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Subsidy removal and its effect on inflation in Nigeria? A critique

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Abstract

The study investigates the impact of fuel subsidy removal on inflation trajectory in Nigeria. Monthly time series data on inflation, domestic fuel price (proxied by pms price), exchange rate, money supply and fiscal policy (proxied by government spending) covering the period 2014M01 to 2023m05, were utilized for the study. The period coincided with full fuel subsidy intervention by the fiscal authority without any structural break, policy reforms or partial subsidy removal, thus, the justification for the period selection. Following some econometric diagnostic tests, a traditional Vector Autoregressive (VAR) model was employed to establish the ex-ante and ex-post inflation trajectory in pre and post subsidy removal era in Nigeria. The ex-ante result reveals significant positive response of inflation due to shocks to domestic fuel price in 11 months periods, though, transitory with about two months lag. Using the simulation-scenario analysis, the ex-post results shows the trajectory path of inflation due to subsidy removal which suggests 9 months acceleration in inflation in the future after the month the policy was announced. Also, the study establishes different scenarios of domestic fuel price and how inflation responds to such. Similarly, the study sets inflation threshold across several scenarios developed in this study and found that inflation would begin to decelerate from the month of February 2024 after 9 months of consistent upward trend from June 2023. Finally, we recommend a holistic policy collaboration between the fiscal authority and the CBN in addressing the ‘’known and expected’’ inflationary pressure coming from shocks to domestic fuel price due to subsidy removal. The fiscal authority should also roll out permanent measures to address the welfare implications of subsidy removal in Nigeria, while keeping eyes on inflation trajectory as well.

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1. Introduction

Nigeria is one of the largest producers of crude oil in Africa, with oil accounting for a significant portion of the revenue that accrues to the government (see, Ezeanolue & Okpanachi 2019; Adeniyi *et al*., 2011; Bazilian and Onyeji, 2012) [17, 26]. The reliance on crude oil sales and imports has made fuel pricing dynamics a critical component of the Nigerian economy. The economy over the years has been programmed to revolve around the supply of cheap petroleum products, to the extent that, the average household in Nigeria invariably depends on subsidized by-products of crude oil such as petrol and kerosene for domestic and commercial uses.

Prior to the second quarter of 2023, the Petroleum Motor Spirit (PMS) prices were fully subsidized by the national government, subsuming the cost in its annual budgets. Subsidies are important direct policy instruments adopted by governments to attain economic, social and environmental objectives.

Subsidizing fuel refers to the government's practice of providing financial assistance to reduce the cost of fuel for consumers.

Energy resources are one of the areas that have witnessed active intervention of governments all over the world, especially in developing countries through comprehensive subsidization of energy consumption (see, Berument *et al*., 2010; Coady *et al*., 2017; and Krane & Monaldi, 2017) [27, 25]. When these subsidies are removed, the price of fuel typically increases, which can have cascading effects on the wider economy, including inflation. These practices have gone a long way in consistently making the prices of PMS highly affordable to the average Nigerian.

Historically, there were periods of partial removal of fuel subsidies prior to the emergence of the Tinubu's administration. For instance, in 2012, there were partial subsidies removal by the Jonathan's administration which were subsequently suspended by the then government. However, during those periods, PMS prices in Nigeria hovered around N65 - N200.

Subsequently, the emergence of a new government ushered in a total removal of fuel subsidies commencing from the beginning of the second quarter of 2023, with the rationale that, the subsidy could no longer justify its ever-increasing costs amidst dwindling resources. This development has, however, led to the PMS Price skyrocketing almost immediately nationwide, pushing the pump prices to over N537. This would no doubt impact significantly on the country's economy in the short and long terms, particularly with its attendant effects on individual households and general prices of goods and services. Hence, the need to investigate the magnitude of the impact of such policy on inflation trajectory for Nigeria in the short and medium horizons.

In considering the benefits of the policy to the economy, fuel subsidies are regarded as government interventions aimed at reducing the cost of fuel for the final consumers. In Nigeria like many other economies, fuel subsidies have been a significant burden on government finances due to the increasing cost of subsidy payments. The petroleum sector which has been contributing substantially to the growth of the Nigerian economy for several decades has gradually lost its potential benefits due to significant subsidy payments on imports of petroleum products. Nigeria is perceived as a net importer of crude oil, despite the fact that the Country produces crude for exports, it still remains the largest importer of refined petroleum products in Africa, currently importing more than 80% of its refined petroleum products (see for example, Ezeanolue and Okpanachi 2019;, Adeniyi *et al*., 2011; Bazilian and Onyeji, 2012; Berument *et al*., 2010; Coady *et al*., 2017; and Krane & Monaldi, 2017) [17, 26, 27, 25]. Gains that could have accrued as revenue for the government from crude export are used to subsidize fuel importations.

Nigeria's inflation rate has been on an increasing trajectory in recent times, as the prices of fuel increase due to subsidy removal, the cost of goods and services including transportation, food, and electricity also increases, which disproportionately reduces the purchasing power and disposable incomes of households (see, Adenikinju, 2009; Gustavo, et' al, 2022; Ocheni, 2015 and Bazilian & Onyeji, 2012) [16, 26].

The ripple effects of the petrol crisis on the Nigerian economy are multi-dimensional: price distortions, volatilities, Dutch-disease, corruption, and inefficiencies. Against this backdrop, this paper seeks to assess the response of consumer prices to changes in PMS prices over the years. The overarching aim of this study is to assess the effects of fuel subsidy removal on inflationary trajectory in Nigeria, especially during periods of full subsidy removals.

The rest of the paper is organized as follows: Section II provides some stylized facts on the variables of interest, followed by Section III which takes stock of the relevant literature on the pass-through of fuel prices to inflation. Section IV delves into the model and methodology of estimations and interpretation of results, while section V concludes with a summary of the findings and the policy implications.

2. Objectives of the Study

Having established that subsidy removal increases fuel prices which has effects on inflation trajectory in Nigeria, thus, any shocks to fuel prices has an almost direct and immediate impact general prices (see Khalid et' al, 2014; and Gustavo, et' al, 2022). Consequently, the overarching aim of the study is to assess the overall impact of subsidy removal on inflation trajectory in Nigeria. Thus, specifically, the study attempts to assess:

1. Evaluate the Impact of subsidised PMS prices on Inflation Trajectory in Nigeria
2. Assess the pass through effects of subsidy removal on inflation trajectory in Nigeria
3. Determine the short/long run relationships between domestic fuel price and inflation

2.1 Stylised Facts

2.1.1. Nexus between Petrol Price and Inflation

No doubt, the price of PMS is considered a major driver and determinant of the cost of living in Nigeria and most developing economies, as it is used by all including small businesses and many households given the unstable electricity/power supply experienced in those economies. Consequently, any increase in PMS price could directly and immediately impact the prices of goods and services across the country. When petrol prices increase, small businesses tend to raise their prices to cover the increased cost of operations which could translate to higher prices for the final consumers, thus affecting the overall welfare of the citizenry. The chart below depicts the trend of PMS and inflation trajectory in Nigeria. It is observed that there exists the presence of a co-movement between the two variables in the later part of the review period, indicating that, as periods when PMS prices increase; inflation trajectory also trends in the same direction.

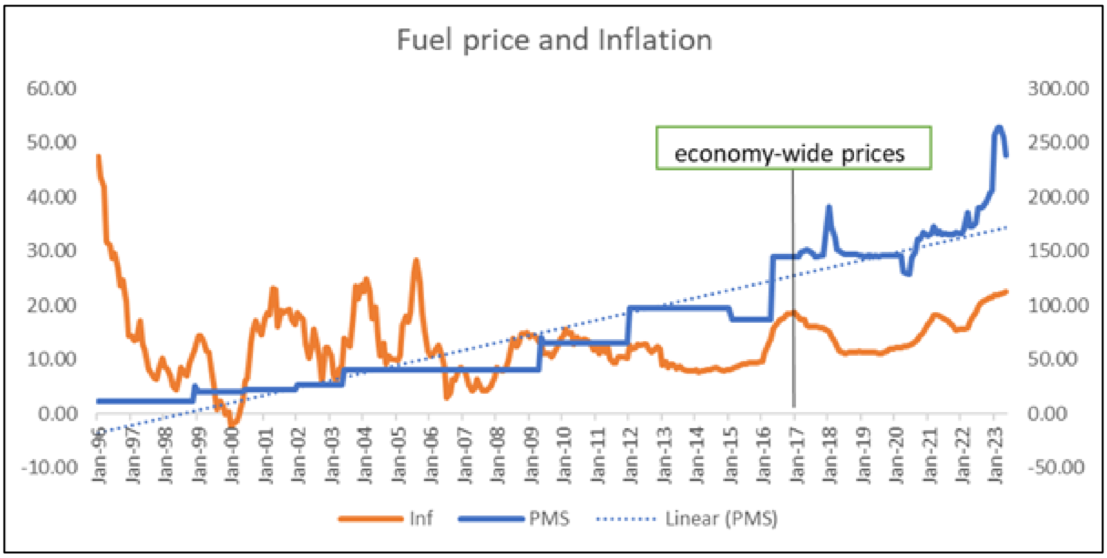

Fig 1: Trend in fuel price and Inflation

For instance, as PMS prices increased from 86.50/litre to 145.00/litre in June 2016, inflation also experienced an upwards trend, moving from 13.72 in April 2016 to 15.58, in May 2016 and 17.13 in as at July 2016. Based on the trends, in Figure 1, it is evidence that a rise in inflation even prior to the full implementation of the subsidy removal policy, could as well suggests the contribution of other variables jacking prices up in the economy. Although, it's expected that considering a year-on-year base effect, the pace of inflation will decelerate significantly though overall prices of goods and services will remain elevated.

