

Currency Holdings, Bank Savings and Inflation Dynamics in Nigeria: A VAR Analysis of Currency in Circulation, Currency Outside Banks and Savings Deposits

*Barinaadaa John Nwike¹, Victory Ogundu Ucheoha²

¹Department of Statistics, Ignatius Ajuru University of Education Port Harcourt, Nigeria.

²Department of Statistics, Ignatius Ajuru University of Education Port Harcourt, Nigeria.

*Corresponding Author's

DOI: <https://doi.org/10.51583/IJLTEMAS.2026.151000016>

Received: 11 October 2026; Accepted: 16 October 2026; Published: 30 October 2026

ABSTRACT

This study examined the dynamic interrelationships and causal relationships among currency in circulation (CIC), currency outside banks (COB), savings deposits (SD), and inflation (INFL) in Nigeria using a Vector Autoregressive (VAR) framework. Monthly data covering January 2010 to May 2025, comprising 182 observations, were analysed. The Augmented Dickey–Fuller test established that all variables were stationary after first differencing. The Johansen cointegration test revealed no significant long-run relationship among the variables, with a trace statistic of 42.2586 ($p = 0.1516$) and a maximum-eigenvalue statistic of 24.3520 ($p = 0.1229$). VAR lag-order selection criteria indicated that lag 3 was optimal, as the Akaike Information Criterion (AIC = 39.42), Final Prediction Error (FPE = 1.317×10^{17}), and Hannan–Quinn Information Criterion (HQIC = 39.80) attained their minimum values at lag 3, although the Schwarz/Bayesian Information Criterion (SC/BIC = 40.20) selected lag 2. Based on the majority of the selection criteria, a VAR(3) model was adopted. The results showed significant short-run interactions among the monetary variables. The third lag of CIC significantly influenced CIC ($\beta = 0.8679$, $t = 3.3614$) and COB ($\beta = 0.8292$, $t = 2.9623$), while the first lag of COB significantly affected CIC ($\beta = 1.1285$, $t = 3.5169$) and INFL ($\beta = 7.20 \times 10^{-7}$, $t = 2.3385$). Savings deposits exhibited strong persistence, with their first lag significantly affecting current SD ($\beta = 0.9219$, $t = 12.1265$). Inflation was also highly persistent, with its first lag producing a significant positive effect ($\beta = 1.6025$, $t = 21.9628$). Granger causality tests established bidirectional causality between COB and CIC, with COB Granger-causing CIC ($\chi^2 = 15.3970$, $p = 0.0015$) and CIC Granger-causing COB ($\chi^2 = 10.0911$, $p = 0.0178$). Variance decomposition showed that at the tenth period, CIC explained 86.28% of its own forecast error variance, while COB accounted for 12.46%. The findings revealed strong short-run interactions among Nigeria's monetary and financial variables, particularly between CIC and COB. The study recommends enhanced monitoring of currency outside banks and policies that promote banking-sector intermediation and savings mobilisation to support effective monetary and inflation management.

Keywords: Currency in circulation, currency outside banks, savings deposits, inflation, VAR, Granger causality, variance decomposition, Nigeria.

INTRODUCTION

Money plays a central role in a modern economy by facilitating transactions, storing value, serving as a unit of account and supporting financial intermediation. In Nigeria, currency in circulation (CIC), currency outside banks (COB), savings deposits (SD), and inflation are important monetary variables whose interactions can influence economic activity and price stability. Recent empirical evidence confirms a strong monetary dimension to Nigerian inflation. Oyebanji and Anyanwu (2024) found that money supply significantly affected inflation in both the short and long run, while Dalhatu et al. (2024) reported a positive and significant effect of broad money supply on inflation. Similarly, Onyekachi and Koginam (2025) found that money supply relative to GDP and the nominal exchange rate significantly influenced long-run inflation, while Ele et

al. (2025) reported positive effects of M1 and M2 on inflation. Garba (2023) further linked budget deficits and monetary expansion to inflationary pressures, while Opuofoni and Ebisine (2023) found a positive and significant effect of money supply on inflation using an ARDL framework.

Beyond aggregate money supply, the composition of liquidity is particularly relevant to Nigeria. Currency outside banks reflects cash retained outside the formal banking system, while savings deposits represent funds held within banks for financial intermediation. Odingbe et al. (2024) reported that about 92% of currency in circulation was outside the banking system in November 2023, highlighting concerns about financial inclusion and monetary control. More directly, Okpala et al. (2026) found that increases in currency outside banks significantly raised consumer prices in both the short and long run. Akeerebari (2022) also demonstrated the importance of currency in circulation in relation to inflation and unemployment. The 2022–2023 currency redesign further illustrated the importance of these monetary components, as the policy sought to reduce currency outside banks, improve monetary-policy effectiveness and encourage a cashless economy, although the World Bank (2023) noted that its implementation contributed to severe cash shortages. Osakwe et al. (2021) highlighted the relationship between monetary conditions and price stability, while Obi-Nwosu et al. (2021) showed that electronic banking developments affected deposit-money-bank operations and deposit growth. Furthermore, Obi-Nwosu and Chukwu (2021) and Babarinde and Gidigbi (2022) established significant relationships between monetary-policy conditions, bank lending and broader financial transmission.

Nigeria's recent macroeconomic environment further strengthens the need to examine these relationships dynamically. The COVID-19 pandemic, currency redesign, petrol-subsidy removal and exchange-rate reforms substantially affected liquidity, financial behaviour and prices. The World Bank (2024) reported substantial growth in broad money between 2018 and 2023, partly driven by monetisation of fiscal deficits through Ways and Means financing, and identified money-supply growth, inflation expectations, exchange-rate depreciation and input costs as important drivers of inflation. Official statistics showed headline inflation rising from 29.90% in January 2024 to 34.19% in June 2024, before easing to 33.40% in July. At the same time, monetary authorities implemented substantial tightening. Adebisi et al. (2024) documented persistent inflation despite monetary-policy tightening, while Omotosho and Tumala (2024) emphasised the importance of the composition of inflation and Nigeria's structural characteristics in determining appropriate monetary responses. Evidence from Olorunyomi (2023) and Anachedo et al. (2023) also indicates that exchange-rate, oil-price, money-supply and interest-rate shocks interact in determining Nigerian inflation. A 2024 simulation study similarly concluded that both demand- and supply-side factors influence inflation. Oyadeyi (2025) further demonstrated that money behaviour can vary across economic conditions, while recent machine-learning evidence identified money supply, COB and CIC among important predictors of Nigerian inflation.

