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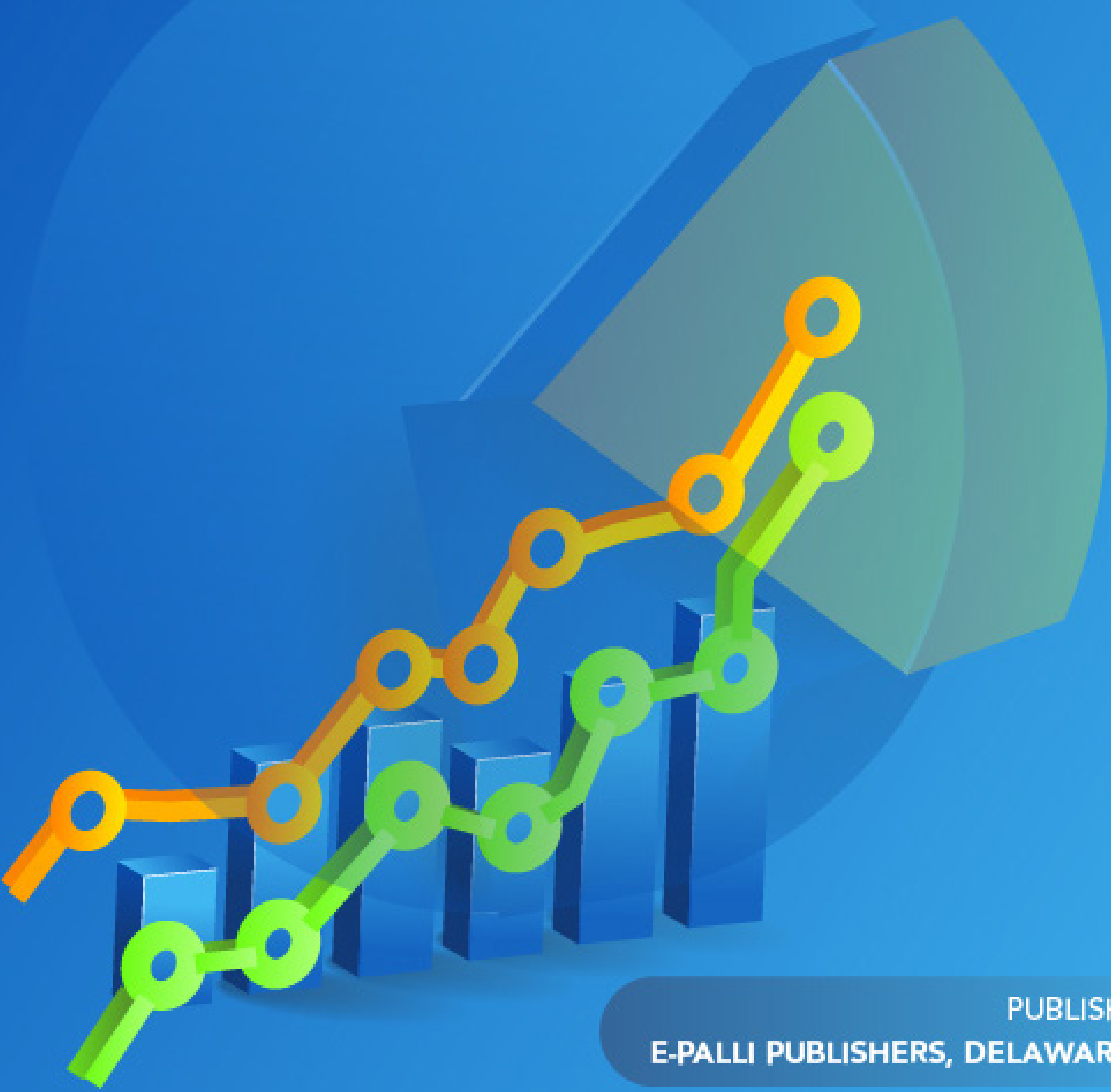

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Macroeconomic Shock Transmission in Nigeria Before and During COVID-19 Pandemic: Evidence from a VECM Framework

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ABSTRACT

Macroeconomic instability remains one of the major challenges affecting economic performance in Nigeria, particularly through fluctuations in exchange rate, inflation, economic growth, interest rate, exports, and money supply. Outbreak of the COVID-19 pandemic further intensified these challenges by disrupting economic activities, international trade and policy transmission mechanisms. This study therefore examined the transmission and dynamics of macroeconomic shocks in Nigeria by comparing the pre-COVID-19 and during COVID-19 periods using the Vector Error Correction Model (VECM) framework. The study employed monthly time-series data on exchange rate, inflation rate, gross domestic product, interest rate, export rate, and money supply. Stationarity of the variables was examined using Augmented Dickey-Fuller and KPSS tests, while Johansen cointegration, VECM estimation, Granger causality, impulse response functions and variance decomposition techniques were applied. The results showed that all variables were integrated of order one, I(1), in both periods. The pre-COVID-19 regime revealed five cointegrating equations, indicating stronger long-run relationships, whereas the COVID-19 period showed only three cointegrating equations, suggesting weakened macroeconomic integration. The error correction coefficient for exchange rate changed from (-0.997, $p < .001$) before COVID-19 to (-1.567, $p < .001$) in COVID-19 period, establishing exchange rate as the primary adjustment variable. Variance decomposition further showed that the exchange rate made the highest contribution (17.26%) to GDP variation and emerged as the dominant macroeconomic shock transmission channel influencing GDP dynamics during the pandemic. The study concluded that COVID-19 significantly altered macroeconomic shock transmission and weakened adjustment mechanisms in Nigeria, thereby necessitating stronger exchange rate management and macroeconomic stabilization policies.