2.1.2 Nexus between Petrol Price and Exchange Rate

With oil accounting for the largest share of foreign exchange earnings to the Nigerian economy, its role in determining the value of the foreign exchange rate of the Naira and vis-à-vis cannot be over-emphasized. The pass-through of changes in oil price to exchange rate and vis-à-vis particularly for oil exporting and importing economies is entrenched in both theory and practice. This is more pronounced when considering the fact that oil is an important source of energy for countries as well as the major export product of some economies.

The chart below depicts movements in prices of PMS and trends in the Exchange rate for Nigeria, major part of the study period shows a co-movement between the variables. This implies a direct relationship between the variables. When exchange rate depreciated from N197.10/US$ to N309.61/US$ in May 2016, the price of PMS also increases from N86.50/litre to around N145.00/litre in the same period, accordingly.

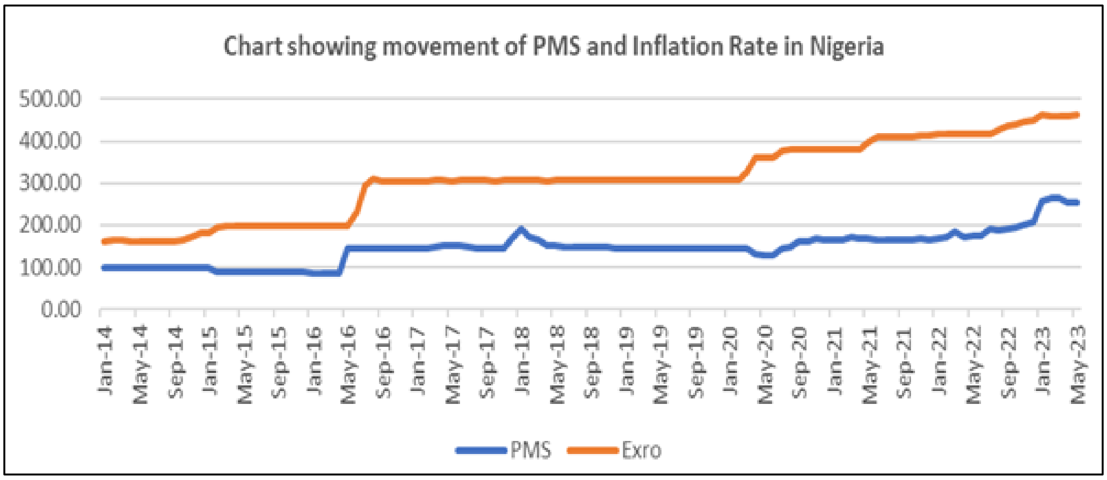

Fig 2: Trend in fuel price and Inflation

The Recent developments in the Nigeria's Forex market occasioned by the significant volatility will invariably impact on prices of PMS. For instance, the newly licensed PMS importers including the NNPC would now have to painstakingly access FOREX at a higher cost through the autonomous sources which was hitherto official, thus making the landing cost more expensive, as it is passed on to the final consumers.

2.2 Pass-Through Channels

On the pass-through channels, economic theory suggests that the removal of subsidies would result in an increase in the prices of petroleum products, which would affect directly and indirectly inflation and hence the cost of living of households. Since households consume fuels for transport, lighting and cooking, the prices of which are included in the CPI index. Consequently, removing the subsidy could potentially lead to an increase in inflation in the short term. However, over the long term, the removal of the subsidy could result in greater economic stability and growth. (Cukierman, 2016).

Where fuel prices are subject to market forces, the magnitude of this pass-through to inflation depends on the extent to which consumers can adjust to the new fuel price level, either by reducing their consumption or switching to alternative energy sources, although the likelihood of a significant dampening effect on the initial fuel price increases is small (see Shang 2021).

Many studies have focused on examining the implications of fuel subsidy regimes on the performance of the Nigerian economy. For instance, Umar and Umar (2013) and Siddig *et al*. (2014) noted that Nigeria's subsidy regime distorts fiscal planning, encourages inefficient consumption, and increases inequality as richer households benefit more. Siddig *et al*. (2014) further showed that subsidy reduction increases the GDP and reduces household income.

Ismail *et al* (2014) in examining the impact of subsidy on the transportation sector in Nigeria utilized the Co-integration and Error-Correction Model (ECM) to examine the relationship between subsidized gasoline prices and the transport sector from 1995-2013. The result showed that subsidy had a positive and significant relationship with transport sector which implies that removing gasoline subsidies could increase the operational cost of the transportation sector.

Similarly, Nwosa and Ajibola (2013) examined the long run and short-run relationship between gasoline price and sectoral output in Nigeria for the period from 1980 to 2010. Six sectors (agriculture; manufacturing; building and construction; wholesale and retail; transportation and communication) of the economy were examined. The long run regression estimate showed that fuel price is a significant determinant output in all sectors examined with exception to the building and construction sector while the short run error correction estimate revealed that only output of the agriculture and the manufacturing sectors of the Nigerian economy is affect by gasoline price increase in the short run.

Although not many studies have focused on fuel subsidy removal and inflation trajectory for Nigeria, only a few have proven that, fuel subsidy removal in Nigeria could actually cause inflation and reduce economic welfare (Adenikinju, 2009) [16]; hurt economic growth and reduce household income (Ocheni, 2015).

Other studies that have also examined the impact of fuel subsidy removal on inflation trajectory in Nigeria are: Ogunrinola and Olufemi (2014) who examined the impact of fuel subsidy removal on inflation in Nigeria by developing a six-variable autoregressive distributed lag (ARDL) model using quarterly data for the period 2001Q1 to 2012Q4. The study established that the impact of fuel subsidy removal on inflation was significant. Fuel subsidy removal led to an increase in inflation, which persisted over the short term.

Similarly, Obayelu and Oni (2014) conducted an analysis of macroeconomic impacts in Nigeria using a Computable general equilibrium (CGE) model. The study found that the removal of fuel subsidy resulted in a short-term increase in inflation and led to a decrease in the real GDP.

Moreover, Akpan and Udofia (2016) conducted a study examining the impact of fuel subsidy removal on inflation in Nigeria from 1977 to 2014. The study used time-series econometric techniques such as the augmented Dickey-Fuller (ADF) test and Granger causality test. The findings indicated that fuel subsidy removal had a positive and significant long-run effect on inflation, implying that it could lead to a short-term increase in inflation.

Omotosho (2019) [2] developed and estimated a New-Keynesian DSGE model that accounts for pass-through effect of international oil price into the retail price of fuel. Results showed that oil price shocks caused significant and persistent impacts on output, accounting for about 22 percent of its variations up to the fourth year. The benchmark model (i.e. with fuel subsidies), indicate that a negative oil price shock contracts aggregate GDP, boosts non-oil GDP, increases headline inflation, and depreciates the exchange rate. Results generated under the model without fuel subsidies indicate that the contractionary effect of a negative oil price shock on aggregate GDP is moderated, headline inflation decreases, while the exchange rate depreciates more in the short run.

Ayinde and Adebisi (2016) opined that the removal of fuel subsidies in Nigeria and could lead to an increase in inflationary pressures. They noted that the removal of subsidies would raise the cost of fuel, leading to higher transportation costs and production costs.

On the flip side, study by Ezeanolue and Okpanachi (2019) who established a contrary view found that the removal of fuel subsidies might not have a significant impact on inflation, as they suggest that there may be other factors that are more closely linked to inflation in Nigeria. The authors noted that the inflationary pressures in Nigeria are largely driven by exchange rate fluctuations, supply shocks, and fiscal policies, among others.

For other developing and advanced economies, Kpodar and Abdallah (2020) exploit variations in domestic fuel prices for a large sample of economies, and test successfully the hypothesis that cross-country differences in the pass-through of fuel price changes are driven by country-specific factors such as energy intensity, labor market flexibility, and central bank credibility.

Furthermore, Gelos and Ustyugova (2017) also find that commodity price shocks (world food and fuel prices) have stronger effects on domestic inflation in developing countries than in advanced economies, with countries exhibiting certain structural characteristics being subject to larger spill overs.

In summary, much of the empirical literature finds that the pass-through from oil prices to headline inflation is present, but the effect is mild and transitory over time. However, fewer studies provided evidence of no effects of fuel price changes on inflation. It is apparent from the review above that there have not been substantial studies on subsidy removal-induced pricing and inflationary pressures for Nigeria. This paper looks to bridge the literature gaps by estimating empirically, the pass-through of fuel price changes due to full subsidy removals on inflation trajectory in Nigeria. The paper adds to the literature in terms of the empirical techniques employed in the study, as most studies have relied on partial and general equilibrium models.

2.3. Theoretical Basis

To drive our theoretical foundation for this study, we extend and modify Blanchard and Gali's (2007) hypotheses to explain country specific[1] heterogeneity in the response of inflation to domestic fuel price shocks. Using the same theoretical approach, Gelos and Ustyugova (2017) also find that commodity price shocks (world food and fuel prices) have stronger effects on domestic inflation in developing countries than in advanced economies, with countries exhibiting certain structural characteristics being subject to larger spill overs (as in KPodar & Liu 2021).

