Equation (7) captures both structural innovations and Zeros-value on the contemporaneous coefficients based on economic theory and empirical studies as argued by Sims (1986). The main diagonal elements of matrix A are set to unity, because structural equation is normalized on endogenous variable.

4.1 Empirical Results and Discussion

Table 1: Unit-Root Tests

	ADF TEST		KPSS TEST	
Variables	T-Statistic	Probability	T-Statistic	Critical Value
LFPI	-6.3202**	0.0000	1.2084*	0.46300
LERV	-8.8414**	0.0000	1.1271*	0.46300
LMPR	-6.6999**	0.0000	0.2300*	0.14600
LIFP	-5.2195**	0.0000	1.2105*	0.46300
LTPC	-11.8963**	0.0001	1.2125*	0.46300
DUM	-4.4451*	0.0005	0.1563*	0.14600

Source: Researcher's Computation (2024) using E-views 10 software package. Note: * and

** indicate stationarity at level, trend and intercept, and at first difference; at 5% significant level.

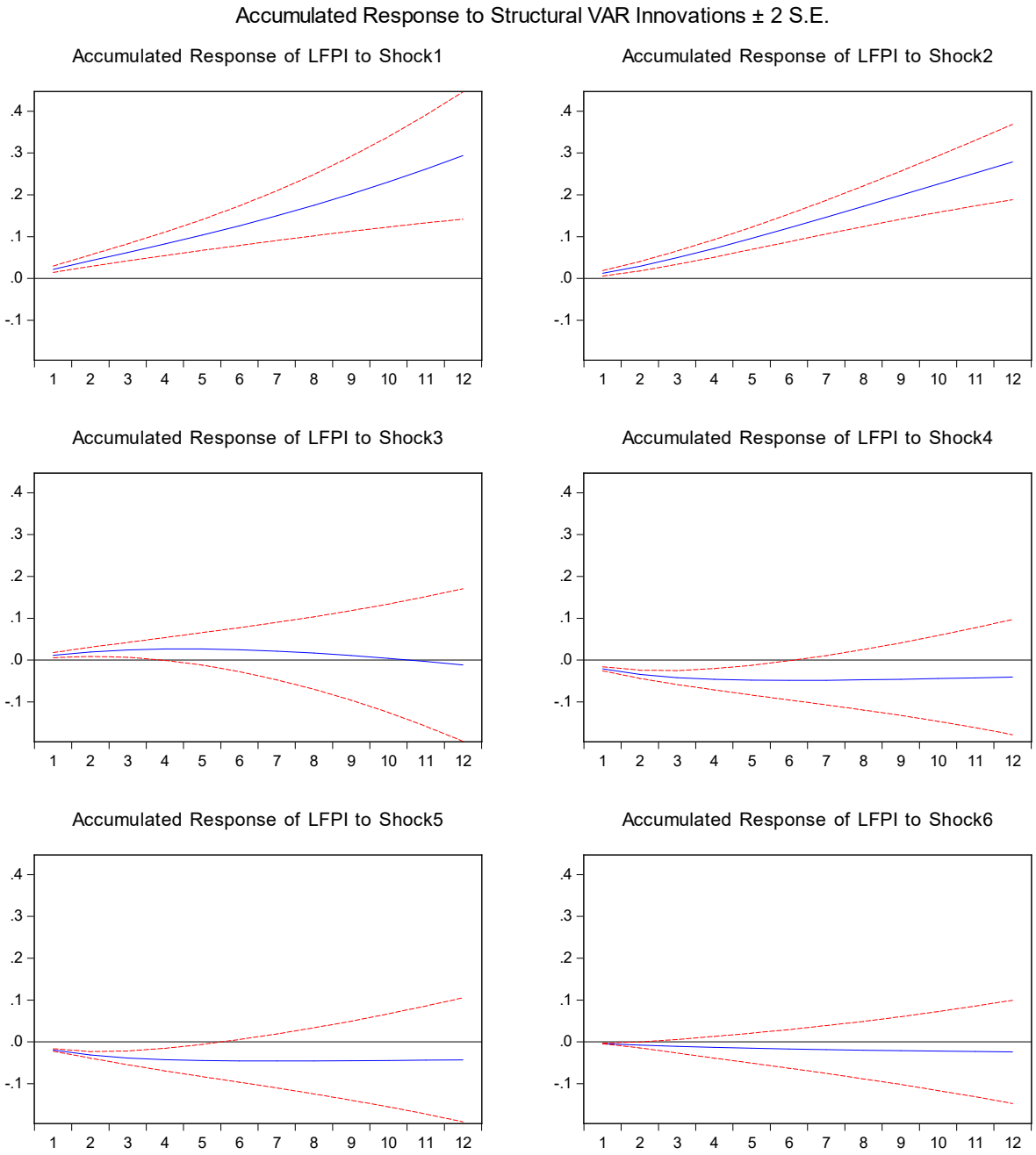
Table 1 presents the summary of unit- root tests results, using Augmented Dickey-Fuller (ADF, 1981) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS, 1992) approaches. The results of ADF indicate that all the variables were non-stationary at levels, but achieved after first difference with exception of DUM that is achieved at level, trend and intercept in both tests. On contrast, all the variables were achieved stationary at level in case of KPSS test.