INTRODUCTION

Mordi (2014) observes that the macroeconomic environment in Nigeria, particularly the exchange rates, inflation rate, and economic growth, is an interrelated set of variables that have a significant effect on the stability and development of the economy. In developing economies such as Nigeria, exchange rates are volatile, inflation rates are high, and growth is inconsistent, all of which continue to pose a challenge to policymakers and researchers. It is important to have an idyllic interaction of these macroeconomic variables to develop policies that facilitate sustainable growth and price stability. According to Berhe and Gebrehiwot (2020), the exchange rate is an important connexion between local and foreign markets, and it affects the flows of trade, investment decisions, and capital flows. Predictability in the economy is facilitated by stable exchange rates, and foreign investment can be discouraged by volatility which can destroy trade balances as well as negatively affect the performance of the economy (Cletus Okwuchukwu & Onyeanu, 2023). Nigeria's inflation has effects on both its monetary situation at home and the external price pressure that is exported by fluctuation in the exchange rates (Mordi, 2014). The connexion between economic growth and inflation is quite complicated because moderate inflation can increase the growth rate, as this will promote investment, however the extreme variant of inflation will lead to the destabilization of the economy and slow the growth rates in the long term (Oyadeyi *et al.*, 2025). Inflation affects the purchasing power, factors that motivate investment, and the cost of production (Osuji *et al.*, 2022).

Structural breaks occur when there is a shift in the underlying data-generating process of a time series. Such breaks may affect the mean, variance or other model parameters and can significantly alter the volatility dynamics of the economy. In the context of macroeconomic variables, structural breaks are particularly important because they often correspond to periods of major economic disturbances. For instance, the 2008 global financial crisis, the oil price collapse, the COVID-19 pandemic and changes in monetary policy generated substantial disruptions in economic markets worldwide. The importance of structural break analysis is even more pronounced in emerging economies such as Nigeria, where markets are often exposed to economic instability, exchange rate volatility, inflationary pressures, and policy uncertainty. The Nigerian economic market has experienced several episodes of economic and financial disruptions resulting from the COVID-19 shock, oil price fluctuations, exchange rate reforms, banking sector crises, political instability, and global economic shocks.

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The Vector Error Correction Model (VECM) is an advanced econometric technique widely used in macroeconomic analysis to examine both the short-run dynamics and long-run equilibrium relationships among economic variables. In many economies, macroeconomic variables such as exchange rate, inflation, interest rate, gross domestic product (GDP), money supply and export are interconnected and often move together over time (Enders, 2015). Although these variables may fluctuate in the short run due to economic shocks, policy changes, or external disturbances, they may still maintain a stable long-run relationship. The VECM provides an appropriate framework for capturing these interactions (Enders, 2015). The VECM is derived from the Vector Autoregressive (VAR) model when the variables are non-stationary but cointegrated and cointegration implies that despite short-run fluctuations, the variables share a common long-run equilibrium path (Soren,1988). In macroeconomic studies, pre- and COVID-19 period shocks and crises can temporarily push variables away from equilibrium. The VECM incorporates an error correction mechanism that measures the speed at which the variables adjust back to their long-run equilibrium after a shock occurs. In empirical macroeconomic research, the VECM is particularly useful for analyzing shock transmission mechanisms through Impulse Response Functions (IRFs) and Variance Decomposition Analysis. Impulse response analysis traces the effect of a one-time shock in one variable on the current and future values of other variables in the system (Gujarati & Porter, 2009).

LITERATURE REVIEW

The relationship among major macroeconomic variables in Nigeria, especially the exchange rate, inflation, and economic growth, has continued to attract significant attention in econometric research due to their important role in economic stability and development. The theoretical explanation for exchange rate behavior can be linked to Gustav Cassel's (1918) Purchasing Power Parity (PPP) theory, which explains that exchange rates tend to adjust in order to equalize prices between countries when expressed in the same currency. This theory provides a useful basis for understanding exchange rate movements in an open economy like Nigeria. The foundation for inflation modeling is rooted in Irving Fisher's Quantity Theory of Money, which highlights the close relationship between money supply, economic activity, and price levels. Fisher (1911) explained that inflation is largely influenced by monetary conditions and overall economic activities. This idea has become important in analyzing how inflation interacts with exchange rates, output growth, and other macroeconomic variables. In addition, the New Keynesian Phillips Curve developed by Clarida, Galí, and Gertler (1999) provides a modern explanation of inflation dynamics. The framework suggests that inflation is influenced by factors such as output gaps, expectations, and external shocks. This support treating inflation as an endogenous variable within macroeconomic systems, since it does not operate independently but responds to both domestic and external economic conditions. Furthermore, Mankiw (2021) says Keynesian economics offers a broad framework for understanding short-run economic fluctuations by emphasizing aggregate demand as a major determinant of economic performance. Key concepts such as effective demand, the multiplier effect, and liquidity preference remain highly relevant in explaining fiscal policy and macroeconomic management in modern economies.

Recent empirical studies on macroeconomic shocks and economic performance in Nigeria have increasingly adopted multivariate econometric frameworks such as the Vector Error Correction Model (VECM), Structural Vector Autoregressive (SVAR), and Structural Vector Error Correction (SVEC) models to capture dynamic relationships among macroeconomic variables.

