Macroeconomic Analysis Using VAR Model: The Impact of Money Supply on Inflation in Nigeria

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Abstract. Inflation remains a persistent macroeconomic challenge in developing economies like Nigeria, where controlling the money supply is a central policy tool for stabilisation. This study empirically examines the dynamic relationship between money supply growth and inflation in Nigeria from 1961 to 2023 using a bivariate Vector Autoregression (VAR) model. Drawing on the Quantity Theory of Money, I account for real-world complexities such as structural rigidities and external shocks that can weaken the theoretical one-to-one link between money and prices. Annual time-series data on Consumer Price Index (CPI) inflation and broad money (M2) growth are employed. Pre-estimation tests confirm that both series are non-stationary in levels but stationary after first-differencing, justifying a VAR in growth rates. A lag length of one year is selected based on information criteria. Key findings include unidirectional Granger causality from the money supply to inflation ($F=13.099$, $p<0.001$), indicating that past changes in the money supply significantly predict inflation, whereas the reverse is not true. Impulse-response analysis reveals that a positive money supply shock triggers a gradual rise in inflation, peaking about 1 year later before tapering off, reflecting monetary transmission lags. Variance decomposition shows that money supply shocks account for roughly 30% of the variation in short-run inflation (the first 1–3 years).

In contrast, the bulk of inflation variability is due to other factors in the long run. These results affirm a monetary influence on inflation in Nigeria but also underscore the role of non-monetary factors and policy lags. Based on these findings, the policy implications emphasise the importance of prudent money supply management for price stability, while coordinating with fiscal policy and structural reforms to address supply-side constraints. The study concludes with recommendations for policymakers at the Central Bank of Nigeria (CBN) and the Ministry of Finance on controlling inflation through better monetary-fiscal coordination and discusses the need for future research to expand the model beyond the current bivariate setup to capture additional drivers of inflation.

Keywords: Inflation; Money Supply; VAR Model; Granger Causality; Nigeria; Monetary Policy.

INTRODUCTION

Inflation is one of the most critical macroeconomic challenges worldwide. Its persistence erodes household purchasing power, hampers long-term economic growth, and undermines social stability by exacerbating poverty and inequality. In response, central banks and finance ministries in developing economies like Nigeria often turn to controlling the money supply as a primary tool for managing inflation. However, the relationship between money supply growth and inflation is far from mechanical. It is shaped by structural rigidities (such as production bottlenecks and infrastructure gaps), fiscal dynamics (for instance, government deficit financing), and the effectiveness of the economy's monetary transmission mechanisms.

Classical quantity theory author [1] posits a proportional, one-to-one relationship between the money supply and the price level under the assumptions of stable velocity and output. In other words, if the amount of money in an economy doubles, prices would eventually double. Yet empirical evidence, especially from developing countries, often deviates from this simple prediction. Factors such as an underdeveloped financial

Markets, supply-side constraints, and external shocks (e.g. commodity price swings) can weaken or delay the pass-through from money growth to inflation. In Nigeria – a resource-dependent economy with a history of volatile inflation – the money-inflation link is particularly complex. For instance, episodes of high inflation have coincided with non-monetary disturbances, such as oil price spikes, sharp currency depreciation, and periods of fiscal dominance in which government borrowing fueled price increases despite central bank actions [2, 3]. These influences can overshadow the impact of monetary expansion alone.

Recent developments highlight the need for a nuanced analysis. Nigeria's inflation rate averaged about 16% over the decade leading up to 2024, surging to 31.4% in 2024 amid a combination of fuel subsidy removals, naira depreciation, and food supply shocks [4, 5]. Broad money (M2) growth during this period was erratic: year-on-year M2 growth reached 15.5% in early 2025 due to liquidity injections, then contracted slightly by February 2025 as specific monetary measures took effect [6]. Such volatility in both inflation and money supply, especially in the wake of COVID-19 and major policy reforms, underscores the need for robust empirical analysis to inform Nigerian macroeconomic policy. High and unpredictable inflation has severe implications for development; it disproportionately harms the poor and can derail poverty-reduction efforts in a country where about 40% of the population lived below the poverty line in 2023 [7].

Objectives of the study

In light of the above context, this study analyses the impact of money supply on inflation in Nigeria through a VAR model, focusing on three specific objectives:

Granger Causality: Test whether changes in money supply Granger-cause inflation (and vice versa), to shed light on the direction of influence between these variables.