4.2 Structural Vector Autoregressive (SVAR) Model

The estimation begins from an estimated VAR in its reduced form, thereby imposing restrictions using recursive long-run impulse response as delineated in the methodological section. It chose the optimal lag order of 1, based on Akaike information criteria (AIC), it then checked the residual tests for econometrical robustness against serial correlation, heteroscedasticity and Normality. Lastly, stability test was also conducted based on (AR Roots: Graph) and found all the eigenvalues to be less than one.

4.3 Effect of Exchange Rate Volatility on Food Prices Index in Nigeria

4.3.1 Structural Impulse Response Functions traces the effect of one-time price shocks on the endogenous variables. Each response includes the effects of a specific shock on one of the variables in the model at current effect (t) and future values (t + 1) of the prices as shown in figures below:



Source: Researcher's Computation (2024), using E-views 10.

Figures 1: Accumulated Response to Structural VAR Innovations (IRFs) for a period of 12 Quarters. Shock 1 refers Food Price Index shock; shock 2 refers to Exchange Rate Volatility shock; shock 3 refers to Monetary Policy Rate shock; shock 4 refers to Imported Food Prices shock; shock 5 refers to Transportation Costs shock; shock 6 refers to Dummy shock.

The first figure shows FPI increasing positively to its own shocks. That is, the food prices are steadily increase for the whole quarters. The second figure is the response of ERV shock which equally indicates positive effect with the FPI up to 12th quarters. This implies that exchange rate volatility had the greatest effect in fluctuating the food prices which is connected with the most

recent gradual depreciation of Naira. The third graph captures the innovations of interest rate to FPI that shows decreasing effect up 9th quarters, and continue to decrease down to 12th quarters negatively. This could indicate that increases in food prices are perceived as short-run by supply-side factors rather than demand-driving inflation.

The fourth graph reports negative increase shocks for the 12th quarters following a structural one standard deviation of IFP to FPI. This could mean the exchange rate effects to Naira depreciation by making domestic food prices rise in response to supply shortages of food items from the global markets. The fifth graph is the response of TPC shock to FPI which reveals a negative effect throughout the quarters. As food prices increase, transportation services might decease if the consumers and suppliers opt for cheaper goods following the fuel subsidy removal that cause rising of food prices on transportation costs. The last graph is the response of DUM shock to FPI that shows negative effect, which indicates that unusual events occurred in the environment that led to food prices. This negative response might suggest that certain policies are implemented to effect of high prices.