Arulogun *et al.* (2024) examined the effects of fiscal policy variables and oil price shocks on sectoral output growth in Nigeria using the VECM framework. Their findings revealed that oil price shocks and fiscal disturbances significantly influence sectoral output in both the short run and long run. The study further established that macroeconomic shocks are transmitted gradually across sectors, thereby affecting output adjustment and overall economic stability. Similarly, Olawale *et al.* (2026) employed a VECM-based approach to analyze macroeconomic interactions in Nigeria between 2001 and 2023 and confirmed the existence of cointegration among major macroeconomic variables. Their results showed that exchange rate and inflation shocks significantly affect economic growth dynamics in both the short and long run, while the impulse response analysis indicated gradual convergence to equilibrium after disturbances.

In a related study, Ifeacho *et al.* (2025) utilized a Structural Vector Error Correction (SVEC) model to investigate inflation and economic growth dynamics in Nigeria. The study found a significant long-run negative relationship between inflation and economic growth, while the error correction mechanism confirmed the existence of equilibrium adjustment following macroeconomic shocks. This finding aligns with the conclusion of Oyadeyi *et al.* (2025), who investigated the threshold effects of inflation, interest rate, and exchange rate on economic growth in Nigeria. Their results revealed that inflation and exchange rate volatility become harmful to economic growth once certain threshold levels are exceeded, emphasizing the importance of maintaining macroeconomic stability.

Using a Structural Vector Autoregressive (SVAR) model, Umar & Umar (2024) analyzed inflation dynamics in Nigeria and reported strong exchange rate pass-through effects on inflation. Their impulse response analysis showed that exchange rate and money supply shocks generate persistent inflationary pressures before equilibrium is restored. Likewise, Olanrele and Angahar (2025) examined the macroeconomic effects of interest rate shocks using a rolling impulse response framework within SVAR model. Their findings indicated that interest rate shocks significantly affect GDP growth, inflation, and exchange rate movements over time. The study further observed that macroeconomic responses vary across periods, reflecting structural instability in the Nigerian economy.

Beyond conventional macroeconomic relationships, Adebanjo *et al.* (2026) extended the VECM framework by incorporating environmental variables into macroeconomic analysis through the EKC-STIRPAT model. The study found that technological innovation, economic growth, and carbon emissions exhibit both short-run and long-run interactions, while the VECM adjustment mechanism confirmed gradual equilibrium restoration after shocks. This demonstrates the growing application of multivariate error correction frameworks in examining broader economic and environmental interactions.

Comparatively, these studies share several similarities. First, most studies confirmed the presence of cointegration among macroeconomic variables, suggesting that long-run equilibrium relationships exist despite short-run fluctuations. Second, the studies consistently found that exchange rate shocks, inflationary disturbances, oil price volatility, and monetary policy shocks significantly influence economic growth and macroeconomic stability. Third, impulse response and variance decomposition analyses commonly revealed that macroeconomic disturbances have persistent effects before equilibrium adjustment occurs.

However, differences also exist across the studies. While Arulogun *et al.* (2024) focused primarily on sectoral output responses to fiscal and oil price shocks, Umar and Umar (2024) concentrated on inflation dynamics and exchange rate pass-through effects. Similarly, Olanrele and Angahar (2025) emphasized interest rate shocks, whereas Ifeacho *et al.* (2025) focused on the inflation-growth relationship using the SVEC framework. Adebanjo *et al.* (2026), on the other hand, broadened the scope by integrating environmental sustainability variables into macroeconomic analysis. Furthermore, recent reports from World Bank and International Monetary Fund also support the empirical evidence that exchange rate depreciation, inflationary pressures, and monetary tightening remain major macroeconomic challenges affecting Nigeria's growth performance and economic sustainability.

A lot of studies have looked at these variables, but most of them use yearly or quarterly data. In this study, monthly data were used and pre and COVID-19 periods shock was examined to capture the performance of these macroeconomic before COVID 19 and during COVID-19 periods, which makes it possible to discern short-term movements and shocks in the economy. This approach gives a clearer and more detailed picture of how the economy is actually affected in the pre-COVID-19 and during COVID-19 periods.

MATERIALS AND METHODS

Monthly data on Nigeria exchange rate (EXR), inflation rate (INF), gross domestic product (GDP), interest rate (INT), export rate (EXPR) and money supply (MS) from January 1980 to June 2025 was used for this study and obtained from the National Bureau of Statistics (NBS), Central Bank of Nigeria (CBN) and World Development Indicator (WDI).

The stationarity properties for all variables were determined using Augmented Dickey-Fuller (ADF) and Kwiatkowski Phillips Schmidt Shin (KPSS) test. Where ADF test was proposed by Dickey and Fuller (1981) and the test assumed that the error terms are statistically independent and have a constant variance. ADF test assumed that the variables are non-stationary.

The ADF model is specified as

$$\Delta y_t = \alpha + \beta_t + \gamma y_{t-1} + \sum_{i=1}^{p-1} \delta_i \Delta y_{t-i} + u_t \qquad (1)$$

Where Δy_t is the first difference of the series y_t, y_(t-1) is the lagged value of the series, α,β,γ,δ_i are the coefficients, t is the trend component, p is the lag order and u_t is the error term.