This study departs from others that used crude oil price as the variable of interest to proxy domestic fuel price shocks to inflation (see Kilian 2009, Peersman and Van Robays 2012, and Baumeister and Peersman, 2013), we follow more recent studies in the literature that used domestic fuel price and how shocks to it affects price level in an economy[2] (see Kpodar & Liu 2021 and Kpodar & Abdallah 2020), since several other studies found that inflation reacts to changes in fuel prices (see for instance for the Euro area: Álvarez *et al*. (2011) and Castro and Jiménez-Rodríguez (2017); and Caceres, Poplawski-Ribeiro and Tartari (2013) for Central African countries). Similarly, studies provide evidence of an asymmetry in the responses of inflation to domestic fuel prices shocks as positive fuel price increase leads to larger effect on inflation[3] than negative price shocks, (see Kpodar & Liu, 2021 and Choi *et al*., 2018, and Kpodar & Abdallah, 2020).

3. Methodology

3.1 Data Description

This study utilizes time series data from January 2014 to May 2023, representing 112 observations. The period was chosen to accommodate the period of full subsidy intervention without any structural break, since periods prior to 2014 were accompanied by partial subsidy removal and other distortions in the oil sector. We use five variables in our estimation, and they include headline inflation, PMS pump price, exchange rate (I&E), money supply and fiscal policy (proxied by government spending). These variables, among others, have been found in several studies (see, for example, Kpodar & Liu, 2021; and Kpodar & Abdallah 2017) to be the main drivers of inflation in emerging economies and Nigeria.

Thus, fuel price was proxied by the average pms price of the 36 states of Nigeria and the FCT, exchange rate was proxied by the official exchange rate at the I&E window and M3 represents the stock of money in the economy. Government spending is represented by capital and recurrent expenditures; this is done to capture the true dynamic nature of government expenditure and its impact on inflation. All data was sourced from the statistical database of the CBN and the National Bureau of Statistics (NBS).

3.2. The VAR model

There is a large body of literature assessing the macroeconomic impact of domestic fuel price shocks and the role of fuel subsidies (see, Berument *et al*., 2010) [27], especially in oil producing economies like Nigeria (see, Ezeanolue and Okpanachi, 2019; and Omotosho, 2019) [2], as well as the implications of subsidy removal across several economies (see, Coady *et al*., 2017; Krane & Monaldi, 2017; and Omotosho, 2019) [25, 2]. In order to assess the impact of subsidy removal on inflation trajectory in both pre and post subsidy removal periods, the vector auto-regression (VAR) methodology, pioneered by Sims (1980) has been widely used in several studies. To address the above objective in our study, we used a VAR model to produce two forecasts, namely: in-sample and out- sample forecasts, which were leveraged to identify the differential impacts of the model variables, especially PMS subsidies, on inflation. Thus, we employ ''one-model two-forecasts" approach, since VAR could address all the objectives in the study.

This study extends Omotosho, 2019 [2] by considering two broad scenarios, namely, one without subsidy and another with subsidy. This was done to ascertain the relative impact of subsidized and unsubsidized fuel prices on inflation trajectory in Nigeria. However, we depart from Omotosho 2019 [2] by introducing money supply and government spending in our model (as in Ezeanolue and Okpanachi, 2019) in order to effectively address the objectives of the study.

Specifically, our study also analyses both pre and post subsidy removal periods, by simulating the pass-through impacts of fuel price shocks before and after the removal of subsidies using different methodologies. While Omotosho 2019 [2] employed DSGE model to address the same problem, our study utilises a VAR technique. We acknowledge that, Omotosho 2019 [2] represents the first attempt at incorporating fuel subsidy into a Dynamic Stochastic General Equilibrium (DSGE) model for Nigeria and estimating the pass-through effect of oil prices into domestic fuel price.

Our study also makes the first attempt to evaluate the impact of fuel subsidy on inflation by leveraging simulation analysis in the out-of-sample forecasts. We set out different scenarios of fuel prices since its now market-driven and evaluated how different pms prices could impact on inflation trajectory in the future.

The first run of the VAR model produces in-sample forecasts, along with the impulse response function (IRF), while the second run of the VAR model takes care of the out-of-sample forecasts that involve scenario analysis to produce the impact of fuel subsidy removal on inflation trajectory (this is in line with the work of Jorda 2005)..

3.3. The Model Specification

The study employs the vector autoregressive (VAR) model. VAR has been widely used in the literature to address similar objectives stated in the study (see Ezeanolue and Okpanachi, 2019). Thus, the study, therefore, evaluates the resulting impulse responses and forecast error variance decompositions to explain the relationship between the variables in the model. It also evaluates the impact of fuel price prior to subsidy removal era (and other relevant variables) on inflation, and the possible impact of subsidy removal on inflation in both short and long runs.

Therefore, We consider a time series of k dimensions y_t, $t = 1, \ldots, T$ and assume that y_t can be estimated by a vector auto-

[1] While Blanchard and Gali used cross country analysis, we modified the approach by considering county specific issues to treat inflation drivers for the case of Nigeria and how specific shocks to those drivers affect inflation, with emphasis on shocks to domestic fuel prices.

[2] This becomes more necessary as domestic fuel price shows the true picture of pass through to inflation, while crude oil price is purely exogenous, thus, could not serve the purpose in the VAR model

[3] Specifically, we recognise the works of Kpodar & Liu, 2021; and Kpodar & Abdallah 2017 in this regard. These set of studies found strong pass-through impact of domestic fuel price to inflation, but such impact was found to be transitory and last for about 10 months period. While our study found domestic fuel pass-through to inflation to last for about 11 months with 4 months lag, after which the effect begins to die out, suggesting absence of cointegration.

regression of finite order *p which generalises a one-variable AR(p) process to n variables*. Given the following structural vector autoregressive model:

$$\boldsymbol{B_0 y_t = B_1 y_{t-1} + \cdots + B_p y_{t-p} + u_t} \quad (1)$$

Our objective is to learn about the parameters, where y_t is an $(n \times 1)$ vector of endogenous variables in the system, $\boldsymbol{u_t}$ is (n x 1) vector of white noise innovations which are assumed to be uncorrelated with their own lagged values and uncorrelated with all the right hand side variables i.e. the lagged $\boldsymbol{y_s}$, $\boldsymbol{B_1}$ represents the (n x n) matrix of coefficients. The essence is to ascertain the impact of fuel price dynamics on inflation trajectory prior to subsidy removal in Nigeria, by considering series of key inflation drivers (including its own lags) in Nigeria with fuel price as the main target in the VAR model. We, therefore, establish that:

$y_t = f\ (inflation, pms\ price, exchange\ rate, money\ supply, govt\ spending)$ (1a)

The $(n \times 1)$ vector of u_t in equation (1) above refers to a structural shock or innovation and signifies zero mean with serially uncorrelated error term (zero and finite variance), i.e. the vector of white noise innovations. The error term is assumed to be unconditionally homoscedastic. The matrix is not assumed to be diagonal thus, the error terms of the individual equations can be contemporaneously correlated, while all innovations should be uncorrelated with their own lagged values and uncorrelated with the right-hand side variables (i.e. the lagged y_{ts}). For notational convenience, all deterministic regressors have been suppressed. Accordingly, we also assumed that there are no contemporaneous terms on the righthand side of the equation. The model can be written more concisely as:

$$\boldsymbol{B(L) y_t = u_t} \quad (2)$$

where $B(L) \equiv B_0 - B_1 L - B_2 L^2 - \ldots - B_p L^p$ is the autoregressive lag order polynomial. The variance-covariance matrix of the structural error term is typically normalized such that:

$$\boldsymbol{E(\ u_t u_t') \equiv \Sigma_u \ = \ I_K} \quad (3)$$

This implies first, that the number of structural shocks and variables are equivalent. Second, since by definition, structural shocks are mutually uncorrelated, it is implied that Σ_u is diagonal. Third, the variance of all structural shocks is normalized to unity without a loss of generality given that the diagonal elements of B_0 remain unrestricted. For the in-sample VAR forecasts to be estimated, the reduced-form VAR representation must first be derived. This requires y_t being expressed as a function of lagged y_t only. The reduced form representation is derived by pre-multiplying both sides of the equation 1 (i.e. structural VAR representation) by B_0^{-1}, now we have:

$$\boldsymbol{B_0^{-1} B_0 y_t = B_0^{-1} B_1 y_{t-1} + \cdots + B_0^{-1} B_p y_{t-p} + B_0^{-1} u_t} \quad (4)$$

Hence, the same model can be represented as:

$$\boldsymbol{y_t = A_1 y_{t-1} + \cdots + A_p y_{t-p} + \varepsilon_t} \quad (5)$$

The ***reduced form VAR*** above is the basis for our in-sample forecasts and the impulse response analysis and would also aid us in setting path to our concerned variable(s) to see the out-of-sample forecast pattern of the model in the simulation process, where $A_i = B_0^{-1} B_i$, i=1, …, ρ, and $\varepsilon_t = B_0^{-1} u_t$. Equivalently, the model can be written more compactly as:

$$\boldsymbol{A(L) y_t = \varepsilon_t} \quad (6)$$

Where $A(L) = I - A_1 L - A_2 L^2 - \cdots - A_p L^p$ denotes the autoregressive lag order polynomial.