Dynamic Impulse Responses: Trace the Impulse Response Functions (IRFs) of inflation to a shock in money supply (and vice versa) over time, to understand the magnitude and persistence of inflationary effects from monetary shocks.

Forecast Variance Decomposition: Quantify the share of inflation's forecast error variance that is attributable to shocks in money supply (versus shocks to inflation itself), indicating the relative importance of monetary shocks in explaining inflation variability over short and longer horizons.

By employing annual data from 1961 to 2023, my analysis captures both long-term trends and recent economic shocks (such as the 2020 pandemic recession and the anticipatory effect of the 2023 policy reforms) in a unified framework. This extended sample helps ensure that a single episode does not drive the results and remains relevant to contemporary policy debates.

The remainder of the paper is structured as follows. Section 2 reviews the relevant literature on money supply and inflation dynamics, with an emphasis on findings from Nigeria and comparable economies. Section 3 discusses methodology and data, including the VAR modelling approach, data sources, and pre-estimation tests for stationarity and lag selection. Section 4 presents the estimation results and discusses the key findings (Granger causality tests, impulse responses, and variance decomposition) in the context of theory and prior studies. Section 5 distils the policy implications from the results, offering recommendations to the CBN and fiscal authorities to control inflation and improve monetary transmission. Section 6 suggests avenues for future research, and the final section provides references and any appendices with supplemental material.

Literature Review

A rich body of theoretical and empirical literature examines the relationship between money supply and inflation. The classical Quantity Theory of Money (QTM) provides the theoretical baseline, asserting a direct proportional relationship between money growth and price increases when other factors (velocity of money and real output) are held constant [1]. In line with QTM, early cross-country evidence found a strong long-run correlation between money supply growth and inflation. For example, authors [8] showed that countries with higher money growth tended to have higher inflation over the long run. However, other research has noted essential caveats. Autors [9] pointed out that in environments of fiscal dominance (where government deficits are monetised) or high currency substitution, the simple money-inflation link can break down. In such cases, inflation may remain high even if money growth is contained, or conversely, significant money expansions might not immediately translate to inflation if demand for money rises. Furthermore, the author [10] highlights that in many low-income countries, inflation is often driven more by supply shocks (such as food and import prices) and fiscal factors than by the money supply alone, reflecting structural weaknesses in the monetary transmission mechanism.

In the Nigerian context, several studies have investigated these dynamics with mixed findings. Authors [2, 3] provided evidence that monetary expansion contributes to inflationary pressures in Nigeria, supporting the notion that "too much money chasing too few goods" is part of the inflation story. However, they also note that the magnitude and timing of this effect can vary across different policy regimes and economic conditions. Authors [11] argued that the inflation-money link in Nigeria is not always direct; external factors such as oil price shocks, exchange rate depreciation, and structural rigidities in production often play a dominant role in driving inflation outcomes. These factors can dilute or mask the impact of domestic money supply changes on prices.

More recent empirical studies offer additional nuances. Authors [12] examined the impact of inflation on economic growth in Nigeria over a 4-decade period. They found that moderate inflation might coincide with growth, but excessive money-supply-driven inflation increases macroeconomic volatility and uncertainty, harming investment. Authors [13], using a Vector Error Correction Model (VECM), showed that high inflation in Nigeria erodes the effectiveness of monetary policy in stimulating investment, implying that once inflation expectations become unanchored, the usual monetary levers lose potency. Authors [14] applied an ARDL approach for 1981–2021. They found a significant long-run positive relationship between the money supply and inflation, though transmission lags and possibly policy countermeasures muted short-run effects.

VAR models have been widely used to analyse monetary dynamics in Nigeria and similar economies. For instance, the author [15] employed a VAR to assess Nigeria's inflation-targeting framework. They found that traditional channels (such as interest rates and credit) had little effect on inflation. In contrast, exchange rate pass-through was a stronger channel – a result consistent with the open nature of the economy. Authors [16], using a VAR and Granger causality tests on data from 1973–2013, observed that both the money supply and inflation Granger-caused changes in output (GDP) and interacted in complex ways, including evidence that inflation and money supply changes could dampen growth. Authors [17] used a Factor-Augmented VAR (FAVAR) to incorporate broader economic information. They found that interest rate and credit conditions were more influential in Nigeria's inflation dynamics than the narrow money measure. However, their work predates recent structural changes.