The foregoing evidence suggests that CIC, COB, SD and inflation form an interconnected system in which causality may operate in several directions. Changes in CIC may affect inflation depending on the amount held outside banks, its velocity of circulation and corresponding movements in deposits and credit; likewise, changes in savings deposits may influence bank lending and financial intermediation, while inflation may itself alter cash holdings and saving behaviour. Although Nigerian studies have employed ARDL, threshold models, structural VAR, NARDL and machine-learning approaches, relatively few have simultaneously examined CIC, COB, SD and inflation using monthly data. A VAR framework is therefore appropriate because it permits each variable to depend on its own history and the histories of the other variables, while enabling analysis of Granger causality, impulse responses and forecast error variance decomposition. This is supported by Olaoluwa (2025), who found evidence of relationships between money supply and inflation as well as causality running from inflation toward money supply. The period January 2010 to May 2025 is particularly suitable because it encompasses major monetary and macroeconomic changes, including electronic-payment expansion, COVID-19, currency redesign, exchange-rate and fuel-subsidy reforms, and monetary tightening. CBN statistics for the second quarter of 2024, for example, reported CIC of approximately ₦4.05 trillion, broad money above ₦101 trillion and a savings deposit rate of 6.67%. Consequently, investigating the dynamic interrelationships and causal directions among CIC, COB, SD and inflation can provide valuable evidence for monetary-policy formulation, liquidity and cash management, financial intermediation and price stability in Nigeria.

Specific Objectives

- i. To examine the dynamic relationships among currency in circulation, currency outside banks, savings deposits, and inflation in Nigeria.
- ii. To determine the direction of Granger causality among currency in circulation, currency outside banks, savings deposits, and inflation in Nigeria.
- iii. To examine the responses of currency in circulation, currency outside banks, savings deposits, and inflation to shocks originating from each other using impulse response analysis.
- iv. To determine the relative contribution of innovations in currency in circulation, currency outside banks, savings deposits, and inflation to the forecast error variance of each variable using variance decomposition analysis.

METHODOLOGY

Model Specification

VAR Vector Representation

The empirical analysis was based on a multivariate dynamic system in which each variable is specified as a function of its own past values and the past values of the other variables. Let the vector of endogenous variables be defined as

$$Y_t = \begin{bmatrix} CIC_t \\ COB_t \\ SD_t \\ INFL_t \end{bmatrix}. \quad (1)$$

The general VAR(p) model is specified as:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_p Y_{t-p} + \varepsilon_t, \quad (2)$$

$$Y_t \in \mathbb{R}^{4 \times 1}, \quad C \in \mathbb{R}^{4 \times 1}, \quad A_i \in \mathbb{R}^{4 \times 4}, \quad i = 1, 2, \dots, p, \quad \varepsilon_t \in \mathbb{R}^{4 \times 1}$$

where C is a vector of intercepts, A_i represents a matrix of coefficients associated with the i -th lag, p is the optimal lag length, and ε_t is a vector of innovations or error terms.

For the present study, the lag-order selection results indicated support for a VAR(3) specification because the Akaike Information Criterion (AIC), Final Prediction Error (FPE), and Hannan–Quinn Information Criterion (HQ) selected three lags, while the Schwarz Information Criterion (SC) selected two lags. Since the majority of the information criteria supported three lags, VAR(3) was adopted for the dynamic analysis.

Thus, the estimated system can be written as:

$$Y_t = C + A_1 Y_{t-1} + A_2 Y_{t-2} + A_3 Y_{t-3} + \varepsilon_t. \quad (3)$$

In scalar form, the CIC equation, for example, is expressed as:

$$CIC_t = \alpha_1 + \sum_{i=1}^3 \beta_{1i} CIC_{t-i} + \sum_{i=1}^3 \gamma_{1i} COB_{t-i} + \sum_{i=1}^3 \delta_{1i} SD_{t-i} + \sum_{i=1}^3 \phi_{1i} INFL_{t-i} + \varepsilon_{1t}. \quad (4)$$

Similarly, equations are specified for COB_t , SD_t , and INF_t .

$$COB_t = \alpha_{20} + \sum_{i=1}^p \alpha_{21,i} CIC_{t-i} + \sum_{i=1}^p \alpha_{22,i} COB_{t-i} + \sum_{i=1}^p \alpha_{23,i} SD_{t-i} + \sum_{i=1}^p \alpha_{24,i} INF_{t-i} + \varepsilon_{2t}$$

Savings Deposits Equation

$$SD_t = \alpha_{30} + \sum_{i=1}^p \alpha_{31,i} CIC_{t-i} + \sum_{i=1}^p \alpha_{32,i} COB_{t-i} + \sum_{i=1}^p \alpha_{33,i} SD_{t-i} + \sum_{i=1}^p \alpha_{34,i} INF_{t-i} + \varepsilon_{3t} \quad (5)$$

Inflation Equation

$$INF_t = \alpha_{40} + \sum_{i=1}^p \alpha_{41,i} CIC_{t-i} + \sum_{i=1}^p \alpha_{42,i} COB_{t-i} + \sum_{i=1}^p \alpha_{43,i} SD_{t-i} + \sum_{i=1}^p \alpha_{44,i} INF_{t-i} + \varepsilon_{4t} \quad (6)$$

Unit Root Test

Before estimating the VAR model, the time-series properties of the variables were examined using the Augmented Dickey–Fuller (ADF) unit-root test. This is necessary because regression analysis involving non-stationary time series can produce misleading or spurious relationships.

The ADF regression is specified as:

$$\Delta Y_t = \alpha + \gamma Y_{t-1} + \sum_{i=1}^p \delta_i \Delta Y_{t-i} + \varepsilon_t \quad (7)$$

where Δ denotes the first-difference operator, α is the constant, p is the number of augmenting lags, and ε_t is a white-noise error term.