In order to generate consistent estimates of the **reduced-form VAR** parameters A_i, i=1…, ρ, the reduced-form errors ε_t, and their covariance matrix $E(\ u_t u_t') \equiv \Sigma_\varepsilon$, standard estimation techniques are employed (for documented evidence, see Lütkepohl 2005). The reduced-form innovations $\mathcal{E}_t$ are typically a weighted average of the structural shocks u_t and as such studying the response of vector y_t to reduced-form shocks $\mathcal{E}_t$ does not reveal anything about the response of y_t to the structural shocks u_t. If one is interested in learning about the structure of the economy, it is the latter responses that are of significance and they are dependent on B_i, i=0…, ρ. Thus to reconstruct u_t from $u_t = B_0 \mathcal{E}_t$ and B_i, i=1…, ρ from $B_i = B_0 A_i$, we have to recover the elements of B_0^{-1} from consistent estimates of the reduced-form parameters by assuming that $E(\ \mathcal{E}_t) = 0$ representing the variance matrix:

By construction, $\mathcal{E}_t = B_0^{-1} u_t$. Hence, the variance of $\mathcal{E}_t$ is:

$E(\ \mathcal{E}_t \mathcal{E}_t') = \ B_0^{-1} E(\ u_t u_t'\ ) B_0^{-1\prime}$

$\sum_\varepsilon = B_0^{-1} \sum_u B_0^{-1\prime}$

$$\sum_\varepsilon = \ B_0^{-1} B_0^{-1\prime} \quad (7)$$

We intend to simplify the VAR specification system using only two variables (i.e. fuel price denoted by $\boldsymbol{P}$ and inflation rate denoted by $\boldsymbol{\pi}$), and subsequently, we extend the system to accommodate other endogenous variables in the model, which include exchange rate denoted by $\boldsymbol{e}$, money supply denoted by $\boldsymbol{m}$ and government spending denoted by $\boldsymbol{S}$. In doing so, we re-write the contemporaneous response coefficients of the targeted variables 'parameter $\boldsymbol{A}$' in equation (6) above in a matrix algebraic form to account for the identity component of the parameter which could be written as:

$$A = \begin{bmatrix} 1 & b12 \\ b21 & 1 \end{bmatrix} \quad (8)$$

The two-model equation after modifying equation (4) and (5) above (for $\boldsymbol{y_t}$ to now be π_t and $\boldsymbol{p_t}$) would then appear in the format below, considering inflation and fuel price to be the endogenous variables in the VAR system for now, thus, we have:

$$\boldsymbol{\pi_t} = \begin{bmatrix} \pi_t \\ \boldsymbol{p_t} \end{bmatrix}, \boldsymbol{B} = \begin{bmatrix} \alpha 11 & \alpha 12 \\ \alpha 21 & \alpha 22 \end{bmatrix} \text{ and } \boldsymbol{\varepsilon_t} \ = \ \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \quad (9)$$

We present equation (10) below as a summarised and condensed version of equations (8) and (9), this is also conducted for simplicity purpose, thus, we have:

$$\boldsymbol{\pi_t = g_{11} \pi_{t-1} + g_{12} p_{t-1} + \varepsilon_t} \quad (10)$$

Building from equation (6) on equation (10), we could further establish that:

λ (L) =A-1 G(L) , and $\boldsymbol{\varepsilon}_t$= A-1 ut (11)

Thus, substituting equations (10) and (11) with their matrix components would turn:

$$\pi_t = \begin{bmatrix} \pi_t \\ \boldsymbol{p}_t \end{bmatrix} = \lambda(g) \text{ x } \begin{bmatrix} \pi_{t-1} \\ \boldsymbol{p}_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \quad (12)$$

$$\begin{bmatrix} \pi_t \\ \boldsymbol{p}_t \end{bmatrix} = \begin{bmatrix} g_1 \\ g_2 \end{bmatrix} + \begin{bmatrix} g11 & g12 \\ g21 & g22 \end{bmatrix} \text{ x } \begin{bmatrix} \pi_{t-1} \\ \boldsymbol{p}_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \end{bmatrix} \quad (13)$$

Overall, from equations (8) to (13), ***A*** represents contemporaneous response coefficients of the targeted variables, ***G(L)*** is a matrix polynomial in the lag operator ***L*** and, ***B*** matrices denote variance-covariance matrix of structural shocks respectively. Moreover, $\boldsymbol{\varepsilon}_t$ are structural disturbances, in this case assumed to be structural shocks which make them give economic relationship meaning. In this process, et is also assumed to be a diagonal covariance matrix $\sum_e$ represented by matrix ***B*** which makes each shock in the system uncorrelated. Since the shocks in the system are normalised such that each structural shock form one standard deviation, that transforms the covariance matrix to an identity matrix I_n.

Finally, we incorporated other endogenous variables in our VAR system equations to see the interaction of each variables in response to its lag, and the lags of other endogenous variables in the VAR model. Thus, we now have pms price, exchange rate, money supply, government spending and inflation to take the following forms:

$$\pi_t = g_{11}\pi_{t-1} + g_{12}\boldsymbol{p}_{t-1} + g_{13}\boldsymbol{e}_{t-1} + g_{14}\boldsymbol{m}_{t-1} + g_{15}\boldsymbol{s}_{t-1} + \boldsymbol{\varepsilon}_{1t} \quad (14)$$

$$\boldsymbol{p}_t = g_{21}\boldsymbol{p}_{t-1} + g_{22}\pi_{t-1} + g_{23}\boldsymbol{e}_{t-1} + g_{24}\boldsymbol{m}_{t-1} + g_{25}\boldsymbol{s}_{t-1} + \boldsymbol{\varepsilon}_{2t} \quad (15)$$

$$\boldsymbol{e}_t = g_{31}\boldsymbol{e}_{t-1} + g_{32}\pi_{t-1} + g_{33}\boldsymbol{p}_{t-1} + g_{34}\boldsymbol{m}_{t-1} + g_{35}\boldsymbol{s}_{t-1} + \boldsymbol{\varepsilon}_{3t} \quad (16)$$

$$\boldsymbol{m}_t = g_{41}\boldsymbol{m}_{t-1} + g_{42}\pi_{t-1} + g_{43}\boldsymbol{p}_{t-1} + g_{44}\boldsymbol{e}_{t-1} + g_{45}\boldsymbol{s}_{t-1} + \boldsymbol{\varepsilon}_{4t} \quad (17)$$

$$\boldsymbol{s}_t = g_{51}\boldsymbol{s}_{t-1} + g_{52}\pi_{t-1} + g_{53}\boldsymbol{p}_{t-1} + g_{54}\boldsymbol{m}_{t-1} + g_{55}\boldsymbol{e}_{t-1} + \boldsymbol{\varepsilon}_{5t} \quad (18)$$

Equations (14) to (18) above represent the VAR system equations with five variables interacting with each other. We determine the lag value criteria using **n(n-1)/2** based on Sims (1980) and found five (5) lags as the optimum lags using AIC, FPE and LR criteria, while HQ and SC suggested two lags. In the starting point of the analysis, we present the reduced form VAR in its structural form to be able to establish economic interpretation from the model. Our VAR derivation stopped at the reduced form VAR equation since the study employs normal VAR not structural VAR, thus, the basis for this study roots its foundation from equation (5), other specifications were derived to simplify the analysis.

4. Analysis and Results Discussion

4.1. Unit Root Tests of the Variables

One important pre-estimation test that is required for the analysis is the test of the stationarity and level of integration of the variables in the model. Given the descriptive statistics of the variables, the pre-test was highly necessary as it was expected that the variables were not mean-reverting and their use in the model in their current form could lead to spurious results and erroneous recommendations.

Table 1.1: Unit-root tests for the variables, using Augmented Dicky-Fuller (ADF) and Phillips-Perron (PP) Methods.

Table 1: Unit Root Tests of the Variables

	ADF		P-P		
Variables	**Level**	**1st Diff**	**Level**	**1st Diff**	**Level of Integration**
Inf	-1.7607	-4.1722***	-1.6200	-4.2500***	I(1)
Pms	-1.6352	-9.6190***	-1.7976	-9.5880***	I(1)
exro	-2.9978	-5.2380***	-2.3847	-5.9326***	I(1)
M3	-0.4377	-9.1778***	-0.1282	-10.8016***	I(1)
Gex	-0.9049	-4.7900***	-9.0223***	-	I(1,0)

Note: *, **, and *** indicate 10%, 5% and 1% significance levels respectively; 3. ADF is Augmented Dickey-Fuller and P-P is Phillips-Perron

All variables are integrated of order (1) for ADF test except government spending, which is stationary at level. Given the different orders of integration of the variables in the model, with a mixture of I(1) and I(0) variables, it is necessary to transform them before executing the model. VAR process requires that all model variables must be stationary. Consequently, we differenced all variables, thereby transforming them to I(0) order.

4.2. Stability of the VAR model: AR ROOT

To determine the relative stability of our VAR model, we rewrite our original equation (5) above as follows:

$$\boldsymbol{y}_t = \boldsymbol{A}_1\boldsymbol{y}_{t-1} + \cdots + \boldsymbol{A}_p\boldsymbol{y}_{t-p} + \boldsymbol{\varepsilon}_t \quad (19)$$

VAR model is said to be stable if the roots of the matrix $\boldsymbol{A}_1$ in equation (19) are less than 1 in absolute values. For this to happen, the inverse roots of AR characteristic polynomial should lie within the roots circle as shown in the figure below. The points within the inverse roots circle represent the number of lags and the number of equations in our VAR system.