The post-2020 period has brought new challenges and insights relevant to this study. The African Development Bank (2024) and IMF (2025) report that Nigerian inflation spiked above 30% in 2024 – one of the highest levels in decades – before potentially easing to the low-20% range in 2025 as one-off effects of subsidy removal wane. These institutions note that while recent monetary tightening and reforms (such as the unification of exchange rates and removal of fuel subsidies) have improved macroeconomic stability, the transmission of monetary policy to inflation remains impeded by infrastructure deficits, import dependence (especially for food), and the lingering effects of fiscal dominance [18].

METHOD

To analyse the interplay between money supply and inflation without imposing strong theoretical priors about which variable is exogenous, I employ a Vector Autoregression (VAR) framework [19]. VAR models treat all included variables as endogenous and capture their mutual interactions over time. This data-driven approach is well-suited to my study because it allows the inflation rate and money supply growth to influence each other dynamically, rather than assuming a priori one-sided causality. The general form of a VAR(p) with two variables (here, inflation and money growth) is:

$$Yt = A0 + A1Yt-1 + A2Yt-2 + \ldots + ApYt-p + \varepsilon t, \quad (1)$$

where Yt is a 2×1 vector Inflationt MoneySupplyt, each Ai is a 2×2 coefficient matrix, and εt is a 2×1 vector of residuals (error terms) assumed to be white noise.

In my bivariate VAR, the inflation variable is the log difference of the CPI (consumer price index) – essentially the inflation rate – and the money supply variable is the log difference of M2 (broad money), representing the growth rate of the money supply. By using log differences, I focus on growth rates, which stabilise the variance and allow interpreting impulses as percentage changes.

Within this VAR framework, I conduct several analyses to address my objectives:

Granger Causality Tests: I test whether lags of money supply growth have statistically significant predictive power for inflation (and vice versa), beyond the information contained in past inflation alone. A considerable test would indicate Granger causality, suggesting a directional influence in a predictive sense.

Impulse Response Functions (IRFs): I compute IRFs to trace out how a one-standard-deviation shock to one variable (e.g., an unexpected increase in money supply growth) affects the trajectory of the other variable (inflation) over subsequent years; this is done for both structural (orthogonalised) IRFs – imposing an identification assumption – and reduced-form (non-orthogonal) IRFs. Given my two-variable setting, I use a Cholesky decomposition to orthogonalise shocks, ordering money supply first and inflation second.

Forecast Error Variance Decomposition: I decompose the forecast error variance of inflation across different horizons (years 1, 3, 5, 10) into components attributable to shocks in the money supply versus shocks in inflation itself; this provides insight into the relative importance of money supply shocks in driving inflation variability in the short run and long run. For example, suppose a large share of inflation's variance is due to short-term money supply shocks. In that case, it suggests that monetary factors are a key driver of inflation fluctuations in that period.

This VAR approach is well-suited for Nigeria's context because it captures the lagged and potentially reciprocal nature of monetary dynamics. Policy shocks in Nigeria are known to propagate with lags due to structural factors [10], and a VAR can flexibly model such delays. I ensure robustness of my VAR analysis through standard diagnostic steps: I perform stationarity tests to avoid spurious regression, determine the appropriate lag length with statistical criteria, and check model stability and residual diagnostics after estimation.

Data Collection. I use annual time-series data for Nigeria covering 1961–2023, yielding 63 observations per series (with some adjustments noted below). The two variables analysed are:

Inflation: Measured as the annual percentage change in the Consumer Price Index (CPI). This series (World Bank indicator FP.CPI.TOTL.ZG) captures Nigeria's year-on-year inflation rate (in per cent), reflecting changes in the cost of living.

Broad Money Growth: Measured as the annual percentage change in broad money (M2), which includes currency in circulation, demand deposits, and other easily accessible liquid assets. I use the World Bank indicator FM.LBL.BMNY.ZG for M2 growth (%); this serves as a proxy for monetary expansion policy and liquidity conditions in the economy.