Where KPSS test is used for assessing a time series stationarity around a trend or mean. It tests the null hypothesis that there is a series with a trend and level stationary (Kwiatkowski *et al.*, 1992).

$$x_t = \mathrm{r}_t + \beta_t + u_t \qquad (2)$$

Where x_t is the numeric vector, r_t is the random walk, β_t is the trend coefficient, u_t is the error-term. Using both ADF and KPSS gives a more robust assessment for the stationarity on pre and during COVID 19 periods.

Johansen Cointegration test is used to examine long-run equilibrium relationships among the variables and determine the number of cointegrating vectors in the model for the pre and during COVID 19 periods. Johansen Cointegration test involves a VECM estimate, which is

$$\Delta y_t = \Pi_{t-1} + \Pi_1 \Delta y_{t-1} + \Pi_2 \Delta y_{t-2} + \cdots + \Pi_{p-1} \Delta y_{t-p+1} + u_t \qquad (3)$$

Then, Johansen decomposes Π

$$\Pi = \alpha\beta' \qquad (4)$$

Where α (n × r) is the adjustment coefficients, β (n × r) is the cointegrating relationships, r is the number of cointegrating relationships. The trace test and maximum eigenvalue test are the two likelihood ratio tests that Johansen proposed to test the significance of the canonical correlations and thereby the reduced rank of the Π matrix: (Sanusi, 2010).

The trace test

$$\mathrm{J_{trace}} = -\mathrm{T} \sum_{\mathrm{i=r+1}}^{\mathrm{n}} \ln(1 - \hat{\lambda}_i) \qquad (5)$$

The trace test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of n cointegrating vectors and the

The maximum eigenvalue test

Where T is the sample size and ($\hat{\lambda}_i$) is the ith largest

$$J_{max} = -T\ln(1-\hat{\lambda}_i) \qquad (6)$$

canonical correlations.

The maximum eigenvalue test tests the null hypothesis of r cointegrating vectors against the alternative hypothesis of r +1 cointegrating vectors.

The VEC model is used to model the short-run dynamics and long-run equilibrium relationship in a co-integrated system of equations for the two regime which are pre-COVID 19 and during COVID 19 periods. A VECM will be estimated when there's cointegration among the exchange rate, inflation and economic growth in the two periods.

The equation for the VEC model is

The model implementation that shows the break point

$$\Delta y_t = \pi_0 + \pi y_{t-1} + \sum_{i=1}^{p-1} \pi_i \Delta y_{t-i} + u_t \qquad (7)$$

and the regime considering COVID-19 as the break point.

Where COVID-19; t = 2020

The regimes are Pre-COVID 19: t < 2020 and during COVID 19: t≥2020, Δy_t is the first difference of the vector variables for the regimes, $y_{(t-1)}$ is the lagged value of the vector variables for the regimes, π_0 the vector of the intercept, π_i is the matrix of the coefficients, p is the lag order, u_t is the error term for the regimes.

The Granger Causality tests is used for nature and directional causality checking between variables for the two periods. It also shows how variables Granger-cause each other in a model.

Impulse Response analysis is used in time series analysis to measure the reaction of a variable to a shock made to another variable, expressed as the change in one standard deviation of the variable. It is crucial for understanding the dynamic effects between variables, especially for the two periods. Impulse response function traces the dynamic response of variables to shocks.

Where z_i is the response variable at time t, ε_t is the shock to

$$z_j = \sum_{j=0}^{\infty} A_j \varepsilon_{t-j} \qquad (8)$$

the system at time t, A_t is the impulse response coefficient for the jth period.

Variance Decomposition in a VECM framework is

$$AIC = 2k - 2\ln(\hat{L}) \qquad (9)$$

used to determine the proportion of the forecast error variance of each variable that can be attributed to its own innovations and to shocks from other variables in the system. Variance decomposition provides information about the importance of shock in the explanation of fluctuations in the variables over time.

The Akaike Information Criterion (AIC) is a statistical measure used for model selection that assesses a model's predictive accuracy and goodness of fit balancing functions against the complexity of the model, which is represented by the number of parameters. The model with the smallest AIC value is considered the best fit, as it indicates a good balance between explaining the data and not being overfit for the two periods.

The basic formula is

Where k is the number of parameters, $\hat{L}$ is the maximum value of the likelihood function

The Bayesian Information Criterion (BIC) is a statistical technique used in model selection that balances a model's goodness-of-fit with its complexity. To choose the best model, one selects the model with the lowest BIC value, which is calculated by penalizing models with more parameters, especially in the context of a larger number of observations for the two periods.

The basic formula is

Where k is the number of parameters in the model, n is

$$BIC = k\ln(n) - 2\ln(\hat{L}) \qquad (10)$$

the number of observations, $\hat{L}$ is the maximum value of the likelihood function for the model.