4.3.2 Structural Variance Decomposition explains the proportion of variations for the food prices that is attributed to its "own shocks" as well as those from other endogenous variables shocks as shown below:

Table 2: Variance Decomposition of LFPI using Structural VAR Factor

Period	S. E	Shock1	Shock2	Shock3	Shock4	Shock5	Shock6
1	0.040067	29.98776	9.360908	8.408701	27.78261	23.42956	1.030462
2	0.051921	33.21222	16.31376	7.305752	22.88494	19.21389	1.069434
3	0.060383	35.46002	23.31743	6.027235	18.57146	15.59445	1.029403
4	0.067887	36.99770	29.39816	4.873111	15.08774	12.69598	0.947305
5	0.075124	38.15137	34.17895	3.979445	12.39049	10.44872	0.851025
6	0.082307	39.16513	37.67252	3.363115	10.32574	8.717371	0.756123
7	0.089504	40.18186	40.05715	2.984761	8.734424	7.372390	0.669413
8	0.096735	41.26995	41.54713	2.789171	7.488841	6.311965	0.592938
9	0.104011	42.45308	42.33874	2.723901	6.495783	5.461946	0.526543
10	0.111339	43.73113	42.59482	2.745601	5.689578	4.769650	0.469224

11	0.118728	45.09262	42.44488	2.820863	5.024222	4.197652	0.419762
12	0.126185	46.52157	41.99016	2.925049	4.467186	3.719055	0.376980

Source: Researcher's Computation (2024), using E-views 10, Note: S. E. means Standard Errors.

Table 2 shows that the food prices are accounted the average variance of 39% is explained by its own shocks. This finding indicates that while some portion of food prices variability can be caused by the remaining variables. The average proportion of the variation in FPI attributed to ERV is 30%. This infers that exchange rate volatility had the greatest impact to the Naira fluctuations of food prices for the period observed in this study. The structural shocks of MPR account for 4%. This gives some insights into the transmission channels of monetary policy interventions with the food prices. it informs policy decisions related to inflation targeting, monetary policy adjustments, and food price stability. The variation of food prices explained the average of 12% by imported food prices inflation (IFP) reflects the interdependence of foreign markets and the transmission of price signals across globe. That is Changes in imported food prices can have a pass-through effect on domestic food prices to a number of factors such as market structure, competition, pricing strategies to consumers and producers to price changes. The variation of TPC in FPI is 10%, which influence market competition and pricing strategies among food suppliers and retailers. That, higher transportation expenses may limit the ability of food distributors to compete on price, leading to potential food market price impacts. The proportion of the variation in FPI attributable to DUM is much smaller peaking at a maximum of 0.25%. This suggests that, on average, food prices are expected to increase by 0.25% when the unforeseen condition (such as Covid-19 and the removal of fertilization subsidy) compared to when these factors do not exist.

5. Conclusion and Policy Recommendations

The thrust objective of this paper is to examine the effect of exchange rate volatility on food prices in Nigeria with quarterly time series data spanning 1999Q1 to 2023Q4. To identify the contemporaneous and dynamic relationships among the variables, the paper employed the structural vector autoregressive (SVAR) approach and modeled food prices based on food prices index (FPI) against policy instruments of exchange rate volatility (ERV), monetary policy rate (MPR), imported food prices (IFP), transportation costs (TPC) and dummy variable (DUM). The findings of structural impulse response functions of the food prices index responded positively increase to itself and to ERV, but a decrease to MPR and IFP, while the respond to TPC and DUM turned to a decrease. The result of the structural variance decomposition reveals that ERV is the only principal

variable that influence the food prices in Nigeria. Other variables do not significantly affect the variation food prices. Since, the results reveal that these policy instruments have been effective in influencing the food prices for the period of study, especially the exchange rate volatility, hence the paper recommended that the monetary authorities should diversify of holding US dollar as the main exchange rate currency and spreads it across multiple currencies; and engage in Community-Supported Agriculture (CSA) programme that will reduce dependency on food supply imports.

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