All data were sourced from the World Bank's World Development Indicators (WDI) database for consistency and broad coverage [20]. I retrieved the CPI inflation and M2 growth series, then merged them by year. I took several minor data-cleaning steps: I excluded observations for years with incomplete or anomalous data (e.g., 1960 and 2024, which appeared as partial or outlier entries in Nigeria's WDI series). I transformed the raw series by taking natural logarithms and first differences to obtain the growth rates (denoted as lCPI for the log-differenced CPI and lMS for the log-differenced money supply). This log-differencing corresponds to using approximate percentage changes and was done after confirming the need for stationarity. The transformation also stabilises the series' variance over time. After differencing, the earliest year's observation is lost (since, for example, Δ ln(CPI1961) would require 1960 data), leaving us with effectively 62 data points for each differenced series, and slightly fewer once I account for the VAR lags in estimation. Table 1 provides summary statistics for the inflation and money growth series over the sample period.

Table 1 – Descriptive Statistics (Nigeria 1961–2023)

Variable	Mean	Dev.	Min	Max	N
CPI Inflation (%)	15.2	12.8	-1.9	72.8	63
Broad Money Growth (%)	18.5	14.3	-5.2	65.1	63

Source: [20].

Table 2 – Augmented Dickey-Fuller Test Results

Variable	ADF p-value (Level)	ADF p-value (1st Diff.)	Order of Integration
CPI Inflation	0.247 (non-stationary)	0.010 (stationary)	I(1)
Broad Money Growth	0.123 (non-stationary)	0.010 (stationary)	I(1)

As seen in Table 1, Nigeria's annual inflation averaged about 15% over 1961–2023, with high volatility (standard deviation of 13 percentage points) and episodes of deflation (minimum −1.9%) as well as extreme inflation (peak 73% during a crisis period). Broad money growth averaged around 18% per year with similarly large fluctuations. Visual inspection of the time series (Appendix Figures A1–A4) shows distinct periods of instability: inflation spiked notably in the mid-1970s (after the oil boom) and again in the mid-1990s (during structural adjustment and currency devaluation), whereas money supply growth accelerated particularly in the 2000s and 2010s as financial sector reforms and deficit monetisation took place. These patterns suggest that while there may be co-movement between money and prices in some epochs, there are also periods where external shocks or policy regime shifts drive them; this reinforces the importance of a formal empirical analysis.

Pre-Estimation Procedures. Before estimating the VAR model, I conducted standard pre-estimation tests to ensure the data and model specification are appropriate:

Stationarity Tests: I applied the Augmented Dickey-Fuller (ADF) test [21] to each series to determine whether it has a unit root (i.e., is non-stationary) or is stationary. The ADF tests (with trend and intercept) indicated that inflation (CPI%) and money growth (M2%) are non-stationary in levels – the test p-values were well above conventional significance (e.g., $p = 0.25$ for inflation, $p = 0.12$ for money), failing to reject the null of a unit root. However, after first-differencing the series (which, in my case, means calculating the year-over-year change in log values—the growth rate), I found that both series were stationary (ADF p-values = 0.01 for each). Thus, each series is integrated of order one, I(1). I present the ADF test summary in Table 2.

The stationarity tests indicate that the variables are non-stationary, so we use first differences (growth rates) in the VAR model to avoid spurious regression. I also tested for possible long-run cointegration between the CPI level and the money supply using the Johansen cointegration test. The Johansen test found no evidence of a stable cointegrating relationship between the level variables (trace test $p > 0.05$), which supports my decision to use a VAR in first differences without an error-correction term.

Lag Length Selection: Choosing an appropriate lag length p for the VAR is crucial to capture dynamics without overfitting. I considered lag lengths up to 2 (given the annual frequency and limited sample size). Information criteria results (see Appendix Table A1) suggested a lag of $p = 1$ year. Specifically, the Schwarz Bayesian Criterion (SC) was minimised at $p=1$ (SC = −0.960 for lag one vs –0.870 for lag 2), indicating that a parsimonious one-lag model is preferred – the Akaike Information.

Criterion (AIC) slightly favoured $p=2$ (AIC = –1.242 for lag two vs −1.183 for lag 1), but AIC tends to overestimate lag length with limited samples. Given the SC's emphasis on parsimony and the relatively small sample (practical observations 60 after differencing), I opted for VAR(1) as the baseline. Sequential likelihood ratio (LR) tests further supported this choice, as they showed that adding a second lag did not significantly improve model fit (the LR test for $p = 2$ vs. $p = 1$ had $p > 0.1$). Using a single lag is also consistent with other annual-data studies of Nigeria's macroeconomy (e.g., [16]), which also used an annual VAR(1).