RESULTS AND DISCUSSION

Results and discussion before covid-19 period

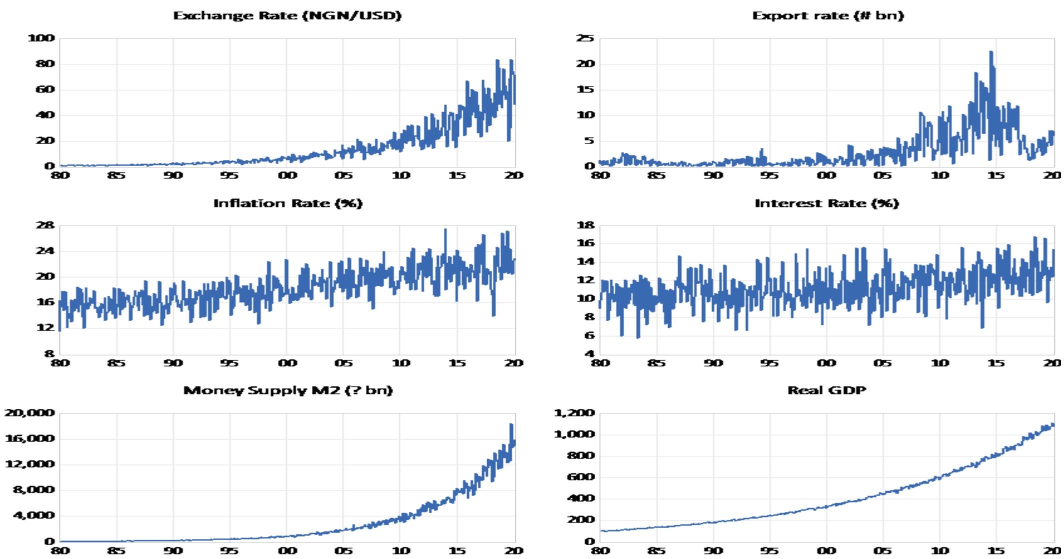

Figure 1: Trend Analysis of the period Before COVID 19

Table 1: Descriptive Analysis of the period Before COVID-19

Statistics	**EXR**	**INF**	**GDP**	**INT**	**EXPR**	**MS**
Mean	13.413	18.358	417.321	11.249	2.795	2689.269
Median	6.039	18.109	332.189	11.213	1.339	879.995
Maximum	83.877	27.463	1111.388	16.807	22.554	18375.800
Minimum	0.309	11.547	99.348	5.709	0.023	42.235
Std. Dev.	16.960	2.845	277.446	1.864	3.573	3713.371
Skewness	1.803	0.361	0.807	0.123	2.211	1.749
Kurtosis	5.815	2.833	2.519	3.118	8.629	5.314
Jarque-Bera	420.219	11.011	56.993	1.497	1029.268	353.319
P-value	0.000	0.004	0.000	0.473	0.000	0.000
Observations	482	482	482	482	482	482

Source: Author's Computation, 2026

Figure 1 shows the individual graphical illustration of the variables used in this study and help to indicate the general trend and provides details about the patterns of variability and volatility in the variables during the given period. The graphical illustration indicates that the variables have an upward trend.

Based on the results in Table 1, the exchange rate has an average of 13.41 per dollar and a median of 6.039 dollars, indicating the existence of extreme values during the sample period, which is common in the history of the exchange rate with hits of sharp depreciation. A high volatility is also further indicated by the fact that the highest value (83.88 dollars) was compared with a minimum (0.31 dollars). This is strengthened by the existence of a standard deviation (16.96), which implies broad variations about the mean. This value of positive skewness (1.80) and kurtosis (5.82) is leptokurtic, which has a fat tall and narrow peak and has fat tails to the right. Jarque-Bera value is also statistically significant (420.22, $p < .05$), meaning that the exchange rate series is not normally distributed.

There is a mean (18.36) and a median (18.11), which means that it appears to be fairly symmetric about its Centre. The inflation variable has a moderate variability, as the standard deviation of inflation is 2.85, as compared to other variables. The skew (0.36) shows that there is slight skewness to the right, whereas the kurtosis (2.8) is almost near the normal distribution standard of 3. Nonetheless, the Jarque-Bera test is statistically significant (11.01, $p < .05$), meaning that inflation does not follow normality, and to a minor extent compared to both the exchange rate and money supply.

The GDP displays a mean (417.32) and a median (332.19), and the result of this is that there is an increasing trend in the output of the Nigerian economy through the years. The difference between the minimum (99.35) and maximum (1111.39) values is quite wide, which means that there has been an increase in the economy over the long term, and the economy has changed structurally. An existing dispersion is verified by the standard deviation (277.45). GDP is skewed in the positive (0.81), and the kurtosis (2.83) is also nearer to the normative of normality (3) of the distribution. The Jarque-Bera statistic is significant (56.99, $p < .05$), which means that the GDP data is not normally distributed.

The interest rate has a mean (11.25) and a median (11.21), indicating that the central value is stable. The standard deviation (1.86) is fairly low and suggests that the variation is not high as in the case of exchange rate and GDP. The skewness (0.123) and kurtosis (3.12) values show that the distribution is somewhat symmetric and leptokurtosis is moderate. However, the Jarque-Bera test at the level of 5 percent (1.497, $p > .05$) indicates that interest rate data is normally distributed.

The mean of export is 2.80 and the median is 1.34, which demonstrates that some extreme export values were produced at some point. The highest value (22.55) compared to the lowest value (0.02) is an indication of high volatility in the performance of exports. A heavy skew of the data (2.21) and a large kurtosis (8.63) are indicators of a heavy-skewed and leptokurtic distribution. The Jarque-Bera (1029.27, $p < .01$) shows that the export rate is not normally distributed.

Money supply has the largest mean (2689.27) and also a very high standard deviation (3713.37), meaning that the monetary growth is also very high during the study period and has a median (880.0) and the maximum (18375.80) are also the indicators of high growth and volatility. Its skewness is positive (1.75) with a high kurtosis (5.31) and the Jarque-Bera test violates the assumption of normality (353.32, $p < .05$).