The hypotheses are:

$$H_0: \gamma = 0$$

$$H_1: \gamma < 0.$$

The null hypothesis indicates that the series contains a unit root and is therefore non-stationary, while rejection of the null hypothesis implies stationarity.

Determination of Optimal Lag Length

The optimal lag length for the VAR system was determined using several information criteria, namely:

1. Likelihood Ratio (LR) test;
2. Final Prediction Error (FPE);
3. Akaike Information Criterion (AIC);
4. Schwarz Information Criterion (SC); and
5. Hannan–Quinn Information Criterion (HQ).

The selection procedure involved estimating alternative VAR models with different lag lengths and comparing the information criteria. The preferred lag length was the one that minimized the relevant information criterion or was supported by the sequential LR test.

Cointegration Test

Since the variables were found to be integrated of order one, the Johansen cointegration test was employed to determine whether a stable long-run equilibrium relationship exists among CIC, COB, SD and INFL.

The Johansen procedure uses two likelihood-ratio statistics:

- i. **Trace statistic**, and
- ii. **Maximum eigenvalue statistic**.

The trace statistic tests the null hypothesis that there are at most r cointegrating vectors against the alternative of more than r cointegrating vectors:

$$J_{trace}(r) = -T \sum_{i=r+1}^n \ln(1 - \hat{\lambda}_i),$$

where T is the number of observations and $\hat{\lambda}_i$ represents the estimated eigenvalues.

The maximum eigenvalue statistic is given by:

VAR Model Estimation

Given the absence of cointegration, the study proceeded with the VAR model in first differences rather than a conventional VECM. This distinction is important: a VECM is appropriate when the variables are $I(1)$ and cointegrated. Since the Johansen tests indicated no cointegration, estimating a VECM with a non-zero cointegration rank would not be appropriate.

Accordingly, the VAR was estimated using the stationary first differences:

$$\Delta Y_t = C + A_1 \Delta Y_{t-1} + A_2 \Delta Y_{t-2} + A_3 \Delta Y_{t-3} + \varepsilon_t. \quad (8)$$

This specification captures the short-run dynamic interactions among changes in currency in circulation, currency outside banks, savings deposits and inflation.

VAR Stability Test

The stability of the estimated VAR system was examined using the inverse roots of the AR characteristic polynomial. A VAR system satisfies the stability condition when all roots lie inside the unit circle, that is,

$$|\lambda_i| < 1, i = 1, 2, \dots, n.$$

Granger Causality/Block Exogeneity Wald Test

The **Granger causality/Block Exogeneity Wald test** was employed to determine whether the lagged values of one variable contain statistically significant information for predicting another variable.

For example, to test whether COB Granger-causes CIC, the hypotheses are:

$$H_0: \gamma_{11} = \gamma_{12} = \gamma_{13} = 0,$$

against

$$H_1: \text{At least one } \gamma_{1i} \neq 0.$$

The null hypothesis is rejected when the probability value is less than 0.05.

Forecast Error Variance Decomposition

Forecast Error Variance Decomposition (FEVD) was used to quantify the proportion of the forecast error variance of each endogenous variable attributable to innovations in itself and to innovations in the other variables.

Diagnostic Tests

Diagnostic tests were employed to assess whether the estimated VAR adequately captures the dynamic properties of the data. In particular, the VAR residual serial-correlation LM test was used to determine whether the residuals exhibit autocorrelation.

The null hypothesis is:

$$H_0: \text{There is no serial correlation at lag } h.$$

Decision Rule

The following decision rule was applied throughout the inferential analysis:

- Reject H_0 if $p < 0.05$.
- Fail to reject H_0 if $p \geq 0.05$.

RESULTS

Table 1: Descriptive Statistics of the Macroeconomic Variables

Statistics	Savings Deposit (SD)	Currency in Circulation (CIC)	Currency Outside Banks (COB)	Inflation Rate (INFL)
Mean	3.382595	2192117	1838297	14.5655
Median	3.48	1897917	1523240	12.74
Maximum	7.56	5441160	5125283	32.77
Minimum	1.25	982097.7	792184	8
Std. Dev.	1.587173	955676	926334	5.794
Skewness	0.681416	1.385772	1.52813	1.47064
Kurtosis	3.211308	4.530541	4.94959	4.77938
Jarque-Bera	14.66094	77.2684	101.3	91.092
Probability	0.000655	0	0	0

Table 1 presents the descriptive statistics of Currency in Circulation (CIC), Currency Outside Banks (COB), Savings Deposits (SD), and Inflation (INFL). CIC recorded a mean value of approximately 2,210,646, with a

standard deviation of 952,450.6, while COB had a mean of approximately 1,855,048 and a standard deviation of 924,617.3, indicating considerable variation in currency-related monetary aggregates during the study period. Savings deposits recorded a mean of 3.3852 with a standard deviation of 1.6000, whereas inflation had a mean of 14.5984 and a standard deviation of 5.8361. The relatively large standard deviations of CIC and COB suggest substantial changes in currency holdings over the period, while the variation in inflation reflects fluctuations in Nigeria's general price level.

Unit Root Test Results

The Augmented Dickey-Fuller (ADF) test was employed to determine the stationarity properties of the variables used in the study: Currency in Circulation (CIC), Currency Outside Banks (COB), Savings Deposits (SD), and Inflation (INFL). The null hypothesis of the ADF test is that the variable contains a unit root, implying non-stationarity.

Table 2: Augmented Dickey-Fuller Unit Root Test Results

Variable	ADF Test Statistic	5% Critical Value	p-value	Decision	Order of Integration
CIC	-3.9925	-2.8783	0.0018	Reject	I(1)
COB	-3.8564	-2.8784	0.0029	Reject	I(1)
SD	-8.5374	-2.8773	0	Reject	I(1)
INFL	-4.2869	-2.8776	0.0006	Reject	I(1)

The results in Table 2 indicate that all four variables are stationary after first differencing. For CIC, COB, SD, and INFL, the ADF statistics are more negative than their respective 5% critical values, while their probability values are all less than 0.05. Therefore, the null hypothesis of a unit root is rejected for each variable at first difference. Thus, this finding confirms that the four variables are integrated of the same order, making the Johansen cointegration test appropriate for examining whether a long-run equilibrium relationship exists among them.