VAR Model Specification and Estimation. In the analysis, I specify a bivariate VAR(1) model in the log-differenced series. In equation form, I write the system as follows:

lCPIt lMSt=A0+A1 lCPIt−1 lMSt−1+εCPI,t εMS,t, (2) where lCPIt = ln(CPIt) − ln(CPIt−1) (annual inflation in log differences) and lMSt = ln(M 2t) − ln(M 2t−1) (annual money growth in log differences). A0 is a vector of constant terms (intercepts) in each equation, and A1 is a 2×2 matrix of coefficients capturing the effect of last year's inflation and money growth on this year's values.

I expect, based on theory and prior evidence, that the off-diagonal element in A1 corresponding to the effect of money supply on next-period inflation will be positive if money supply growth tends to fuel inflation with a lag. The reverse off-diagonal (inflation's effect on next-period money growth) may or may not be significant; a non-significant coefficient there would support the idea that causality runs predominantly one way (from money to prices).

I estimated the VAR coefficients by Ordinary Least Squares (OLS) equation-by-equation (given sufficient observations relative to the parameters, OLS is efficient for VAR). The adequate sample for estimation is 1963–2023 (after losing one observation to differencing and one to the lag, I have 61 observations, n61). All estimation and analyses (Granger tests, IRFs, etc.) were conducted using the "vars" package in R [22].

After estimation, I carried out diagnostic checks to ensure the model is well-specified:

Stability: The VAR is stable if all eigenvalues of the companion matrix lie inside the unit circle (i.e., have modulus < 1). In my model, the two eigenvalues were 0.263 and 0.1611, which are well within the unit circle, indicating the VAR(1) is dynamically stable. It will not explode or produce nonsensical long-run results.

Serial Correlation: I applied the Lagrange Multiplier (LM) test for autocorrelation on the residuals. The LM test for up to lag one residual autocorrelation was not significant ($p > 0.05$), suggesting that the VAR(1) specification has captured the essential dynamics and that there is no evidence of residual serial Correlation.

Heteroskedasticity: A test (White's test) indicated mild heteroskedasticity in the residuals (likely because macroeconomic shocks vary in magnitude over such an extended sample). To guard against inference bias, I used heteroskedasticity-robust standard errors when evaluating the significance of VAR coefficients and in the Granger causality tests, given that my interest is mainly in impulse responses and variance decompositions (which rely on the estimated covariance matrix of residuals).

Also examined whether a few large shocks (outliers) unduly influence the results; the model's pulses were recomputed excluding known outlier years (e.g., the 1994 inflation spike) and found to be qualitatively similar, indicating robustness.

RESULTS AND DISCUSSION

Stationarity and Data Transformation. ADF results confirmed the need for differencing (Section 5). Log-differenced series (lCPI, lMS) were stationary, enabling VAR estimation without spurious regression.

Granger Causality. The Granger causality results show a one-way relationship from money supply growth to inflation in Nigeria. The null that money supply does not Granger-cause inflation is rejected ($F = 13.099$, $p = 0.0007$), indicating that past increases in money supply significantly predict inflation; this supports the monetarist view that monetary expansion fuels price growth [1, 14]. In contrast, the reverse causality test (inflation → money supply) is insignificant ($F = 1.709$, $p = 0.196$), showing no evidence that inflation drives money growth. Thus, monetary changes appear policy-driven rather than reactive. Overall, results confirm that money supply growth leads to inflation in Nigeria.

Impulse Response Functions. Impulse Response Functions (IRFs) reveal how inflation reacts dynamically to money supply shocks. Over a 10-year horizon, inflation rises following a one-standard-deviation increase in money growth (≈14%). The effect appears within the first year, peaks around the second year (0.3–0.4 percentage points above baseline), and fades by the fifth, implying a temporary rate effect but a lasting rise in the price level. This pattern aligns with Nigeria's weak monetary transmission and structural bottlenecks noted by authors [10, 17]. In contrast, inflation shocks do not raise the money supply response, which is near zero, suggesting no feedback loop. (Figure 1: Orthogonalised impulse response of inflation (lCPI) to a one-standard-deviation shock in money supply (lMS), with 95% confidence interval.) The delayed response shown in Figure 1 is consistent with Nigeria's underdeveloped financial system and structural factors; money takes time to percolate into general prices. It also mirrors post-2020 experiences: despite strong economic growth, inflation's sharp climb took a couple of years, exacerbated by factors such as naira volatility and supply chain issues [18].

