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A STRUCTURAL VECTOR ERROR CORRECTION (VEC) APPROACH TO ANALYZING THE DYNAMICS OF INFLATION IN NIGERIA

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Abstract

This study employed a structural vector error correction (SVEC) framework to investigate the dynamic interactions among inflation, money supply, and real GDP. The variables are all integrated of order one and cointegrated. The shocks were identified by decomposing them into permanent and transitory in tandem with the underlying economic theory. In the short-run, the results revealed that shocks to inflation (permanent shocks) were predominantly driven by innovations in money supply and output. To identify the long run shocks, investment was constrained to have zero effects on the other variables; this way, investment shocks were found to be purely transitory which implies that fluctuations in investment primarily generate short-run deviations from equilibrium without altering the long-run path of inflation, money supply, or output.–These results point to the need for maintaining credible and consistent monetary policy measures, and fostering sustainable output growth which could help in achieving long-term price stability.

Keywords: Inflation, Macroeconomic Variables, structural vector error correction model
JEL Classification Codes: E0, E3, E5, E6

1.0 Introduction

Inflation is one of the critical macroeconomic indicators which significantly impacts economic stability, growth, and overall societal well-being (Jusaj, 2025). Over the decades, policy makers and economists have focused intensively on understanding the dynamic nature of inflation (Martins & Verona, 2023, Rudd, 2022, Shah et al., 2020). The dynamics of inflation remain a contentious macroeconomic issue to policy makers and analysts due to the distortions it sets for domestic macroeconomic conditions; the

distortions have the potential of derailing the economy from the trajectory of sustainable economic growth and development (Augustine et al., 2020). For a developing economy like Nigeria, which is characterized by significant structural imbalances and uncertainties, an insight into the dynamics of inflation is necessary and, investigating the major determining factors that contribute to changes in the level of prices over time is imperative.

Anyanwu (1993) contends that Nigeria started experiencing high inflationary trend as a result of the government policies to stimulate a faster rate of economic growth, higher labour productivity and development. In spite of this, the incessant depreciation of the Naira over the years has often aggravated the inflationary situation in the country. Inflation remains one of the most daunting macroeconomic challenges facing Nigeria, with far-reaching consequences on economic stability, poverty levels, and overall development (Haruna & Haliru, 2025). Over the past decades, Nigeria has experienced recurring inflationary pressures often engendered by structural weaknesses, policy inconsistencies, exchange rate volatility, insecurity, and heavy dependence on imports (Onyekwena & Edafe, 2024). Despite various monetary and fiscal interventions by the government, inflation has continued to erode purchasing power, widen inequality and, create uncertainty for investors and consumers. The dynamics of inflation in Nigeria have often been complex due to the interplay between supply-side constraints, namely insecurity which affects agricultural output and high transportation costs and demand-side factors, such as government spending and monetary expansion. Furthermore, the depreciation of the naira, subsidy removal, and global commodity price shocks have utterly aggravated domestic price levels thereby leading to higher rates of inflation (Adewunmi, 2023).

The Central Bank of Nigeria (CBN) has in the recent years persistently resorted to interest rate hiking to manage inflation; yet, these measures have either had limited or a delayed impact due to structural rigidities in the economy (Ihimoyan et al., 2022). Consequently, inflation continues to be a major encumbrance to macroeconomic stability and inclusive growth in Nigeria. Given the socio-economic implications of persistent inflation such as increased cost of living, declining real incomes, and business uncertainty, there is a pressing need to understand the underlying drivers and dynamics of inflation in Nigeria (Idisi et al., 2023). Therefore, a comprehensive analysis is crucial to formulating effective and sustainable policy response that can mitigate inflationary pressure and foster economic resilience.

2.0 Literature Review

This section undertakes a review of related literature which has two strands, namely theoretical and empirical; the aspect on theoretical literature was first presented and discussed then the empirical literature aspect accompanies it.

2.1 Theoretical Literature

The classical theory of inflation is used as the theoretical anchor of this study. The theory offers a straightforward explanation of inflation, primarily emphasizing the relationship between money supply and the price level. The theory intuitively asserts that inflation is a monetary phenomenon whose cause is directly linked to money supply growth. It is a powerful long-run theory, especially relevant to economies with poor monetary discipline (Shaikh et al., 2022). However, it falls short in explaining short-run inflation dynamics, especially in the presence of supply shocks expectations, and price rigidities; these are better captured by the Keynesian and New Keynesian models. Therefore, the classical theory of inflation provides a clear foundation for understanding the inflation dynamics in this study by emphasizing that inflation is primarily driven by changes in money supply. This aligns strongly with the empirical SVEC results, where money supply emerges as the dominant long-run determinant of inflation, with its influence increasing over time. This supports the classical view that sustained monetary expansion leads to persistent increases in the general price level.