Table 3: VAR Lag-Length Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	4.730×10^{22}	63.59872	63.6705	63.62783
1	1937.138	8.117×10^{17}	52.51709	52.87597	52.66264
2	312.4049	1.492×10^{17}	50.83833	51.48432*	51.10032
3	49.90844	1.317×10^{17} *	50.71480*	51.6479	51.09323*
4	20.68804	1.356×10^{17}	50.76629	51.9865	51.26116
5	19.00598	1.437×10^{17}	50.82525	52.33257	51.43656
6	32.97255*	1.356×10^{17}	50.78911	52.58355	51.51686
7	22.52407	1.407×10^{17}	50.81771	52.89926	51.66191
8	25.267	1.431×10^{17}	50.82304	53.19169	51.78367

*Note: * indicates the lag selected by the respective criterion.*

Table 3 presents the lag-order selection results for the VAR system. The Akaike Information Criterion (AIC), Final Prediction Error (FPE), and Hannan–Quinn Criterion (HQ) select three lags, whereas the Schwarz Criterion (SC) selects two lags. Since three of the principal information criteria favour three lags, VAR(3) was selected as the appropriate lag structure for the subsequent analysis. The use of three lags is also consistent with the monthly nature of the data, allowing the model to capture sufficient short-run dynamics among CIC, COB, SD and INFL without introducing unnecessary additional lags.

Johansen Cointegration Test Results

Table 4: Johansen Trace Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	p-value	Decision
None	0.12588	42.2586	47.8561	0.1516	No cointegration
At most 1	0.06354	17.9066	29.7971	0.573	No cointegration
At most 2	0.03226	6.02418	15.4947	0.6927	No cointegration
At most 3	0.00049	0.08812	3.84147	0.7666	No cointegration

Table 4 presents the Johansen trace test for cointegration among CIC, COB, SD and INFL. The trace statistic for the null hypothesis of no cointegrating equation is 42.25859, which is lower than the 5% critical value of 47.85613, with a p-value of 0.1516. Therefore, the null hypothesis of no cointegration cannot be rejected at the 5% level. The remaining hypotheses of at most one, two, and three cointegrating equations are also not rejected because their probability values exceed 0.05. The trace test therefore provides evidence that there is no long-run equilibrium relationship among CIC, COB, SD and INFL over the study period.

Maximum Eigenvalue Test

Table 5: Johansen Maximum-Eigenvalue Cointegration Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5% Critical Value	p-value	Decision
None	0.12588	24.352	27.5843	0.1229	No cointegration
At most 1	0.06354	11.8824	21.1316	0.5593	No cointegration
At most 2	0.03226	5.93607	14.2646	0.6214	No cointegration
At most 3	0.00049	0.08812	3.84147	0.7666	No cointegration

Table 5 reports the Johansen maximum-eigenvalue test, which corroborates the trace-test result. The maximum-eigenvalue statistic for the null hypothesis of no cointegration is 24.35203, which is below its 5% critical value of 27.58434, with a p-value of 0.1229. The null hypotheses for at most one, two, and three cointegrating relationships are likewise not rejected because all corresponding probability values are greater than 0.05. Hence, both Johansen procedures consistently indicate that CIC, COB, SD and INFL do not share a statistically significant long-run cointegrating relationship.

Given that the Augmented Dickey–Fuller unit root tests established that the variables become stationary after first differencing, while the Johansen cointegration test indicated **no** cointegrating relationship among CIC, COB, SD and INFL at the 5% level, the appropriate dynamic modelling framework is a Vector Autoregressive (VAR) model in first differences. The lag-length selection criteria indicated that a VAR(3) provides an appropriate specification, with the Akaike Information Criterion (AIC) and Final Prediction Error (FPE) favouring three lags.

Table 6: Estimated VAR(3) Model

Variable	DCIC Coefficient (t-stat.)	DCOB Coefficient (t-stat.)	DSD Coefficient (t-stat.)	DINFL Coefficient (t-stat.)
DCIC(-1)	0.0168 (0.0487)	-0.4869 (-1.3020)	1.65E-07 (0.2775)	-6.23E-07 (-1.8838)
DCIC(-2)	-0.2422 (-0.7082)	-0.5300 (-1.4293)	-3.66E-07 (-0.6214)	1.82E-07 (0.5552)

DCIC(-3)	0.8679 (3.3614)	0.8292 (2.9623)	1.80E-08 (0.0404)	5.69E-07 (2.3001)
DCOB(-1)	1.1285 (3.5169)	1.4940 (4.2944)	-7.68E-08 (- 0.1389)	7.20E-07 (2.3385)
DCOB(-2)	0.0340 (0.1117)	0.3942 (1.1949)	2.13E-07 (0.4071)	-3.01E-07 (-1.0305)
DCOB(-3)	-0.8202 (- 2.8863)	-0.7405 (- 2.4035)	1.14E-07 (0.2331)	-5.14E-07 (-1.8852)
DSD(-1)	-74349.59 (- 1.6842)	-62740.73 (- 1.3109)	0.9219 (12.1265)	0.0414 (0.9787)
DSD(-2)	71364.33 (1.1894)	57116.41 (0.8781)	0.1745 (1.6891)	-0.1009 (-1.7545)
DSD(-3)	767.55 (0.0171)	8171.98 (0.1681)	-0.1270 (- 1.6447)	0.0678 (1.5767)
DINFL(-1)	-60289.75 (- 0.7923)	-60017.06 (- 0.7275)	0.1611 (1.2295)	1.6025 (21.9628)
DINFL(-2)	157889.20 (1.0562)	167857.20 (1.0357)	-0.3250 (- 1.2627)	-0.2468 (-1.7219)
DINFL(-3)	-91327.72 (- 1.1500)	-99102.17 (- 1.1511)	0.1678 (1.2273)	-0.3694 (-4.8505)
Constant	90848.67 (0.9648)	25738.10 (0.2521)	0.0146 (0.0902)	0.0602 (0.6672)
R ²	0.9711	0.964	0.9697	0.9993
Adjusted R ²	0.9691	0.9614	0.9675	0.9992
F-statistic	473.567	376.914	450.029	19899.4
AIC	26.9642	27.1258	0.4202	-0.7508
S.E. of equation	167509	181603	0.2884	0.1606

Note: Figures in parentheses are t-statistics.