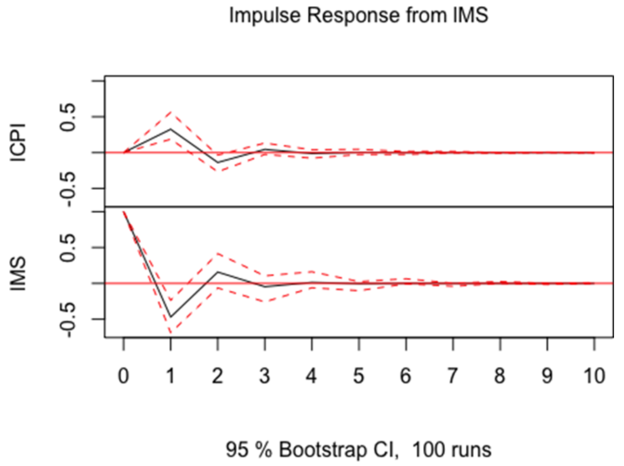

Figure 1 – IRF of ICPI to IMS Shock (Orthogonalized, 95% CI)

This delayed response aligns with underdeveloped financial systems [17] and post-2020 challenges, such as naira volatility [18].

Variance Decomposition. The forecast error variance decomposition (Table 3) shows how much of inflation's variability arises from money supply versus its own shocks.

Table 3 – Variance Decomposition of Inflation (ICPI) at Selected Horizons

Horizon (Years Ahead)	Inflation's Own Shocks (%)	Money Supply Shocks (%)
1	70.1	29.9
3	68.5	31.5
5	75.2	24.8
10	80.3	19.7

At a 1-year horizon, money supply shocks explain about 30% of inflation variance, increasing slightly to 31–32% by Year 3, before falling to 25% at Year 5 and 20% at Year 10. Thus, money explains roughly one-third of short-run inflation but far less in the long run, where non-monetary shocks dominate. These results align with those of the authors [11], who show that supply-side and external factors drive much of Nigeria's inflation. The VAR coefficients ($\beta \approx 0.325$, $p = 0.0006$) confirm that a 1% rise in money growth raises inflation by 0.3%. Overall, money matters, but structural and fiscal factors remain crucial.

CONCLUSIONS

The empirical results carry several important implications for macroeconomic policy in Nigeria, particularly for the Central Bank of Nigeria (CBN) and the Ministry of Finance. I distil the insights into actionable recommendations, recognising that while money supply control is essential, it must be part of a broader, coordinated strategy to tame inflation.

To effectively reduce inflation, Nigeria must pursue coordinated monetary, fiscal, and structural reforms. The unidirectional causality from the money supply to inflation suggests that the Central Bank of Nigeria (CBN) should maintain tight control over monetary aggregates and sustain its restrictive stance (e.g., the 27.5% policy rate as of mid-2025) until inflation expectations stabilise. Given weak interest-rate transmission, targeting M2 growth alongside inflation targets could anchor expectations. However, since monetary shocks explain only about 30% of inflation variance, fiscal coordination is vital. The Ministry of Finance should curb deficits, enhance revenue mobilisation, and reform subsidies to reduce monetary expansion pressures.

Structural factors like food supply gaps, infrastructure constraints, and exchange-rate pass-through account for most inflation; thus, investment in agriculture, logistics, and power infrastructure is essential. Exchange-rate unification and external reserve buildup will strengthen policy credibility. Improving financial market depth and regulating digital finance [23] can enhance monetary transmission. Policymakers must also cushion people with low incomes from short-term adjustment costs through targeted transfers and pro-poor spending. As the African Development Bank (2024) notes, well-managed reforms could raise growth to 3.4% by 2025. Ultimately, sustained monetary discipline, fiscal prudence, and structural transformation are necessary to achieve inclusive, low-inflation growth in Nigeria.