2.2 Empirical Literature

This section conducts review of some empirical studies that are related to the topic. These include Olise and Ejedegba (2025) who examined the monetary policy and inflation dynamics in Nigeria; specifically, looking at the implications for policy formulation from 1986 to 2023 using the VAR model and an annual data from 1986 to 2023. They found that the monetary policy rate (MPR) and money supply have positive effects on inflation; while interest rate and liquidity ratio have negative effects. Chinyere et al. (2025) used the Local Projection Impulse Response Function (LPIRF) in examining the transmission of periodic shocks from exchange rate to inflation in Nigeria and found that exchange rate pass-through to inflation was relatively low (~5.5% after two years), meaning that depreciation of the Naira only modestly translates into consumer price inflation over that horizon. In their examination of oil prices and inflation in Nigeria using Nonlinear Autoregressive Distributed Lag (NARDL) model, Ihugba and Adefabi (2025) found that positive oil price shocks have short-term negative effects, but long-run positive effects on inflation, while Samuel and

Olugbamiye (2024) examined the impact of domestic debt on inflation rate in Nigeria using ARDL model and they found that domestic debt and interest rate negatively impact inflation, external debt, money supply, economic growth positively impact inflation.

Adebiyi, Adamgbe and Odu (2024) examined monetary policy shocks and inflation dynamics in Nigeria within an open economy using Dynamic Stochastic General Equilibrium (DSGE) model; the results revealed significant impact of monetary policy shock on inflation. Amassoma et al. (2024) used Error Correction model (ECM) in examining the influence of money supply on inflation in Nigeria and the result revealed that money supply does not considerably influence inflation both in the long and short run probably owing to the recession that the country fell into. In the same vein, Gbadebo and Muhammed (2024) used Error Correction model (ECM) and found that key factors driving inflation in Nigeria included the exchange rate, interest rate, money supply, and oil prices. Usman and Ibrahim (2021) used Autoregressive Distributed Lag (ARDL) model in assessing the macroeconomic determinants of inflation in Nigeria. Their findings showed that money supply and trade openness have positive effect on inflation both in the short run and long run while exchange rate has positive effect in the short-run but negative effect in the long-run. However, the finding established that the interest rate has a negative effect on inflation in both the short run and long run. Augustine et al. (2020) examined the determinants of dynamics of inflation in Nigeria for 36 years and their findings revealed that inflation was not only a monetary phenomenon but equally caused by changes in other macroeconomic variables such as depreciation of the of the exchange rate and increase in the real GDP in the short and long-run; unemployment and interest in the long-run.

Bello and Sanusi (2019) used smooth transition regression model and a quarterly data from 1995Q1 to 2018Q2 in examining inflation dynamics and exchange rate pass-through in Nigeria. The study has identified two distinct inflation regimes, with food, energy, firms' marginal costs, and imported inflation as the driving forces of prices during low inflation regime (period of exchange rate depreciation), while exchange rate alone dominates during high inflation periods. A shift from low to high inflation is primarily triggered by significant naira depreciation, with a critical threshold of about N75 to the dollar. Bawa et al. (2016) examined the dynamics of inflationary process in Nigeria from 1981 to 2015, using the bounds testing approach to cointegration. The results

showed that past inflation and average rainfall appeared to have been the main determinants of inflation in Nigeria. Moreover, the findings acknowledged strong evidence of importance of the money supply as a trigger of inflation thereby lending credence to the dominance of the monetarist proposition on inflation dynamics in Nigeria.

From the literature so far reviewed, (see Olise & Ejedegba, 2025, Usman & Ibrahim, 2021, Ihugba and Adefabi, 2025), it can be observed that none of the studies used Structural Vector Error Correction (SVEC) approach in examining dynamics of inflation in Nigeria. More over none of the studies used domestic investment as a key variable in analyzing dynamics of inflation in Nigeria. This study addresses these gaps and contributes to the literature by using the SVEC approach to analyze dynamics of inflation in Nigeria, and, by including investment variable which was ignored by other studies.