Generally, it is possible to conclude that the variables have a different extent of non-normality, except the inflation rate, which was normal and they all showed volatility and skewness, which is typical of macroeconomic time-series data.

Table 2: Unit Root Test Before COVID-19 period

At Level						At First Difference				
Variables	ADF Statistic	5 % Critical Value	Prob.	KPSS Statistic	5 % Critical Value	ADF Statistic	5 % Critical Value	Prob.	KPSS Statistic	5 % Critical Value
EXR	2.317	-2.867	1.000	2.195	0.463	-15.899	-2.867	0.000	0.184	0.463
INF	-2.354	-2.867	0.156	2.856	0.463	-14.790	-2.867	0.000	0.269	0.463
GDP	8.739	-2.867	1.000	2.587	0.463	-17.124	-2.867	0.000	0.152	0.463
INT	-0.029	-2.867	0.673	2.842	0.463	-14.735	-2.867	0.000	0.076	0.463
EXP	-1.706	-2.867	0.428	1.895	0.463	-12.041	-2.867	0.000	0.079	0.463
MS	9.610	-2.867	1.000	2.066	0.463	-4.814	-2.867	0.000	0.168	0.463

Source: Author's Computation, 2026

The ADF result in Table 2 shows that all variables are non-stationary at the level. This is evidenced by their probability values greater than the level of significance at 5%. Implying that the null hypothesis cannot be rejected. At first difference, all variables became stationary, as their probability values are statistically significant ($p < .05$), implying that the null hypothesis can be rejected.

The KPSS results in Table 2 reveal that the KPSS statistics for all variables are statistically significant ($p < .05$). This indicates that the null hypothesis of stationarity is rejected, confirming that the variables are non-stationary at the level. At first difference, the KPSS statistics for all variables are not significant ($p < .05$), implying that the null hypothesis of stationarity cannot be rejected.

The results from both ADF and KPSS tests are consistent and complementary. While the ADF test confirms non-stationarity at the level and stationarity at first difference, the KPSS test corroborates this finding by rejecting stationarity at the level and accepting stationarity at first difference. Therefore, it is concluded that all variables are integrated of order one I(1).

*indicates lag order selected by the criterion.

Table 3: Lag Order Selection for the period Before COVID-19

Lag	LogL	AIC	SC
0	-11818.10	50.315	50.336
1	-10039.97	42.902	43.048
2	-9864.032	42.307	42.996*
3	-9760.305	42.018	43.026
4	-9698.507	41.909	43.234
5	-9605.288	41.665	43.308
6	-9531.911	41.506	43.468
7	-9495.538	41.504	43.784
8	-9432.729	41.390	43.988
9	-9391.201	41.367	44.283
10	-9348.842	41.339	44.574
11	-9288.960	41.238	44.790
12	-9214.496	41.074*	44.944

Source: Author's Computation, 2026

Table 3 reveals that the lag length selection relies on the outcomes of the various information criteria, of which the Akaike information criterion suggests lag 12 while the Schwarz information criterion suggests lag 2. SIC suggested a minimum lag of 2, which is likely better to avoid overfitting and maintain simplicity.

Table 4: Unrestricted Cointegration Rank Test (Trace and Max-Eigen) for Before COVID-19 period

	Cointegration Rank Test (Trace)				Cointegration Rank Test (Max-Eigen)			
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Crit. Value	Prob.	Eigenvalue	Max-Eigen Statistic	5% Crit. Value	Prob.
None*	0.324	559.837	95.754	0.000	0.324	187.538	40.078	0.000
At most 1*	0.279	372.299	69.819	0.000	0.279	157.081	33.877	0.000
At most 2*	0.236	215.218	47.856	0.000	0.236	129.108	27.584	0.000
At most 3*	0.108	86.111	29.797	0.000	0.107	54.511	21.132	0.000
At most 4*	0.062	31.599	15.495	0.000	0.062	30.788	14.265	0.000
At most 5	0.002	0.811	3.841	0.367	0.002	0.811	3.841	0.368

Source: Author's Computation, 2026

*indicates the rejection of the hypothesis at the 0.05 level.
The results in Table 4 reveal that the trace null hypotheses of no cointegration, at most one, at most two, at most three, and at most four cointegrating equations are also rejected as the p-value (0.000) is less than the significance level at 5%. However, the null hypothesis of at most five cointegrating equations cannot be rejected as the p-value (0.0909) is greater than the significance level at 5%.

The results in Table 4 reveal that the Max-eigenvalue null hypotheses of no cointegration, at most one, at most two, at most three, and at most four cointegrating equations are also rejected as the p-value (0.000) is less than the 0.05 significance level. However, the null hypothesis of at most five cointegrating equations cannot be rejected as the p-value (0.0909) is greater than the 0.05 significance level. The Maximum Eigenvalue test indicates 5 cointegrating equations at the 0.05 level.

Both the trace and maximum eigenvalue tests consistently indicate the presence of five cointegrating equations. The estimation result indicates that a long-run relationship exists among the EXR, INF, GDP, INT, EXP, and MS. This means that all variables used in this study have a long-run equilibrium relationship.