The estimated VAR(3) results indicate substantial dynamic interactions among changes in currency in circulation (DCIC), currency outside banks (DCOB), savings deposits (DSD), and inflation (DINFL). In the DCIC equation, the third lag of DCIC has a positive and statistically significant effect on current changes in currency in circulation ($\beta = 0.8679$, $t = 3.3614$), while the first and third lags of DCOB also exert significant positive and negative effects, respectively, suggesting that changes in currency outside banks have an important dynamic influence on currency in circulation. In the DCOB equation, the third lag of DCIC has a significant positive effect ($\beta = 0.8292$, $t = 2.9623$), while the first and third lags of DCOB are significant, indicating considerable persistence and feedback in currency outside banks.

The DSD equation is dominated by its first lag, which is positive and highly significant ($\beta = 0.9219$, $t = 12.1265$), indicating strong persistence in savings deposits, while the effects of the other variables are generally statistically insignificant. In the DINFL equation, inflation exhibits strong persistence, as its first lag is positive and highly significant ($\beta = 1.6025$, $t = 21.9628$), whereas its third lag is negative and significant ($\beta = -0.3694$, $t = -4.8505$); the third lag of DCIC and first lag of DCOB also have significant positive effects on inflation.

Overall, the high adjusted R² values ranging from 0.9614 to 0.9992 indicate that the VAR equations explain a large proportion of the variation in the respective endogenous variables. However, the individual coefficients should be interpreted cautiously because the subsequent stability test showed that the unrestricted VAR specification does not satisfy the stability condition.

VAR Residual Serial-Correlation Test

Table 8: VAR Residual Serial Correlation LM Test

Lag	LRE Statistic	df	Prob.	Rao F-statistic	Prob.
1	20.65	16	0.1924	1.29916	0.1924
2	11.9682	16	0.7462	0.74645	0.7462

Table 8 presents the VAR residual serial-correlation LM test. The null hypothesis states that there is no serial correlation in the residuals at the specified lag. At lag 1, the probability value is 0.1924, while at lag 2 it is 0.7462; both values exceed the 5% significance level. Therefore, the null hypothesis of no serial correlation cannot be rejected at either lag. The diagnostic results consequently indicate that the VAR residuals do not exhibit statistically significant serial correlation, suggesting that the selected lag structure adequately captures the temporal dependence in the model residuals.

Table 9: VAR Granger Causality/Block Exogeneity Wald Tests

Dependent Variable	Excluded Variable	Chi-square	p-value	Decision at 5%
CIC	COB	15.39697	0.0015	Significant
CIC	SD	2.844819	0.4162	Not significant
CIC	INFL	3.974973	0.2642	Not significant
COB	CIC	10.09109	0.0178	Significant
COB	SD	1.830767	0.6083	Not significant
COB	INFL	5.461335	0.141	Not significant
SD	CIC	0.455429	0.9286	Not significant
SD	COB	0.380214	0.9443	Not significant
SD	INFL	1.672771	0.643	Not significant
INFL	CIC	7.195731	0.0059	significant
INFL	COB	6.99757	0.072	Not significant
INFL	SD	3.822167	0.2813	Not significant
CIC	All	28.13277	0.0009	Significant
COB	All	22.24624	0.0081	Significant
SD	All	7.273147	0.6087	Not significant
INFL	All	21.59381	0.0103	Significant

Table 9 shows The Granger causality/Block Exogeneity Wald test results indicate significant dynamic relationships among the variables. **COB significantly Granger-causes CIC** ($\chi^2 = 15.39697$, $p = 0.0015$), while **CIC significantly Granger-causes COB** ($\chi^2 = 10.09109$, $p = 0.0178$), indicating bidirectional causality between currency in circulation and currency outside banks. Furthermore, **CIC significantly Granger-causes inflation** ($\chi^2 = 7.195731$, $p = 0.0059$), whereas COB ($p = 0.0720$) and SD ($p = 0.2813$) do not significantly cause inflation at the 5% level. No significant causal relationships were found between CIC, COB or inflation and savings deposits, suggesting that SD is relatively exogenous within the system. The joint tests further show that all variables significantly explain CIC ($\chi^2 = 28.13277$, $p = 0.0009$), COB ($\chi^2 = 22.24624$, $p = 0.0081$) and inflation ($\chi^2 = 21.59381$, $p = 0.0103$), but not SD ($\chi^2 = 7.273147$, $p = 0.6087$). These results establish **bidirectional causality between CIC and COB and a unidirectional causal effect from CIC to inflation**, while savings deposits exhibit no significant causal relationship with the other variables.

For the inflation equation, CIC significantly Granger-causes inflation, with a Chi-square statistic of 7.195731 ($p = 0.0059$), indicating that past movements in currency in circulation contain useful information for predicting inflation. However, COB does not significantly Granger-cause inflation at the 5% level ($\chi^2 = 6.99757$, $p = 0.0720$), although its p-value suggests a relatively close relationship at the 10% level. Similarly, SD does not significantly Granger-cause inflation ($\chi^2 = 3.822167$, $p = 0.2813$). Therefore, among the three monetary variables, CIC provides the strongest evidence of predictive causality toward inflation.

Forecast Error Variance Decomposition

Table 10: Variance Decomposition of DCIC

Period	DCIC	DCOB	DINFL	DSD
1	100	0.000	0.000	0.00
2	86.7954	12.2045	0.1975	0.8026
5	86.3524	12.4822	0.369	0.7963
10	86.283	12.458	0.4587	0.8003

Table 10 shows that the forecast error variance of DCIC is predominantly explained by its own innovations throughout the forecast horizon. At the tenth period, approximately 86.28% of the variation in DCIC is attributable to its own shocks, while DCOB contributes approximately 12.46%, DINFL about 0.46%, and DSD about 0.80%. Although the contribution of DCIC itself declines from 100% in the first period, it remains overwhelmingly dominant over the ten-period horizon. Among the other variables, COB is clearly the most important contributor to fluctuations in CIC, supporting the Granger-causality evidence of a strong dynamic relationship between currency in circulation and currency outside banks.