3.0 Materials and Method

3.1 Model Specification

The functional form of the model was adopted from the work of Ejedegba (2025) and it takes the form:

$$INF = f(MS, RGDP, INVT) \quad (3.1)$$

The econometric from of the functional form of the model is given as

$$INF_t = \alpha_0 + \beta_1 MS_t + \beta_2 RGDP_t + \beta_3 INVT_t + \mu_t \quad (3.2)$$

Where $INF$is inflation proxy by consumer price index and it is measured in percentage, MS is the money supply proxy by broad money supply measured in billion Naira, RGDP is real Gross Domestic Product at constant price and measured in billion Naira and INVT is the domestic investment proxy by growth fixed capital formation measured in billion Naira, μ is whit noise, α is the slope, $\beta_1, \beta_2 \; and \; \beta_3$ are the parameters while t is the time period. The prior expectation is that β_1 >0 and $\beta_2$and $\beta_3 < 0$.

3.2 Techniques of Data Analysis

This section presents and discusses the Econometric methodology employed in the paper. We first begin by conducting some pre-estimation tests, namely the unit root tests and cointegration tests on the series. Moreover, post-estimation statistical diagnosis was carried out on the estimated model and this will be discussed in this section later. The unit root tests used were the Augmented Dickey Fuller and Phillips Perron tests, and, the cointegration test was the Johansen test given the fact that all variables were *I(1)*. The unit root and cointegration tests are based on the following mathematical equations:

$$\Delta y_t = \rho y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + \varepsilon_t \quad (3.3)$$

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2 \left(t - \frac{T}{2}\right) + \mu_t \quad (3.4)$$

The VEC model can be specified as:

$$\Delta X_t = \alpha\beta' X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \mathrm{B}^{-1} u_t \quad (3.5)$$

While the SVEC model is given as:

$$\mathrm{B}\Delta X_t = \mathrm{B}\Pi X_{t-1} + \sum_{i=1}^{p-1} \mathrm{B}\Gamma_i \Delta X_{t-i} + u_t \quad (3.6)$$

Where $\pi = \alpha\beta'$ is the cointegration matrix with α as the loading factor/ speed of adjustment parameter and β as the cointegrating vector. The u_t is the error term accounting for extraneous factors not accounted for in the model. The second model carries out the identification of the shocks by decomposing the shocks into two components, namely permanent shocks represented by the restrictions *k-r* and transitory shocks denoted as *r* respectively.

3.2.1 Shocks Identification

Identifying permanent (supply-side) and transitory (demand-side) shocks is crucial for understanding inflation dynamics. Therefore, to identify the shocks, we disentangle them into permanent and transitory shocks. The permanent shocks were identified by imposing restrictions equivalent to *k-r* number of restrictions, where *k* is the number of variables in the system and *r* is the number of cointegrating vectors. Nevertheless, the transitory shocks were identified by imposing *r* number of restrictions, where the *r* denotes number of cointegrating vectors.

The theoretical assumptions underlying the identification in this paper are:

3.2.2 Permanent Shocks: The restrictions that identify the permanent shocks as imposed on the short run matrix for the contemporaneous relationship among the variables that is inflation (INF), Money supply (MS) real gross domestic product (RGDP) and investment (INVT) can be seen below:

$$\begin{pmatrix} 1 & a_{12} & a_{13} & q_{14} \\ a_{21} & 1 & a_{23} & a_{24} \\ 0 & a_{32} & 1 & a_{34} \\ 0 & 0 & a_{41} & 1 \end{pmatrix}$$

The permanent shocks in the above matrix reveal that:

i. Inflation does not respond contemporaneously to RGDP
ii. Inflation does not respond contemporaneously to investment
iii. Money supply does not respond contemporaneously to investment

3.2.3 Transitory Shocks:

The transitory shocks were identified as *r* which corresponds to the number of the cointegrating vectors. In this study, only one cointegrating vector has been found. Therefore, zero restrictions were imposed on the last column of the long run impact matrix which corresponds to the column for investment. The theoretical assumption underlying this identification is that investment has zero long run effect on the

remaining variables. The transitory shock is presented in the matrix below:

$$\begin{pmatrix} a_{11} & a_{12} & a_{13} & 0 \\ a_{21} & a_{22} & a_{23} & 0 \\ a_{31} & a_{32} & a_{33} & 0 \\ a_{41} & a_{42} & a_{43} & 0 \end{pmatrix}$$

The above matrix indicates that investment does not have long run impact on the remaining three macroeconomic variables in the system, namely inflation money supply and real GDP