APPENDIX

A1: R Code for Analysis Snippet

```
library(pdfetch)
library(tseries)
library(dplyr)
library(xts)
library(vars)

inflation_df <- pdfetch_WB("FP.CPI.TOTL.ZG", countries = "NGA")
Broad_df <- pdfetch_WB("FM.LBL.BMNY.ZG", countries = "NGA")

df_list <- list(inflation_df, Broad_df)
merged_df <- Reduce(function(x, y) merge(x, y, by = "id", all = TRUE), df_list)
df <- merged_df[, -which(colnames(merged_df) %in% c("by", "by.1"))]
names(df)[1] <- "CPI"; names(df)[2] <- "MS"
df <- df[!index(df) %in% as.Date(c("1960-12-31", "2023-12-31")), ]

df <- data.frame(df)
df <- df %>% mutate(across(c(CPI, MS), ~ log(. / lag(.)), .names = "l{.col}"))
df <- df %>% mutate(across(c(lCPI, lMS), ~ ifelse(is.nan(.), mean(., na.rm = TRUE),
df <- df %>% mutate(across(c(lCPI, lMS), ~ ifelse(is.na(.), 0, .)))

adf.test(df$lCPI); adf.test(df$lMS)

re1 <- VAR(df[, c("lCPI", "lMS")], p=1)
summary(re1)

VARselect(df[, c("lCPI", "lMS")])

irf_plot <- irf(re1, impulse = "lMS", response = "lCPI", ortho = TRUE)
plot(irf_plot)

grangertest(lCPI ~ lMS, order = 1, data = df)
grangertest(lMS ~ lCPI, order = 1, data = df)
```

A2: Additional Tables and Figures

Table A1 – Lag Selection Criteria

Lag	AIC(n)	HQ(n)	SC(n)	FPE(n)
1	-1.183	-1.097	-0.960	0.307
2	-1.242	-1.099	-0.870	0.289

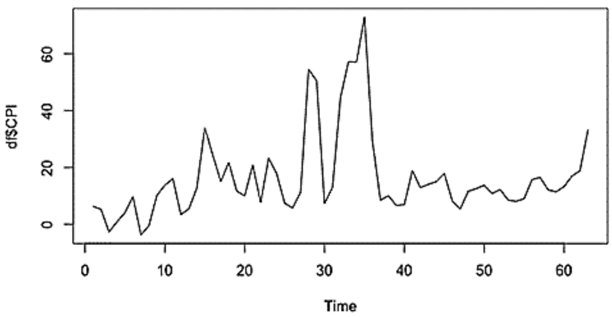

Figure A1 – Raw Time Series Plot of CPI Inflation (1961–2023)

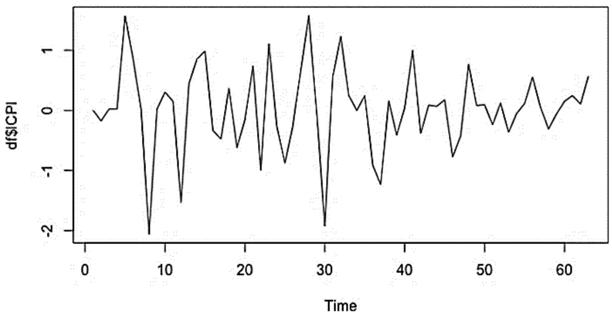

Figure A2 – Stationary Time Series Plot of CPI Inflation (1961–2023)

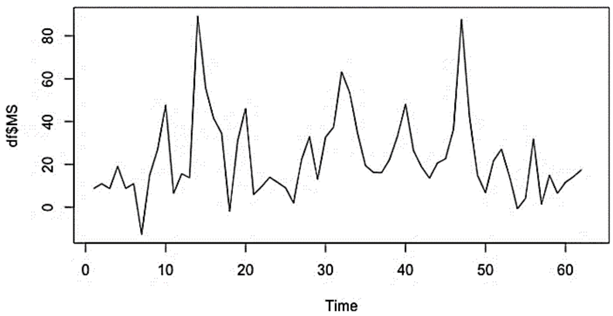

Figure A3 – Raw Time Series Plot of Money Supply (1961–2023)

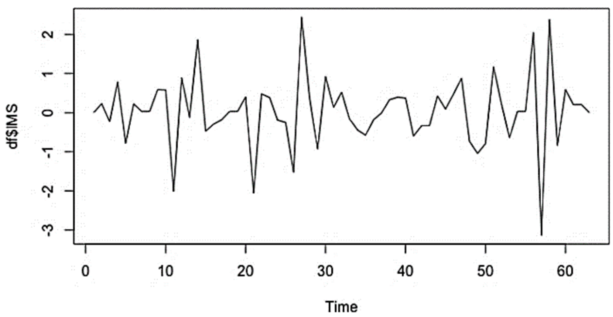

Figure A4 – Stationary Time Series Plot of Money Supply (1961–2023)