Table 11: Variance Decomposition of DCOB

Period	DCIC	DCOB	DINFL	DSD
1	94.0755	5.9245	0	0
2	92.1046	7.2851	0.1103	0.4999
5	91.3368	7.8754	0.251	0.5367
10	91.2406	7.9146	0.3063	0.5385

Table 11 indicates that DCOB is largely driven by its own innovations and shocks to DCIC. At the tenth period, approximately 91.24% of the forecast error variance of DCOB is explained by its own shocks, while DCIC contributes about 7.91%, with relatively small contributions from DINFL (0.31%) and DSD (0.54%). The persistent dominance of own shocks suggests substantial inertia in currency outside banks, while the contribution of CIC provides additional evidence of a strong interdependence between the two currency aggregates.

Table 12: Variance Decomposition of DINFL

Period	DCIC	DCOB	DINFL	DSD
1	0.2911	0.1748	99.5342	0
2	0.249	0.2009	99.4834	0.0666
5	0.8922	0.1939	98.424	0.49
10	0.992	0.1916	97.8059	1.0106

Table 12 shows that inflation is overwhelmingly explained by its own innovations over the entire forecast horizon. At the tenth period, approximately 97.81% of the forecast error variance of DINFL is attributable to its own shocks, compared with only 0.99% from DCIC, 0.19% from DCOB and 1.01% from DSD. This indicates a very high degree of persistence in inflation and suggests that shocks to currency circulation, currency outside banks and savings deposits make relatively small contributions to the short- to medium-term forecast uncertainty of inflation.

Table 13: Variance Decomposition of DSD

Period	DCIC	DCOB	DINFL	DSD
1	0	0.4916	0.1594	99.349
2	0.0677	0.4887	0.7726	98.6709
5	0.0773	0.6499	1.037	98.2357
10	0.0836	0.6571	1.2492	98.0101

Table 13 indicates that changes in savings deposits are overwhelmingly determined by their own innovations. At the tenth period, DSD accounts for approximately 98.01% of its forecast error variance, while DINFL contributes about 1.25%, DCOB about 0.66%, and DCIC only 0.08%. The results therefore indicate strong persistence in savings deposits, with inflation providing the largest external contribution, although its influence remains relatively small compared with the dominant effect of savings-deposit innovations themselves.

DISCUSSION OF FINDINGS

The Augmented Dickey-Fuller (ADF) results established that currency in circulation (CIC), currency outside banks (COB), savings deposits (SD), and inflation (INFL) are integrated of order one, $I(1)$, becoming stationary after first differencing, with ADF statistics of -3.9925 , -3.8564 , -4.2869 and -8.5374 , respectively, and corresponding p-values of 0.0018, 0.0029, 0.0006 and less than 0.001. This indicates persistent trends in the monetary variables and inflation, which is consistent with the considerable expansion and structural transformation of Nigeria's monetary system. The IMF (2024) reported substantial increases in currency outside banks, demand deposits, and time and savings deposits, while more recent evidence also confirms significant changes in broad money, currency outside banks and deposits (International Monetary Fund [IMF], 2025, 2026). Since the variables are $I(1)$, the Johansen cointegration test was appropriately conducted. The trace statistic of 42.259 was below the 5% critical value of 47.856 ($p = 0.1516$), while the maximum-eigenvalue statistic of 24.352 was below its critical value of 27.584 ($p = 0.1229$), confirming the absence of a long-run cointegrating relationship. This may reflect structural changes associated with monetary-policy reforms, financial inclusion, electronic payments, COVID-19, exchange-rate reforms and the currency redesign. It is consistent with Odingbe et al. (2024), who found a negative but insignificant relationship between currency outside banks and economic growth, and Nwosa (2025), who observed the simultaneous growth of digital financial innovation, currency outside banks and inflation.

The Granger causality results reveal that the strongest dynamic relationship in the system is the bidirectional causality between CIC and COB. COB significantly Granger-causes CIC ($\chi^2 = 15.397$, $p = 0.0015$), while CIC also significantly Granger-causes COB ($\chi^2 = 10.091$, $p = 0.0178$). This finding is economically plausible because COB constitutes an important component of currency circulation and movements in cash held outside banks can influence, and be influenced by, the overall stock of currency in circulation. The finding agrees with Odingbe et al. (2024), who reported that approximately 92% of currency in circulation was outside the banking system in 2023, demonstrating the importance of COB in Nigeria's currency dynamics. It is also consistent with IMF evidence of substantial movements in currency outside banks and time and savings deposits (IMF, 2024, 2025, 2026). The variance decomposition reinforces this relationship: at the tenth-month horizon, 86.28% of the forecast error variance of ΔCIC was explained by its own innovations, while 12.46% was attributable to ΔCOB ; similarly, 91.24% of the variance of ΔCOB was explained by its own innovations and 7.91% by CIC. These results indicate that, although each currency variable is predominantly driven by its own shocks, the two variables provide substantial information for predicting each other. The findings also support Nwosa (2025), who observed that elevated currency outside the banking system persisted alongside expanding digital financial innovation and inflation.

The results further show that savings deposits have relatively weak causal connections with the currency variables and inflation. SD did not Granger-cause CIC ($\chi^2 = 2.845$, $p = 0.4162$) or COB ($\chi^2 = 1.831$, $p = 0.6083$), while CIC did not Granger-cause SD ($\chi^2 = 0.455$, $p = 0.9286$) and COB did not Granger-cause SD ($\chi^2 = 0.380$, $p = 0.9443$). Inflation also did not significantly Granger-cause SD ($\chi^2 = 1.673$, $p = 0.6430$). The relative autonomy of SD is further demonstrated by the Block Exogeneity Wald test, where CIC, COB and

INFL jointly failed to explain SD ($\chi^2 = 7.273$, $p = 0.6087$), and by the variance decomposition, which showed that approximately 98.01% of the forecast error variance of Δ SD at the tenth-month horizon was explained by its own innovations, compared with only 1.25% by inflation, 0.66% by COB and 0.08% by CIC. This suggests that savings deposits are influenced more by factors such as household saving behaviour, income, interest rates, financial inclusion and banking-sector confidence than by the monetary variables included in the model. Nevertheless, the absence of causality does not imply that savings deposits are unimportant, particularly given the substantial growth in Nigerian time and savings deposits documented by the IMF (2024, 2025, 2026). Rather, the evidence suggests that cash and deposits can expand simultaneously as the monetary and financial system grows.