3.3 Model Adequacy Diagnostics:

Some statistical tests were carried out to ascertain robustness of the results obtained in the paper, these tests include the serial correlation tests, the VEC stability. These are the most statistically crucial tests for SVEC model. The serial correlation is a lag range multiplier test given as:

$$LM = T.R^2 \quad (3.7)$$

The SVEC stability tests is an eigenvalue test for the moduli of the model. This is a test to examine whether the system will return to equilibrium after a shock. Suppose the VEC model is once again given as:

$$\Delta X_t = \Pi X_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta X_{t-i} + \varepsilon_t \quad (3.8)$$

We may re-write the above model as a state-space relation as:

$$Z_t = AZ_{t-1} + u_t \quad (3.9)$$

Where Z_t is stacked vector of current and lagged variables. Whence, if the eigen values of the system are denoted as $\lambda_1, \lambda_2, \ldots, \lambda_m$, stability requires that $\lambda_1, \lambda_2, \ldots, \lambda_m \leq 1$.

3.4 Sources of Data

The annual time series data used in this study was sourced from the World Development Indicators (WDI) (2024) and central bank of Nigeria database from 1993 to 2024. The choice of the time frame of the data is due to the fact that in 1993 the Central Bank of Nigeria (CBN) started using indirect monetary policy instruments to stabilize macroeconomic variables in the country.

4.0 Presentation and Discussion of Findings

4.1 Unit Root Tests

To avoid spurious regression and a mis-specified model, unit root tests were carried out. In this study, the ADF unit root test was employed to check stationarity of the data and the results are presented in Table 4.1.

Table 4.1 Unit Root Tests

Tests at Level				
Variables	**t- Statistic**	**Critical Values at 1%, 5% &10%**		
INF	-1.1199	-3.43	-2.86	-2.57
MS	-1.2753	-3.43	-2.86	-2.57
RGDP	-0.4126	-3.43	-2.86	-2.57
INVT	-0.2388	-3.43	-2.86	-2.57
Tests at First Difference				
ΔINF	-3.3003**	-3.43	-2.86	-2.57
ΔMS	-4.4549*	-3.43	-2.86	-2.57
ΔRGDP	-3.1417**	-3.43	-2.86	-2.57
ΔINVT	-5.0925*	-3.43	-2.86	-2.57

Source: Authors' computation 2025

Note: *&** indicate significant at 1% & 5% level of significance

The ADF results in Table 4.1 revealed that the series, namely CPI, MS, RGDP and INVT are integrated of order one. Even though MS and INVT are stationary at 1% level of significance; CPI and RGDP were found stationary at 5% level of significance.

4.2 Lag Length Selection Criteria

In order to have appropriate Lag to be use in the cointegration and model the Lag Length Selection Criteria was estimated and the result is presented Table 4.2.

Table 4.2 Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
1	-1050.744	NA	1.46e+28	76.19603	76.95729*	76.42876*
2	-1033.814	24.18591	1.45e+28*	76.12959*	77.65211	76.59504
3	-1021.19	14.42780	2.19e+28	76.37071	78.65449	77.06889
4	-1008.749	10.66341	4.17e+28	76.62495	79.66999	77.55585

Source: Authors' Computation 2025

* Indicates Lag Order Selected by the Criterion

The result of lag order selection criteria shows that both Schwarz Information Criterion (SC) and Hannan-Quinn Information Criterion (HQ) selected lag 1, while Final Prediction Error (FPE) and Akaike Information Criterion (AIC) selected lag 2. Based on the result both the cointegration and SVEC model are estimated using lag 1.

4.3 Cointegration Test

To examine cointegration among the variables and to avoid mis-specification, the Johansen cointegration test was employed and the results are reported in Table 4.3:

Table 4.3 Johansen Cointegration Test				
Hypothesized		**Trace**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.858418	81.00214	47.85613	0.0000
At most 1	0.389563	24.31076	29.79707	0.1876
At most 2	0.253892	9.996933	15.49471	0.2810
At most 3	0.050517	1.503290	3.841466	0.2202
Hypothesized		**Max-Eigen**	**0.05**	
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****
None *	0.858418	56.69137	27.58434	0.0000
At most 1	0.389563	14.31383	21.13162	0.3398
At most 2	0.253892	8.493643	14.26460	0.3307
At most 3	0.050517	1.503290	3.841466	0.2202

Source: Authors' computation 2025

* Indicates 1 cointegrating eqn(s) and rejection of the null hypothesis at the 0.05 level

The Johansen cointegration test in Table 4.3 indicates existence of one cointegrating relationship among the variables. Both the Trace and Max-Eigenvalue tests reject the null hypothesis of no cointegration at the 5% level (p = 0.0000), as the test statistics exceed the critical values. However, the null hypothesis of "at most 1" cointegrating equation cannot be rejected since the statistics are lower than the critical values and the probabilities are insignificant. This implies that while the variables are individually non-stationary, they share a long-run equilibrium relationship, validating the use of an SVEC model for analysis.