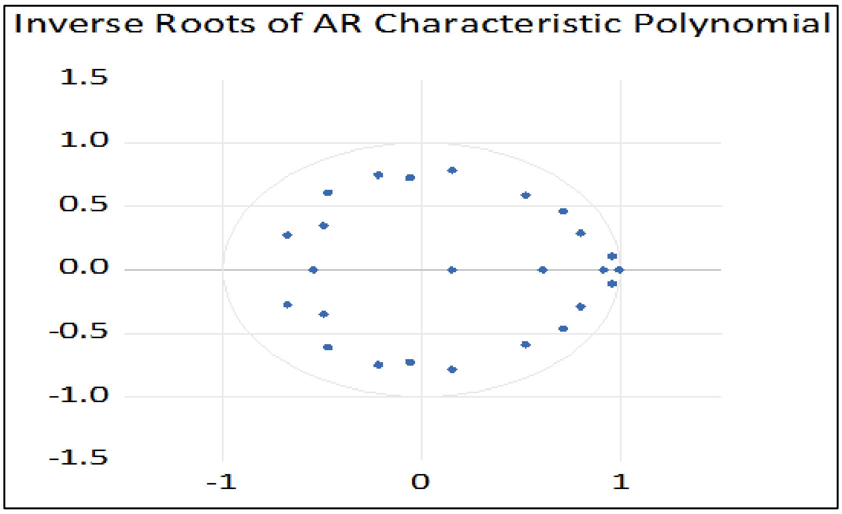

Fig 3: Stability Test

4.3. Impulse Response Function (IRF)

A unit shock is applied to each variable and its effects on other model variables are explained below.

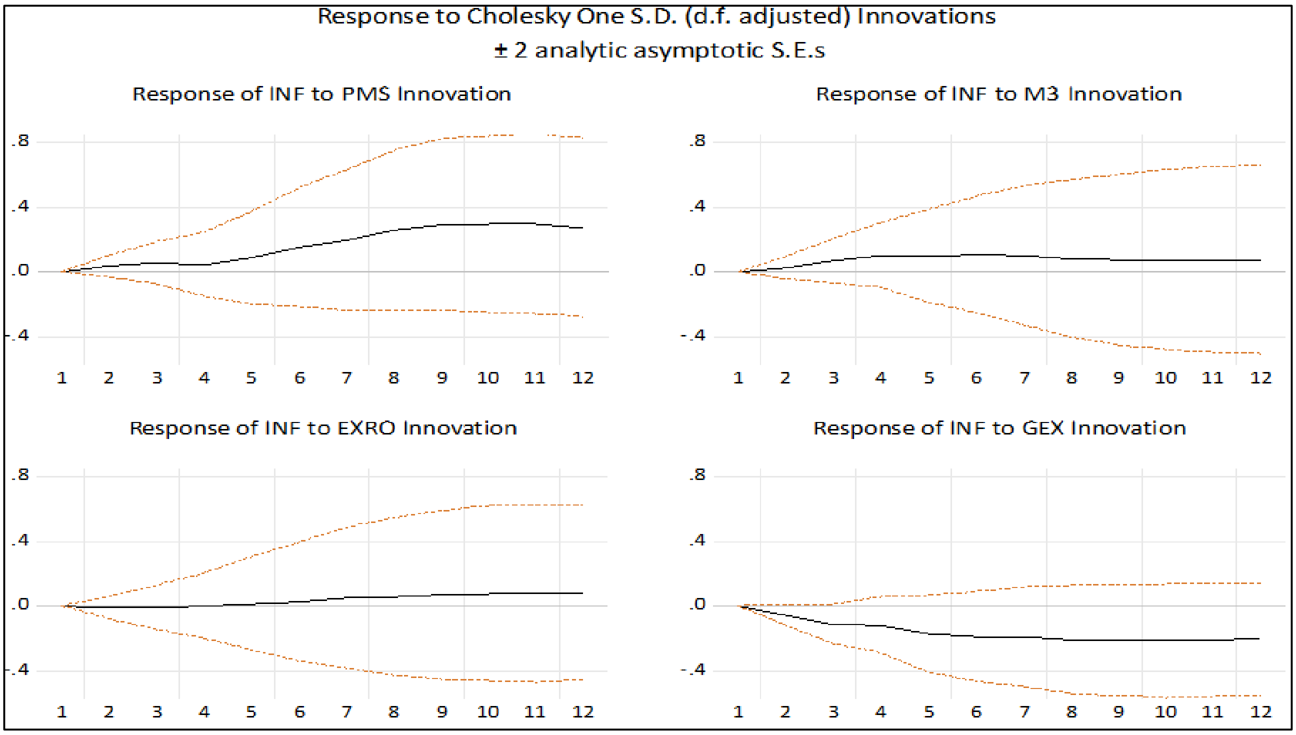

Fig 4: Impulse Response Function

The IRF indicates that inflation responds contemporaneously to itself and to other endogenous variables in the model. Our study suggests inflation responds positively to shocks/innovations coming from fuel price, exchange rate and money supply with some lags, while it responds negatively and significantly to shocks coming from innovation in fiscal policy (government spending).

Specifically, shocks to fuel price appears to have stronger positive effects on inflation compared with other variables in the system, with longer memory in the former. An innovation to fuel price increases inflation marginally but steady from month 1 to month 4, suggesting about 2 months lags, after which inflation accelerates significantly throughout end-month 4 to the rest of the period up to month 11, reflecting the second round effects of fuel price increase on inflation. Thereafter, inflation begins to moderate marginally, suggesting absence of long run relationship between pms price and inflation (similar findings are documented in the literature, see for example, Kpodar & Liu, 2021; Omotosho 2019; Obayelu & Oni 2014; Akpan & Udofia 2016; and Ayinde & Adebisi 2016) [2].

This development suggests that government should roll out permanent measures to tackle the severe effects of subsidy removal in the economy in the immediate short run, since there is a possibility that inflation may accelerate in the long run due to subsidy removal spill-over effects. This finding also suggests authorities should avoid temporary measures like palliatives, which would not moderate the severe effects of inflationary pressure on households' purchasing power permanently. Rather, permanent measures should be undertaken, including wages/salaries reforms. Similarly, with a one Cholesky standard deviation shock to exchange rate, inflation maintains a stable response within its mean on impact throughout month 5, after which inflation begins to increase for the rest of the periods up to month 12, suggesting the impact of exchange depreciation on inflation in Nigeria persists into the long run, although with about 5 months lags. The IRF also suggests that on impact, a one Cholesky standard deviation shock to money supply causes inflation to increase immediately, but marginally, from month 1 to month 7, after which it decelerates marginally throughout the rest of the period, suggesting that increase in money supply increases inflation in line with economic theory, but with a short memory. Thereafter, inflation continues to moderate. We observe the magnitude of the Cholesky deviation direction higher with money supply than with exchange rate, suggesting exchange rate dynamics has been accounted for in subsidy payment by the fiscal authority[4].

Contrary, an innovation to fiscal policy, inflation declines substantially from month 1 to month 6, after which it remains stable up to month 10, and begins to accelerate for the rest of the period, this could be explained from the understanding that capital expenditures component of the government spending drives investment and moderates' inflation.

4.4. Historical Decomposition using Cholesky (d.f. adjusted) Weights

The historical decomposition suggests that all the variables in the model including the lag of inflation contributed unevenly to the variation in inflation in the past periods. This further suggests that inflation drivers in Nigeria are numerous and dynamic. Although, during the study period fuel price shows moderate contribution to the changes in inflation, this is expected since fuel price was fully subsidized between 2014m01 to 2023m05. Thus, the effect was absorbed by the subsidy payment made by the government during the period to maintain stable pms price and to also cushion the effects on inflation. The outcome shows that exchange rate and money supply and the lag of inflation were the main drivers of inflation in our study horizon, this is not surprising since several studies found significant impact of exchange rate and money supply on inflation in Nigeria (see, for example Bulus *et al* 2022).

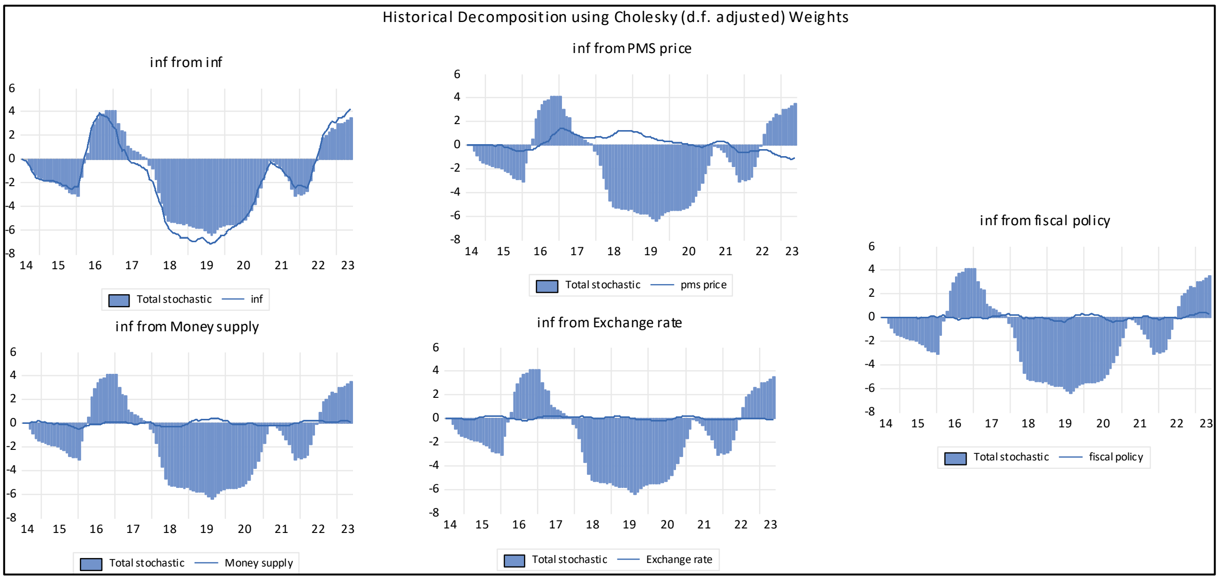

Fig 5: Historical Variance Decomposition

4.5. Forecasts Error Variance Decomposition

The forecast error variance decomposition (FEVD) shows the proportion of movements of a variable due to shock to itself and to shocks to other endogenous variables in the VAR system into the future. This becomes necessary in order to estimate actual decomposition of each variance in the five VAR equations. It gives information about the relative importance of each shock to the variables in the VAR.