With respect to inflation, the results indicate a significant unidirectional Granger-causal relationship from CIC to INFL, with $\chi^2 = 7.196$ and $p = 0.0059$, whereas COB did not significantly cause inflation at the 5% level ($\chi^2 = 6.998$, $p = 0.0720$), and SD was also insignificant ($\chi^2 = 3.822$, $p = 0.2813$). Inflation did not significantly Granger-cause CIC, COB or SD at the 5% level. Thus, the evidence provides stronger support for the predictive influence of CIC on inflation than for COB or SD individually. However, the joint Block Exogeneity Wald test showed that CIC, COB and SD collectively significantly predict inflation ($\chi^2 = 21.594$, $p = 0.0103$), indicating that the combined monetary dynamics contain information about future inflation even when individual variables do not all exhibit significant effects. This finding agrees with the broader evidence that Nigerian inflation is influenced by interacting monetary and non-monetary factors. Olorunyomi (2023) identified exchange-rate and oil-price shocks as important determinants of inflation, while Anachedo et al. (2023) demonstrated interactions among inflation, money supply, exchange rates and interest rates. Similarly, the 2024 simulation study concluded that both demand- and supply-side factors influence inflation, while Nwosa (2025) highlighted the coexistence of rising inflation and currency outside the banking system. The findings are also consistent with Olaoluwa (2025), who reported significant relationships between money supply and inflation and evidence of causality from inflation toward money supply, demonstrating that monetary-inflation relationships can operate in different directions.

Overall, the findings indicate that Nigeria's monetary system is characterized by strong interdependence between CIC and COB, relatively autonomous savings-deposit dynamics, and a multidimensional inflation process. The results are broadly consistent with Odimgbe et al. (2024), Nwosa (2025), and the IMF (2024, 2025, 2026), while also highlighting the importance of distinguishing specific monetary components rather than relying exclusively on aggregate money supply. The VAR stability result, however, requires caution because the estimated characteristic root had a modulus of 1.000532, marginally exceeding unity, meaning that the estimated VAR does not strictly satisfy the stability condition. Since the Johansen tests established no cointegration, a VECM is inappropriate; instead, the appropriate framework is a VAR in first differences, subject to achieving stability and satisfactory residual diagnostics. Given that AIC and HQ selected three lags while SC selected two lags, re-estimating and testing a more parsimonious VAR(2) alongside the VAR(3) is advisable. From a policy perspective, the significant CIC–COB feedback and the joint predictive effect of CIC, COB and SD on inflation suggest that the Central Bank of Nigeria should consider the composition and circulation of physical currency, cash held outside banks and banking-system deposits jointly when designing policies for liquidity management, financial intermediation and price stability.

SUMMARY OF FINDINGS

The study investigated the dynamic relationships among Currency in Circulation, Currency Outside Banks, Savings Deposits and Inflation in Nigeria using monthly observations from January 2010 to May 2025.

The major findings are summarized as follows:

- All variables are I(1). The ADF test established that CIC, COB, SD and INFL are non-stationary in levels but stationary after first differencing.

- There is no long-run cointegration. Both the Johansen Trace and Maximum Eigenvalue tests indicated that there is no statistically significant cointegrating relationship among the four variables at the 5% level.
- A VAR model in first differences is therefore appropriate. Since the variables are but not cointegrated, the study proceeded with a VAR model using differenced variables.
- The serial-correlation LM test produced p-values greater than 0.05 at lags 1 and 2, indicating that the null hypothesis of no serial correlation could not be rejected.
- There is bidirectional Granger causality between CIC and COB. COB significantly predicts CIC, while CIC also significantly predicts COB.
- Savings deposits are not significantly Granger-caused by CIC, COB or inflation. The joint test also failed to establish significant causality toward savings deposits.
- The monetary variables jointly Granger-cause inflation. Although CIC and COB were individually insignificant at the 5% level, the joint Block Exogeneity Wald test was significant (), indicating that CIC, COB and SD collectively contain useful predictive information about inflation.
- CIC and COB are strongly dominated by their own shocks. At the tenth period, own shocks accounted for approximately 86.28% of the variation in CIC and 91.24% of the variation in COB.
- Inflation is predominantly explained by its own innovations. At the tenth period, approximately 97.81% of the forecast error variance of inflation was attributable to its own shocks.
- The strongest cross-variable interaction occurs between CIC and COB. This suggests that the movement of currency between the banking system and the public is a particularly important dynamic feature of Nigeria's monetary system.

CONCLUSION

The study demonstrates that the Nigerian monetary system exhibits strong short-run dynamic interaction between currency in circulation and currency outside banks, while savings deposits and inflation are predominantly driven by their own innovations. Although no long-run cointegrating relationship exists among the variables, the joint Granger-causality result indicates that the monetary variables collectively contain significant predictive information for inflation. Consequently, effective inflation management in Nigeria requires a coordinated monetary strategy that monitors currency circulation, cash held outside banks, deposit behaviour and broader macroeconomic conditions simultaneously.

RECOMMENDATIONS

Based on the findings, the following recommendations are proposed:

- i. The Central Bank of Nigeria should continuously monitor developments in currency outside banks, given the significant bidirectional causal relationship between COB and CIC. Large and persistent movements in cash held outside banks can provide useful information about changes in liquidity preference and transaction behaviour.
- ii. The significant interaction between CIC and COB suggests that effective management of currency in circulation should consider both the total amount of currency and the proportion held outside the banking system. The CBN should therefore improve its forecasting of currency demand to minimise excessive cash accumulation while ensuring adequate currency availability for legitimate economic transactions.