4.4 SVEC Results

In order to examine inflation dynamics in Nigeria the Structural vector error correction (SVEC) model was employed in this study. The model estimation was underlain by the identification procedure discussed earlier. The SVEC model estimation is based on imposing restrictions on the variables usually driven by an economic theory. The shocks were decomposed into permanent and transitory. The Figure 4.1 displays the impulse response functions.

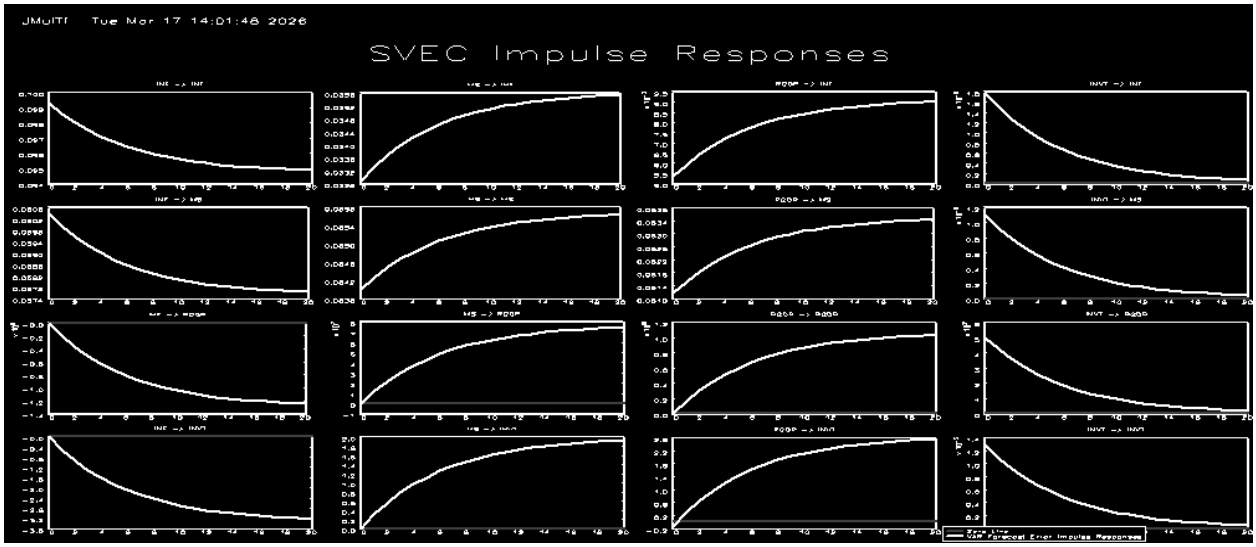

Figure 4.1: SVEC Impulse Responses
Source: Authors' Depiction 2025

The SVEC impulse response functions in the short-run analyse how inflation responds to its own shock as well as to the shocks to other variables in the system, namely money supply, real GDP, and investment. The response of inflation to its own shock as can be observed from the figure appears to be insignificant this implies a temporary effect and mean reversion in inflation. However, the response of inflation to a unit shock to money supply and the real GDP is positive and significant but, its response to a unit shock to investment is negative and insignificant. The positive response of inflation to a unit shock to money supply implies that an increase in the money supply by the Nigerian monetary authorities triggers inflation. These results corroborate the fact that inflation is a monetary phenomenon as monetary expansion leads to higher price levels. Similarly, the positive response of inflation to a unit shock to the real GDP implies that a higher GDP stimulates more demand for goods and services thereby causing a rise in the price level. However, the negative response of inflation to the shock in investment suggests that an increase in investment might reduce inflationary pressure by improving productive capacity. In order to examine proportions of the forecast error in CPI (inflation) that is accounted for by itself as well as other variables, namely money supply, real GDP, and domestic investment, forecast error variance decomposition as a form of innovation accounting was employed and the results are reported in Table 4.4.