Table 5: Long-run Coefficient of the Cointegrating Vector Before COVID-19 period

Variables	**CointEq1**	**CointEq2**	**CointEq3**	**CointEq4**	**CointEq5**
EXR (-1)	1	0	0	0	0
INF (-1)	0	1	0	0	0
GDP (-1)	0	0	1	0	0
INT (-1)	0	0	0	1	0
EXPR (-1)	0	0	0	0	1
MS (-1)	-0.0035 (0.0002) [-14.3869]***	0.0002 (0.0002) [1.2073]	0.0182 (0.0147) [-1.2409]	-4.20E-05 (4.8E-05) [-0.8809]	0.0003 (0.0003) [1.4177]
C	-4.0197	-18.9994	-367.9656	-11.1339	-3.7534

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%

Table 5 presents the estimated long-run coefficients of the cointegrating vectors, each normalized on a different endogenous variable. The existence of five cointegrating equations confirms the existence of a stable long-run equilibrium relationship among the variables.

The long-run estimates indicate that money supply exerts downward pressure on exchange, GDP, and export stability but has a positive influence on the performance of inflation. This highlights the dominant role of monetary conditions in shaping Nigeria's long-run macroeconomic dynamics. The normalization of the cointegrating vectors on LEXR, INF, LGDP, INT, and LEXPR, respectively, the expansion in money supply influences exchange rate strongly in the long run, there is no strong evidence that MS drives inflation in the long run, it does not significantly explain economic growth in the long run and money supply does not significantly affect exports in the long run.

Table 6: Speed of Adjustment Before COVID-19 period

Variables	**D(EXR)**	**D(INF)**	**D(GDP)**	**D(INT)**	**D(EXP)**	**D(MS)**
ECM	-0.997*** (0.068) [-14.688]	-0.024 (0.022) [-1.102]	0.102 (0.137) [0.744]	0.069 (0.019) [0.833]	0.069** (0.026) [2.675]	-17.345** (6.457) [-2.686]

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%

Table 6 shows that the negative and statistically significant error correction term coefficients for exchange, export rate, and money supply exhibit stable and relatively rapid adjustment to long-run disequilibria, while inflation, GDP positive but adjust more slowly to equilibrium. In contrast, the inflation, GDP, and interest does not display significant short-run adjustment, implying that their performance in Nigeria is more policy-driven and less responsive to short-term deviations from a long-run equilibrium.

Table 7: Short-run dynamics Before COVID-19 period

Variables	**D(EXR)**	**D(INF)**	**D(GDP)**
D(EXR(-1))	-	0.0067 (0.0149) [0.4444]	-0.0860 (0.0954) [-0.9016]
D(INF(-1))	-0.0256 (0.1439) [-0.1778]	-	0.2275 (0.2912) [0.7814]
D(GDP(-1))	-0.0532 (0.0205) [-2.5993]**	-0.0217 (0.0065) [-3.3318]**	-

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%

Table 7 presents the short-run interactions among the exchange rate, inflation, and economic growth. The results show that lagged changes in the exchange rate do not statistically significantly affect inflation or GDP in the short run. Lagged inflation exhibits a negative but weak impact on exchange rate and a positive impact on GDP changes. Similarly, lagged GDP shows a negative and statistically significant effect.

Table 8: Goodness of Fit Statistics Before COVID-19 period

Variables	**D(EXR)**	**D(INF)**	**D(GDP)**	**D(INT)**	**D(EXPR)**	**D(MS)**
R-square	0.5382	0.4998	0.2448	0.4881	0.3281	0.3586
Adj. R-square	0.5274	0.4880	0.2270	0.4761	0.3123	0.34345
F-statistic	49.5880***	42.5057***	13.7909***	40.5645***	20.7757***	23.7835***

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%

The R^2 values in Table 8 indicate moderate explanatory power, which is acceptable for macroeconomic time-series models. The null hypothesis of the F-statistic states that all coefficients are equal to zero. All equations have statistically significant F-statistics because they are not equal to zero, so it is confirming that the VECM equations are jointly significant.

Table 9: Residual Covariance and Stability Before COVID-19 period

Determinant residual covariance	**6.35E+10**
Log likelihood	-10056.34
AIC	42.3264
SIC	43.2133

Source: Author's Computation, 2026.

Table 9 shows the low determinant of the residual covariance matrix, and reasonable information criteria values indicate that the VECM is well specified, stable, and dynamically consistent.

Table 10: Granger-causality Test Before COVID-19 period

Dependent Variables	Exchange rate D(EXR)			Inflation rate D(INF)			Economic growth D(GDP)		
Variables Excluded	Chi-square statistic	df	Prob.	Chi-square statistic	df	Prob.	Chi-square statistic	df	Prob.
D(EXR)	-	-	-	0.1976	1	0.6567	0.8128	1	0.3672
D(INF)	0.0316	1	0.8589	-	-	-	0.6106	1	0.4346
D(GDP)	6.7562	1	0.0093	11.1011	1	0.0009	-	-	-
D(INT)	0.1580	1	0.6910	0.2643	1	0.6072	1.7120	1	0.1907
D(EXPR)	0.7299	1	0.3929	0.0611	1	0.8048	0.2117	1	0.6454
D(MS)	9.9742	1	0.0016	5.7484	1	0.0165	2.2120	1	0.1369
All	16.1571	5	0.0064	20.5921	5	0.0010	4.8633	5	0.4328

Source: Author's Computation, 2026.