Table 2: Forecast Errors Variance Decomposition

Shock	*first quarter*	*second quarter*	*third quarter*	*fourth quarter*
Variance decomposition of inflation (% contribution)				
fuel price	*17.86*	*22.01*	*44.28*	*51.26*
money supply	*20.62*	*22.30*	*11.70*	*8.47*
exchange rate	*1.02*	*0.66*	*2.26*	*3.22*
fiscal policy	*60.50*	*55.03*	*41.76*	*37.05*

[4] Similar analysis was conducted in the same model without subsidized fuel price, and exchange rate appears to have stronger and immediate effects on inflation compared to the model with subsidized fuel price. The intuition is that, since subsidized fuel importation is assessed through official exchange rate, then, the actual effects of exchange rate on inflation in a model with subsidized fuel is distorted. This has been tested and documented in this study for further gaps.

For simplicity purposes, we limit our discussion to the forecast error variance decomposition of inflation[5] following shocks to other variables in the system on for four quarters. This helps to identify the contribution of each endogenous variable to the variation of inflation in the future represented in percentage terms. We excluded the contribution of past values of inflation itself to allow for a holistic analysis among the selected variables in the model. This approach allows us to see the specific contribution of each endogenous variable in the model without the contribution of inflation to itself. The result shows a significant effect from changes in exchange rate, which was suppressed by other variables in the model. Fuel price appears to have a consistent non-trivial contribution to the variation of inflation from first to fourth quarters of the next period.

The result also reaffirms that the second-round effects of fuel price shocks to be more severe than the immediate effects. However, other variables in the model appear to have an unstable pattern in their individual contributions to the variation in inflation in the future. Specifically, in the out-sample forecast of 12 months, the variance decomposition shows changes in inflation during that horizon. For example, overall, the FEVD indicates that fuel price would contribute about 17.86 per cent in the first quarter, 22.01 per cent in the second quarter, 44.28 per cent in the third quarter and 51.26 per cent in the fourth quarter of the next period, indicating a consistent increasing contribution of pms to the variation in inflation in the 12 months period. This reaffirms that, the contribution of fuel prices to the variation in inflation in the future is becoming more significant, following the possible hikes in pms price due to subsidy removal, and its resultant impact on inflation dynamics over the forecast horizon. This is consistent with the current situation in the economy, suggesting the possibility of a more severe long run effects of fuel price shocks to inflation trajectory.

4.6. In sample Forecast Analysis

This is conducted to ascertain the predictive power of our forecast model. This is done to obtain a proper in-sample forecasts to have our baseline forecasts which would be used to gauge the predictive power of the model compared with the actual values of our variables. The chats below show the in-sample forecasts for two years from 2021m05 to 2023m05 (24 months period). In order to be consistent with literature, we migrate from one method to another to arrive at the best method with less uncertainties, and to capture the true performance of our model using the best method.

4.6.1. In-Sample Forecast 1: Deterministic Simulation/Dynamic Solution

In this section, we begin with in-sample forecasts by considering deterministic simulation-dynamic solution (this is in line with the work of Obayelu & Oni, 2014; and Oni, 2017). The chats below are the outcome of the first method.

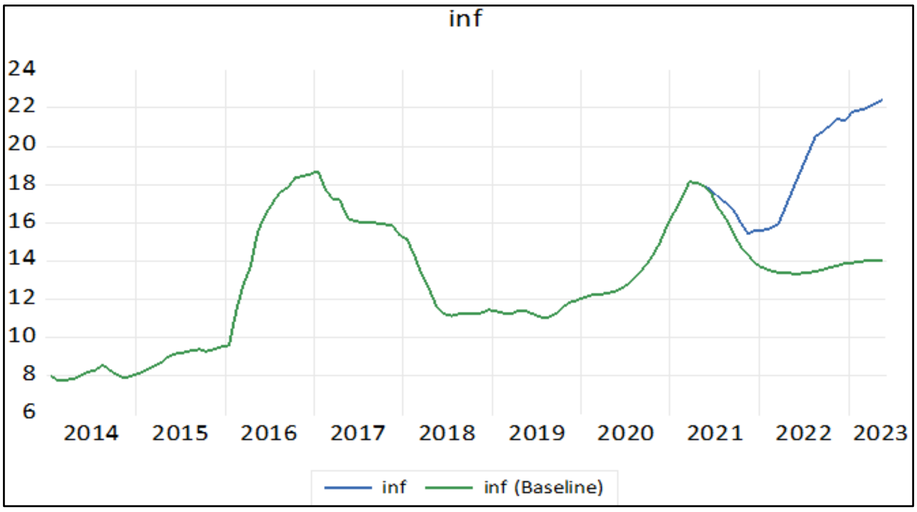

Fig 6: Inflation in-sample forecast

From the chats above, overall, the model is not able to forecast the behaviour of the variables appropriately. This dynamic solution uses only the actual values of the endogenous variables prior to the forecasts sample in producing the forecasts and its uses forecasted lagged values of the endogenous variables to solve forward for the forecasts period. This is not surprising there was a significant deterioration in the forecasted values over time as seen above. These initial forecasts are deterministic, by assuming that our stochastic equation holds exactly over the forecast period. This ignores the fact that this does not hold exactly in reality because of two reasons; the first is the random disturbances, and second, because the coefficients are estimated and not known predetermined actual values of the variables. However, the above problem of uncertainty could be solved by accounting for these sources of uncertainties using stochastic simulation in the VAR system.

4.6.2 In-sample Forecast 2: Stochastic Simulation-Dynamic solution

The use of stochastic simulation is employed here to correct the problem of uncertainties in the previous deterministic simulation. The in-sample forecasts below take into account of sources of uncertainties for proper correction, thus, we have another set of simulations as:

[5] For the forecasts error variance decomposition of pms price, m3, exchange rate and fiscal policy shock are all reported in the appendix section. This is to ensure that the main focus of the study is the contribution of other variables on inflation trajectory variance in the future.

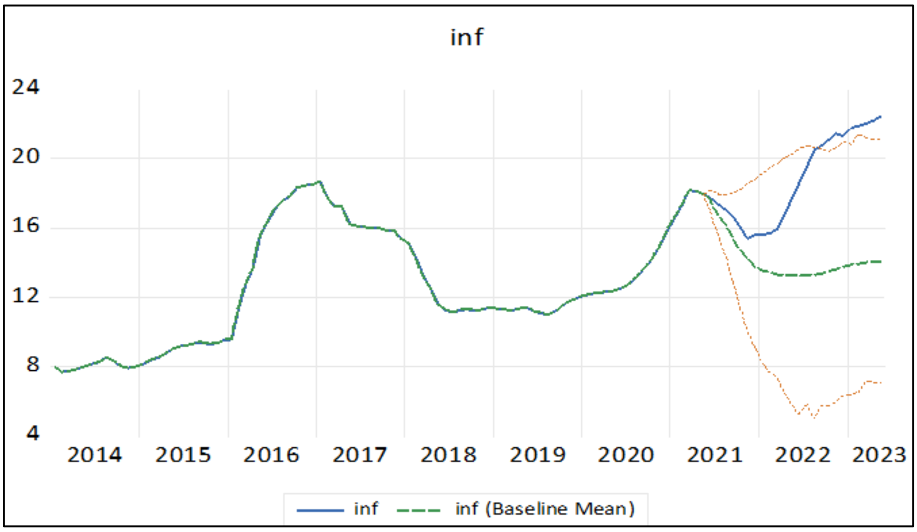

Fig 7: Inflation in-sample forecast

From the above results, we simulate the in-sample forecasts by accounting for uncertainties in our results using stochastic and not deterministic under the simulation type, and also by adding L-bounds confidence intervals to our projections using the bounds criteria. Each variable has a baseline, the mean, the lower and upper bound in this simulation, done to account for the sources of uncertainties.

Most importantly, and unlike the previous simulation that was deteriorating due high level of uncertainties, this simulation appears to be plausible within the confidence bounds of 5%. Also, both the actual and forecast values are within the lower and upper bounds, suggesting that our model forecasts are mimicking reality and could be used for out-of-sample forecast simulation, thereby addressing the issue of uncertainties. The model is used to produce forecasts using the forecasted values of lagged variables over the projection horizon. However, a VAR model is sometimes faced with accuracy issues when forecast is done on forecast, thus, we finally introduced the stochastic simulation using static solution, to correct the issue of accuracy in the VAR model.