The SVEC Forecast Error Variance Decomposition in Table 4.4 shows that in

Source: Authors' computation 2025

Table 4.4 SVEC Forecast Error Variance Decomposition

forecast horizon	INF	MS	RGDP	INVT
1	1.00	0.00	0.00	0.00
2	0.88	0.12	0.00	0.00
3	0.70	0.30	0.00	0.00
4	0.55	0.44	0.00	0.01
5	0.45	0.54	0.00	0.01
6	0.38	0.61	0.00	0.01
7	0.33	0.66	0.00	0.01
8	0.30	0.69	0.00	0.01
9	0.28	0.71	0.00	0.01
10	0.27	0.72	0.00	0.01

the short run (period 1), the entirety of the proportion of the shocks were due to inflation itself with 100% of them stemming from it. This implies that inflation in Nigeria is self-driven. However, as the forecast horizon increases, the influence of money supply (MS) rises steadily, becoming the dominant driver accounting for about 72% variations in inflation in period horizon 10. However, the contribution of inflation to its own shock declined to 27%. The real GDP reveals zero explanation of variations in inflation throughout the period horizons, with investment revealing a very little explanation of variation in inflation (1%). Overall, money supply emerges as the key and dominant source of variations in inflation in the long run.

The results reveal that inflation in Nigeria is highly driven by monetary phenomenon as documented by the classical economists. These results commensurate with those of Ejedegba (2025), Olugbamiye (2024), Adebiyi et al (2024), Gbadebo and Muhammed (2024), Usman & Ibrahim (2021) among others and contradict with those of Amassoma et al, (2024), Augustine et al (2020) among others.

4.5 Diagnostic Tests

To ensure statistical adequacy and reliability of the results, some diagnostic tests were carried out; these include tests for serial correlation and normality of the residuals. The results reveal no serial correlation in the residuals and that the residuals are normally distributed as can be observed in Table 4.5.

Table 4.5 Diagnostic Statistical Tests

Autocorrelation Test				
	LM statistic	**Df**	**p-value**	
	87.3812	80	0.268	
Jarque-Bera Test for Normality				
variable	**tests tat**	**p-value (Chi^2)**	**Skewness**	**kurtosis**
u1	2.7648	0.1375	0.5126	4.1367
u2	2.6729	0.2628	0.4731	4.1149
u3	1.1157	0.5724	-0.439	2.651
u4	1.6267	0.4434	-0.1208	4.1149

Source: Authors' computation 202

5.0 Conclusion and Recommendations

This study employed a structural vector error correction (SVEC) framework to investigate the dynamic interactions among inflation, money supply, and real GDP, within a cointegrated system augmented by investment. The Johansen cointegration test revealed the presence of a single cointegrating vector, indicating the existence of a stable long-run equilibrium relationship among the variables. By imposing theoretically consistent long-run restrictions- specifically constraining investment to have no permanent effect on the system, the SVEC model enabled the decomposition of shocks into permanent and transitory components. This identification strategy is grounded in standard macroeconomic theory, where certain real and nominal disturbances are expected to exert differing long-run influences. The results obtained in this study suggest that permanent shocks are predominantly driven by innovations in money supply and output, reflecting their fundamental role in shaping the long-run trajectory of the economy. In particular, monetary shocks exhibit persistent effects on inflation, consistent with the monetarist proposition that inflation is ultimately a monetary phenomenon. Similarly, output-related shocks contribute significantly to the permanent component, highlighting the role of real economic activity in determining long-run price dynamics. In contrast investment shocks were found to be purely transitory, as imposed by the identifying restrictions. This implies that fluctuations in investment primarily generate short-run deviations from equilibrium without altering the long-run path of inflation, money supply, or output. These results corroborate the fact that investment dynamics are often subject to cyclical adjustments, financing constraints, and short-term expectations rather than structural shifts. The short-run dynamics, as captured by the error correction mechanism and impulse responses, indicate that deviations from the long-run equilibrium are gradually corrected over time, as inflation responds to disequilibria in a manner that restores balance. This interaction between monetary and real variables underscores the presence of both demand-side and supply-side transmission channels. The variance decomposition results further reinforce these conclusions showing that while inflation variability is largely explained by its own shocks in the short-run, the contribution of money supply and output innovations become more pronounced over longer horizons. Overall, the results obtained in this study provide strong evidence in favor of a mixed structural framework, where both monetary

and real factors jointly determine inflation dynamics. Hence, this underscores the need for maintaining credible and consistent monetary policy measures, and fostering sustainable output growth in order to achieve long-term price stability by the Nigerian monetary authorities.

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