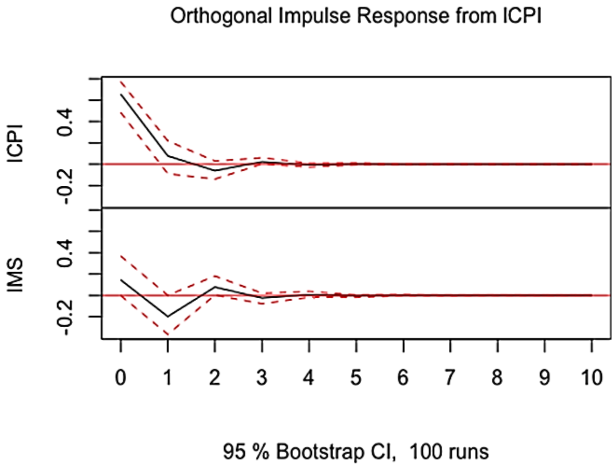

Figure A5 – Orthogonal IRF Plots (CPI)

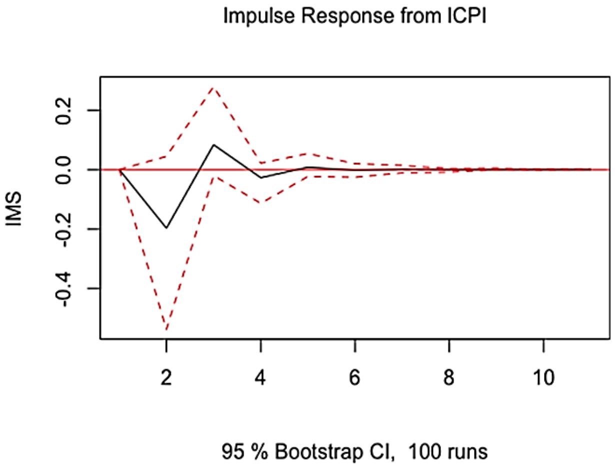

Figure A7 – IRF Plots (CPI)

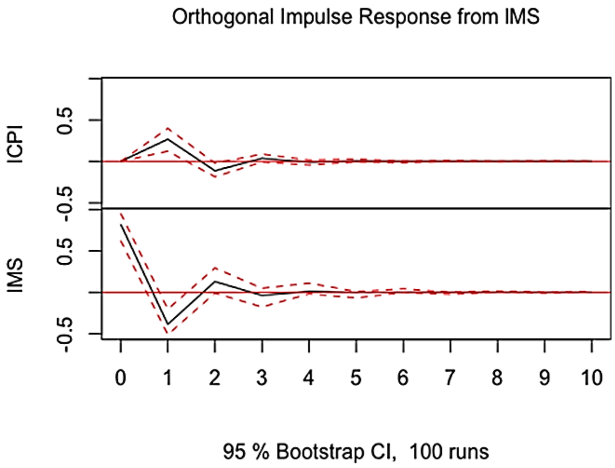

Figure A6 – Orthogonal IRF Plots (Money Supply)

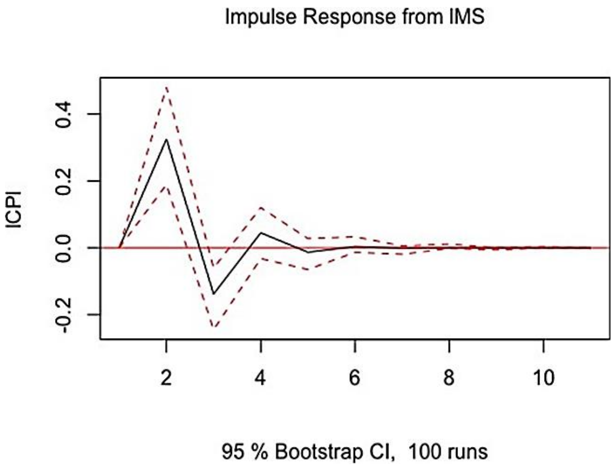

Figure A8 – IRF Plots (Money Supply)

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