4.6.3. In-sample Forecast 3: Stochastic Simulation-Static Solution

The use of stochastic simulation and static solution has received serious attention in the literature over the Deterministic/Stochastic-dynamic solution (see, Oni 2017), especially because we can evaluate the model using static solution that uses actual values of lagged variables to perform the forecast (see chats below), and not forecasted values as in the case of dynamic solution. The charts below represent the most updated in sample forecasts for this study. This is done by using stochastic solution that allows to use actual values of lagged variable unlike the other types in sample forecast highlighted in this paper.

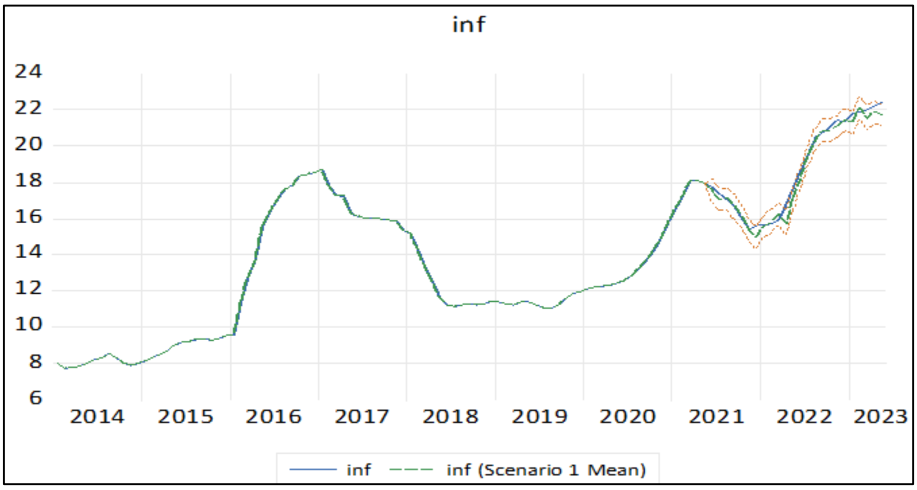

Fig 8: Inflation in-sample forecast

The in-sample forecasts displayed above have upper and lower bounds as well, however, the static forecasts performance seems to be better than dynamic forecasts both in terms of the fits in the model and in terms of smaller standard error bounds interval as could be seen above. This is because the static solution forecast is the factor one period ahead forecast and it uses actual instead of forecasted lagged values over the forecast period like in the stochastic-dynamic solution. Finally, this suggests that our in-sample forecast is fit for the simulation analysis.

4.7. Out of Sample forecast (conditional forecast)

The study carefully conducts in-sample forecast using three different approaches to show the predictive power of the

VAR model before conducting the out of sample simulation using the conditional forecasts. Overall, the results appear plausible which affirms our aim to forecast future shocks on the endogenous variables and how they would impact on inflation trajectory in Nigeria.

4.7.1. The Simulation Analysis

To obtain the desired outcome for this study, we conduct simulation analysis developed by Jordà (2005)[6] with different scenarios to ascertain the path of some selected variables (*pms, exro, gex, m3*) in the VAR system and how shocks to such variables affect inflation trajectory in Nigeria in the future. The local projection approach basically consists in generating multi-step predictions using direct forecasting models that are re-estimated for each forecast horizon to simulate for the out of sample forecasts scenarios. Jordà (2005) argues that the local projections are robust to misspecification of the lag structure as the impulse responses can be defined without any reference to the unknown data generating process. To reduce potential bias in the estimations of the IRFs, Teulings and Zubanov (2014) proposes to augment the local projections with innovations in the regressors between periods *t* and *t+h* when estimating the impulse response at horizon *h* (see Kpodar and Liu 2021).

The study, however, pays more attention to the future path of fuel price dynamics and how such would affect inflation trajectory in Nigeria over time. Having established that our suit of models in the in-sample forecasts period satisfied the necessary and sufficient conditions, we move ahead to conduct the out of sample forecast by applying simulation technique from our existing VAR system. Thus, we have divided the simulation into two categories, the first is the short term out of sample simulation of 6 months (from July 2023 - December 2023) to see the trajectory of inflation due to shocks in pms prices and other endogenous variables in the VAR model, we also conducted a 12 months medium-term forecast simulation by extending the path to June 2024[7]. To achieve this seamlessly, developing from equation 19 in the VAR model, we establish a specification of the simulation and the out of sample forecast as:

$$y_{i,(t+n)} = \psi_0 + N \sum_{i=1}^{p} X_{i,(t+n)} + \xi_{i,(t+n)} \quad (20)$$

Equation (20) above represents the simulation of one time ahead forecast of the variables $(X_1, X_2, X_3, X_4, \ldots\ldots X_n)$ depending on the parameters that determine the future values of variable y_i. Where t represents the current time/period, n represents the number of forecasts periods into the future, *N* represents the number of variables in the model, X_i represents the set of endogenous variables in the VAR system (p, s, m, e) and *i* represents a set of numbers from 1 to p where p represents the lagged-order of the VAR model, where ξ_t are the usual innovations, ψ_0 is a constant term. This is the final stage of the analysis involving an economy with zero subsidy, and the objective is to identify the inflation trajectory in a market-driven petroleum sector.

5. Discussion of the Results

5.1. The Simulation Results

The study established five (6) scenarios in the out of sample space conditional forecast to empirically establish the path of fuel price in a simulation procedure to see the trajectory of inflation in Nigeria for six (6) months into the future, we further extended the forecast horizon to twelve (12) months and saw different responses of inflation to such dynamics in fuel prices in the absence of subsidy (zero subsidy). The outcome of the VAR-Simulation results is carefully discussed in this section. First, we analyse the conditions and assumptions of each scenario below:

Table 3: Scenario Table

	Scenario 1 (with no subsidy)		**Scenario 2 (with no subsidy)**		**Scenario 3 (with no subsidy)**		**Scenario 4 (with no subsidy)**		**Scenario 5 (with no subsidy)**		**Scenario 6 (with full subsidy)**	
Period	pms_1	inf_1	pms_2	inf_2	pms_3	inf_3	pms_4	inf_4	pms_5	inf_5	pms_6	inf_6
2023M06	540.00	22.78	540.00	22.78	540.00	22.78	540.00	22.78	540.00	22.78	254.00	22.78
2023M07	617.00	23.65	617.00	23.65	648.00	23.65	432.00	23.48	617.00	23.65	254.00	23.06
2023M08	617.00	24.29	617.00	24.29	648.00	24.32	432.00	23.91	617.00	24.29	254.00	23.25
2023M09	617.00	24.42	617.00	24.42	648.00	24.49	432.00	24.00	617.00	24.42	254.00	23.38
2023M10	617.00	25.03	617.00	25.03	648.00	25.09	432.00	24.39	617.00	25.03	254.00	23.26
2023M11	617.00	25.94	617.00	25.94	648.00	26.05	432.00	24.89	617.00	25.94	254.00	23.08
2023M12	617.00	26.48	617.00	26.48	648.00	26.65	432.00	25.08	617.00	26.48	254.00	22.83
2024M01	617.00	27.32	648.00	27.32	648.00	27.53	432.00	25.49	432.00	27.32	254.00	22.49
2024M02	617.00	27.70	648.00	27.73	648.00	27.97	432.00	25.52	432.00	27.42	254.00	22.16
2024M03	617.00	27.57	648.00	27.63	648.00	27.88	432.00	25.27	432.00	27.13	254.00	21.83
2024M04	617.00	27.44	648.00	27.49	648.00	27.76	432.00	25.07	432.00	27.02	254.00	21.50
2024M05	617.00	26.88	648.00	26.99	648.00	27.21	432.00	24.58	432.00	26.12	254.00	21.24
2024M06	617.00	26.21	648.00	26.38	648.00	26.52	432.00	24.08	432.00	24.99	254.00	21.00

[6] Studies that have adopted this method include Kpodar & Liu 2021, Auerbach and Gorodnichenko (2013); Jordà *et al.* (2013); Caselli and Roitman (2016); Kpodar and Abdallah (2017, 2020); Ramey and Zubairy (2018); and Alesina *et al.* (2019).

[7] The forecast period is now 12 months (i.e. from July 2023 – June 2024)

The Assumptions										
	scenario 1		scenario 2		scenario 3		scenario 4		scenario 5	
Period	May as base month	June as base	May as base month	June as base month	May as base	June as base	May as base month	June as base	May as base month	June as base
	% pms	% pms	% pms	% pms	% pms	% pms	% pms	% pms	% pms	% pms
2023M06	112.55	-	112.55	-	112.55	-	112.55	-	112.55	-
2023M07	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2023M08	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2023M09	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2023M10	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2023M11	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2023M12	142.86	14.26	142.86	14.26	155.06	20.00	70.04	- 20.00	142.86	14.26
2024M01	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00
2024M02	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00
2024M03	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00
2024M04	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00
2024M05	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00
2024M06	142.86	14.26	155.06	20.00	155.06	20.00	70.04	- 20.00	70.04	- 20.00

Fig 9: The Assumptions

1. Scenario One

In this scenario, we assume that the fuel price would remain fixed at N617 throughout the forecast horizon (from July 2023 – June 2024), this represents 14.26 per cent increase in pms price from N540/litre in the month June 2023 which was applied across the forecast horizon (since pms price is now administered). This is done on the basis of government's commitment in ensuring stable fuel price by introducing partial intervention to retain the pms at the current price as the threshold. The VAR-Simulation outcome shows that inflation would accelerate marginally to 24.29 per cent in August 2023 from 24.08 in the preceding month. Afterwards, inflation would soar to 24.42 per cent in September 2023, 25.03 per cent in October 2023, 25.94 per cent in November 2023 and 26.48 per cent in December 2023. The result also suggests that inflation would surge to a high time pick figure of **27.70 per cent in February 2024 which has been established as the inflation threshold for this scenario.** Subsequently, it begins to decelerate marginally to 27.57 per cent, 27.44 per cent, 26.88 per cent and 26.21 per cent in the months of March 2024, April 2024, May 2024 and June 2024, respectively. The moderation in inflation in the month of March 2024 suggests the waning impact of market expectation as fuel price will no longer increase afterwards.