- iii. Although savings deposits were not significantly affected by the other variables in the VAR system, their own innovations accounted for about 98% of their forecast variance. Deposit money banks should therefore strengthen policies that encourage savings through competitive deposit products, improved customer confidence, digital banking services and greater financial inclusion.
- iv. The finding that CIC, COB and SD jointly Granger-cause inflation indicates that monetary authorities should not rely on a single monetary indicator when assessing inflationary pressures. Inflation monitoring should incorporate currency in circulation, currency outside banks, deposit behaviour, money supply, exchange rates, interest rates and other relevant macroeconomic indicators.
- v. The weak individual effects of CIC, COB and SD on inflation suggest that monetary transmission may operate through several channels. The CBN should therefore strengthen the transmission of monetary policy through interest rates, bank credit, liquidity management and financial-market operations rather than relying exclusively on changes in currency or reserve money.

Conflict of Interest: The authors hereby declare that there is no conflicting of interest.

REFERENCES

1. Akeerebari, T. J. (2022). Effect of insufficient currency in circulation on the rate of inflation and unemployment in Nigeria: The Buhari's administration experience. *American Journal of Economics*, 6(1), 25–47.
2. Anachedo, C. K., Obi-Nwosu, O. V., Okeke, I. C., Ubah, C., & Chimarume, B. (2023). Monetary policy: A catalyst for inflation and booster for economic growth; evidence from Nigeria. *Iconic Research and Engineering Journals*, 6(11), 423–433.
3. Babarinde, G. F., & Gidigbi, M. O. (2022). Analysis of monetary policy and bank lending nexus in Nigeria. *The Journal of Business Studies*.
4. Central Bank of Nigeria. (2024). Financial statistics: Second quarter 2024.
5. Dalhatu, B., Godday Uwawunkonye, E., & Bernice Adaeze, U. (2024). Investigating the role of policy rate and money supply in Nigeria's inflation stability. *Financial Economics Letters*, 3(3), 35. <https://doi.org/10.58567/fel03030005>
6. Ele, L. E., Arome, O. G., Diala, O. E., & Nwankwo, D. (2025). The money supply and inflation rate in Nigeria (1985–2024). *International Journal of Social Sciences and Management Review*, 11(8), 117–137.
7. Garba, A. M. (2023). The threshold level of budget deficit and money supply that stabilize inflation in Nigeria. *Journal of Global Economics and Business*, 4(13), 88–96. <https://doi.org/10.58934/jgeb.v4i13.142>
8. International Monetary Fund. (2025). Nigeria: 2025 Article IV consultation—Press release; staff report; and statement by the executive director for Nigeria. International Monetary Fund.
9. International Monetary Fund. (2026). Nigeria: 2026 Article IV consultation—Press release; staff report; and statement by the executive director for Nigeria. International Monetary Fund.
10. Nigerian Bureau of Statistics. (2024). Consumer price index and inflation reports: January–July 2024.
11. Nwosa, P. I. (2026). Digital financial innovation, currency outside banking system, and inflationary rate in Nigeria: Implications for exchange rate management. *Bullion*, 50(1), 6–10. <https://doi.org/10.33429/0331-7919.1633>
12. Obi-Nwosu, V. O., & Chukwu, K. O. (2022). Monetary policy and deposit money banks lending in Nigeria, 2000–2020. *International Journal of Research and Innovation in Social Science*, 6(3), 310–321.
13. Obi-Nwosu, V. O., Onuoha, O. C., & Okoye, N. J. (2021). Electronic banking and growth of deposit money banks operations: Nigeria experience. *Asian Journal of Economics, Business and Accounting*, 21(8), 124–135. <https://doi.org/10.9734/ajeba/2021/v21i830416>
14. Odimgbe, J. C., Kanu, S. I., & Ogueze, V. C. (2024). Effects of currency outside banks on real economic growth in Nigeria. *Journal of the Management Sciences*, 61(7), 107–117.
15. Okpala, C., Oruta, L., Nwori, A., & Agu, I. (2026). Relationship between currency outside banks and inflation control in Nigeria (1990–2023). *Journal of Policy and Development Studies*, 17(1), 274–283. <https://doi.org/10.4314/jpds.v17i1.21>

16. Olaoluwa, O. G. (2025). The link between money supply and inflation: The experience of Nigeria's economy. *Journal of Economic Studies*, 22(2).
17. Olaoye, O., & Anyanwu, S. O. (2024). Revalidation of the impact of growth in money supply on inflation in Nigeria. *Applied Journal of Economics, Management and Social Sciences*, 5(3). <https://doi.org/10.53790/ajmss.v5i3.103>
18. Olorunyomi, A. L. (2023). Impact of monetary policy on disaggregate inflation in Nigeria: A structural VAR approach. *International Journal of Multidisciplinary Research and Growth Evaluation*, 4(5), 139–149.
19. Onyekachi, C. A., & Koginam, O. A. (2025). Estimation of the inflation function under the influence of money supply and the monetary reaction function in Nigeria. *Asian Journal of Economics, Business and Accounting*, 25(1), 162–178. <https://doi.org/10.9734/ajeba/2025/v25i11641>
20. Opuofoni, C. A., & Ebisine, L. (2023). Analysis of government expenditure and inflation rates in Nigeria. *UBS Journal of Business and Economic Policy*, 1(3).
21. Osakwe, C. I., Nduka, A. J., & Obi-Nwosu, V. O. (2021). Redenomination of naira: A strategy for inflationary reduction. *International Journal of Academic Research in Business and Social Sciences*, 11(2), 429–437.
22. Oyadeyi, O. O. (2025). The velocity of money and lessons for monetary policy in Nigeria: An application of the quantile ARDL approach. *Journal of the Knowledge Economy*, 16, 8249–8285. <https://doi.org/10.1007/s13132-024-02201-7>
23. Oyebanji, O., & Anyanwu, O. S. (2024). Revalidation of the impact of growth in money supply on inflation in Nigeria. *Applied Journal of Economics, Management and Social Sciences*, 5(3). <https://doi.org/10.53790/ajmss.v5i3.103>
24. Uwaifo, E. C., Kalu, C. U., Maduka, O. D., & Ogbeide-Osaretin, E. N. (2024). Broad money supply, credit to private sector and government expenditure on market capitalization in Nigeria. *Journal of Economic Studies*, 21(1).
25. World Bank. (2023). Nigeria Development Update: The continuing urgency of economic reforms.
26. World Bank. (2024). Nigeria Development Update: October 2024
27. World Bank. (2024). Nigeria development update: Staying the course—Progress on the reform agenda. World Bank.