2. Scenario Two

In the second scenario, we assume that the fuel price would remain fixed at N617 for the first six months of the forecast horizon (from July – December 2023), this represents 14.26 per cent increase in pms price from N540/litre in the month June 2023 which was applied across the first part of the forecast horizon. This is done on the basis of government's commitment in ensuring stable fuel price, which we assume to last for six months after which we relax and further assume that fuel price may increase by 20.00 per cent to N648.00 from over the rest of the forecast horizon (From January – June 2024). The VAR-Simulation outcome shows that inflation would increase to 24.29 per cent in August 2023 from 24.08 in the preceding month. Afterwards, inflation would soar to 24.42 per cent in September 2023, 25.03 per cent in October 2023, 25.94 per cent in November 2023 and 26.48 per cent in December 2023. For the second part of the forecast horizon, the VAR result reveals that inflation would rise to 27.32 per cent and **27.73 per cent** in January and February 2024, respectively**, this has been established as the inflation threshold for this scenario.** However, inflation is expected to decelerate marginally for the rest of the period to about 26.38 per cent in the month of June 2024.

3. Scenario Three

In this scenario, we assume that the fuel price would remain fixed at N648.00 throughout the forecast horizon (from July 2023 – June 2024), this represents 20.0 per cent increase in pms price from N540/litre in the month June 2023 which was applied across the forecast horizon. This is done on the fact that the commitment of the government to retain the pms price at N617/litre may not be sustainable, looking at the forces of demand and supply and several distortions in the fiscal space compounded by high deficit and low revenue, which are major factors that could hinder the intervention of the government to ensure price control. The VAR-Simulation outcome shows that inflation would surge to 26.65 per cent in December 2023 from 24.08 in the month of June 2023. Additionally, Inflation would continue to accelerate to its pick figure **27.97 in the month of February 2024, which has been established as the inflation threshold for this scenario.** Subsequently, it begins to decelerate marginally to 27.88 per cent, 27.76 per cent, 27.21 per cent and 26.52 per cent in the months of March 2024, April 2024, May 2024 and June 2024, respectively. We have established in this study and across all the scenarios that inflation would begin to moderate from the month of March 2024, i.e. after nine (9) months of consecutive acceleration since the implementation of subsidy removal.

4. Scenario Four

In this scenario, we are optimistic that fuel price would adjust by 20 per cent decrease from N540/litre as at June 2023, thus, it would remain at a fixed price of N432/litre which was applied across the forecast horizon (from July 2023 – June 2024). This is done on the fact that the commitment of the government with the support of CBN in stabilising foreign exchange may partially cushion the effect of subsidy removal on the fuel price, since exchange is one of the major factors that determine the price of pms in Nigeria. The VAR-Simulation outcome shows that inflation is expected to decelerate to 23.91 per cent in the month of August from 24.08 in the month of July 2023. The result shows that inflation would begin to accelerate marginally to 25.08 in the month of December 2023 and **25.52 per cent in the month of February 2024, which has been established as the inflation threshold for this scenario.** Consequently, it begins to decelerate marginally to 25.27 per cent, 25.07 per cent, 24.58 per cent and 24.08 per cent for the months of March 2024, April 2024, May 2024 and June 2024, respectively. This corroborates with the findings in all the scenarios.

5. Scenario Five

In scenario 5, we assume that the fuel price would remain fixed at N617 for the first six months of the forecast horizon (from July – December 2023), this represents 14.26 per cent increase in pms price from N540/litre in the month June 2023 which was applied across the first part of the forecast horizon. This is done on the basis of government's commitment in ensuring stable fuel price, which we assume to last for six months after which we assume the price to moderate by 20 per cent from June 2023, thus, the fuel price would decelerate to N432/litre over the rest of the forecast horizon (From January – June 2024). The VAR-Simulation outcome shows that inflation would increase to 24.29 per cent in August 2023 from 24.08 in the preceding month. Afterwards, inflation would soar to 24.42 per cent in September 2023, 25.03 per cent in October 2023, 25.94 per cent in November 2023 and 26.48 per cent in December 2023. For the second part of the forecast horizon, the VAR result shows that inflation would continue to accelerate marginally to 27.32 per cent and 27.42 per cent in January and **February 2024, respectively, which has been established as the inflation threshold for this scenario.** However, inflation is expected to decelerate for the rest of the period from 27.13 per cent in the month of March 2024 to about 24.99 per cent in the month of June 2024. The last three months dynamics in inflation corroborates with the outcomes in all the scenarios.

6. Scenario Six: An economy with full subsidy[8]

In this scenario, we are assuming an economy with full subsidy and that the fuel price would remain at N254/litre[9] which was applied across the forecast horizon (from July 2023 – June 2024). This is done with the assumption that government would continue to subside the pms price. The VAR-Simulation outcome shows that inflation is expected to decelerate to 23.25 per cent in the month of August from 24.08 in the month of July 2023. The result shows that inflation would begin to accelerate marginally to 23.38 in the month of September 2023. However, inflation would decelerate for the rest the forecast horizon to about 22.83 per cent in the month of December 2023 and 21.00 per cent in the month of June 2024, this suggests that inflation could be moderated if fuel is subsidized.

5. Policy Implications

The findings suggest inflation responds positively to shocks/changes arising from hikes in fuel prices as a result of subsidy removal. Undoubtedly, this has a negative implication on the economy. The findings further affirm the assertion that changes in oil price drives inflationary phenomena in the economy even though PMS pump prices were being subsidized. As PMS prices increase over time, inflation trends in the same direction as shocks to fuel prices appear to have stronger and more significant effects on inflation as compared with other variables used in the model. This implies that in the events of continuous PMS price increases arising from factors such as subsidy removal, variations in exchange rate and crude oil price etc may pose inflationary pressure and distortions in the economy. In view of the findings of this study, it is recommended, therefore, that, the government should roll out permanent measures to tackle the severe effects of subsidy removal on the economy immediately in the short run. Reforms in the foreign exchange market should be made to stabilize fluctuations since licensed fuel importers have to depend on sourcing forex from unofficial sources to meet demands, thereby making the landing cost more expensive.

In addition, permanent measures such as salaries/wage increments should be taken into consideration, as the subsidy effect directly affects household earnings and purchasing power. Another interesting outcome is that inflation has a null response to government spending, suggesting that the more the government spends on subsidizing fuel, inflation less responds. This, however, further contradicts the assertion that inflation is a monetary phenomenon; as government spending may not necessarily lead to an increase in the volume of money supply in the economy. The trajectory of inflation is of so much concern to the CBN, thus, the need for proper collaboration between fiscal authority and the CBN in addressing the expected inflation pressure. Price stability is the key mandate of any central bank and when inflation goes out of hand, such central bank must be held responsible. We, therefore, recommend further monetary policy tightening and proper exchange rate management by the CBN to help in taming inflationary pressure.

The projections for the future inflation path, using different scenarios of PMS prices without subsidy removal suggest that inflation would moderate marginally oscillating between 22.78 - 26.120 percent. Moreover, the scenario of full subsidy removal would result in inflation soaring to 27.78 percent. This suggests that a continued minimum intervention from the government may be necessary to curtail the rising inflationary trend. Therefore, the government may not necessarily take off its hand completely from intervening in the oil sector when necessary.

6. Conclusion

The paper investigated the effect of subsidy removal on inflation trajectory in Nigeria using different scenarios. It then estimated the impulse response of inflation to a change in PMS within the period of study. The transmission of the PMS price shocks is more protracted; thus, the findings suggest a pass-through between subsidy reforms/policies and PMS prices, hence impacting domestic general prices. The paper also provides evidence that other controlled variables such as exchange rate, and money supply also impact inflation in the short and long-run terms. Most importantly, the study establishes inflation threshold across different domestic prices scenarios which is one of the Nobel contributions in this paper. The study further considers including subsidy10 as a variable in the model in order to control for instrumental component of the fuel price overtime, this has been documented and preserved for further study.

[8] We have noted that, its imperative to simulate an economy with 100% subsidy to see whether inflation would respond to such situation. The results reveal that inflation may decelerate throughout the forecast horizon, suggesting the impact of subsidized fuel in moderating inflationary pressure in Nigeria.

[9] This is the same as the May 2023 fuel price of N254, when fuel was fully subsidized

[10] We have computed and generated the variable "subsidy'' as a residual of the pms price with full subsidy from pms price with zero subsidy, we used a baseline period of June 2023 pms figure of N540 by subtracting all the preceding periods to compute the subsidized component of each litre sold prior to June 2023.

7. References

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