Exchange rate as dependent variable results in Table 10 indicates that GDP, and money supply do not individually Granger-cause the exchange rate, indicating that these variables do not exert a direct short-run causal influence on exchange rate movements when considered in isolation. Therefore, inflation, interest, and export does have a granger causality with exchange rate as the dependent variable. However, the joint causality test reveals that all explanatory variables collectively exert a statistically significant effect on the exchange rate (χ^2 = 16.16, p< 0.05). This implies that although individual effects may be weak, the combined interaction of macroeconomic fundamentals significantly influences exchange rate behavior in Nigeria.

Inflation rate as dependent variable results in Table 10 reveals that the exchange rate, interest rate, and exports individually Granger cause inflation in the short run. Furthermore, the joint test is also statistically significant (χ^2 = 4.8766, p<0.05), indicating the presence of collective short-run causality from these macroeconomic variables to inflation.

Economic growth as dependent variable results in Table 10 indicate that all the explanatory variables Granger-causes economic growth at the 5% level of significance (χ^2 = 11.65, p<0.05). In contrast, exchange rate, inflation, interest rate, and exports do not individually Granger-cause economic growth, suggesting that these variables do not exert a direct short-run causal influence on output when considered separately.

However, the joint causality test reveals a statistically significant effect of all explanatory variables on economic growth and jointly not statistically significant ($\chi^2 = 4.86$, $p>0.05$). This implies that although individual macroeconomic variables may be dependently drive growth, their combined interaction does not significantly influence economic output.

Impulse Response Function

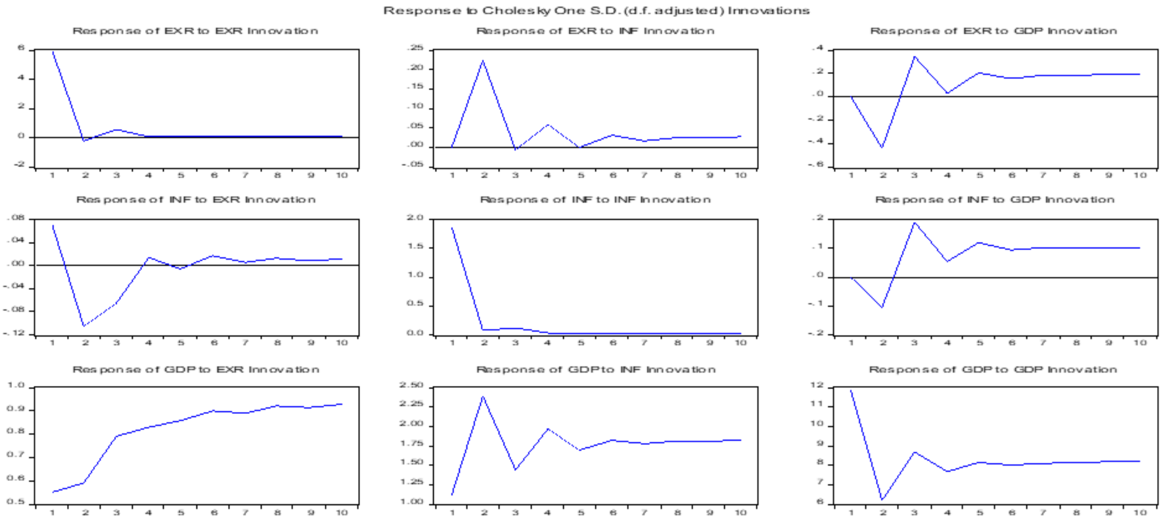

Figure 2: Impulse Response Function Before COVID-19 period

Source: Author's Computation, 2026.

Fig. 2 shows that the responses gradually converge toward stable values, suggesting that exchange rate disturbances are temporary and that the system possesses a mechanism for restoring equilibrium over time. In addition, the impulse responses also show that the inflation disturbances reduce over the time, which implies the existence of long-run macroeconomic responses, as the effects. Lastly, the response of the economic growth is comparatively stable and is drawn to equilibrium values indicating the phenomenon of resilience of the real sector to macroeconomic shocks.

Table 11: Variance Decomposition Before COVID-19 period

Variance Decomposition of EXR										
Period	1	2	3	4	5	6	7	8	9	10
EXR	100.00	98.70	97.76	96.73	95.66	94.59	93.55	92.51	91.49	90.49
INF	0.00	0.57	0.57	0.58	0.62	0.66	0.70	0.75	0.79	0.84
GDP	0.00	0.72	1.67	2.69	3.72	4.74	5.75	6.74	7.72	8.67
Variance Decomposition of INF										
Period	1	2	3	4	5	6	7	8	9	10
EXR	0.09	2.69	2.86	2.86	2.85	2.85	2.85	2.85	2.85	2.85
INF	99.90	96.89	96.43	96.17	95.92	95.68	95.42	95.18	94.93	94.68
GDP	0	0.42	0.71	0.97	1.22	1.47	1.72	1.97	2.22	2.47
Variance Decomposition of GDP										
Period	1	2	3	4	5	6	7	8	9	10
EXR	1.78	2.39	2.56	2.64	2.69	2.72	2.74	2.76	2.77	2.78
INF	2.04	3.33	3.77	3.40	4.13	4.22	4.28	4.22	4.37	4.40
GDP	96.18	94.28	93.66	93.36	93.18	93.06	92.97	92.91	92.86	92.82

Source: Author's Computation, 2026.

The results in Table 11 show that the exchange rate, inflation rate, and economic growth are mostly explained by their own shocks over the forecast horizon and also showed that movements are initially driven by internal

Results and discussion during covid-19 period

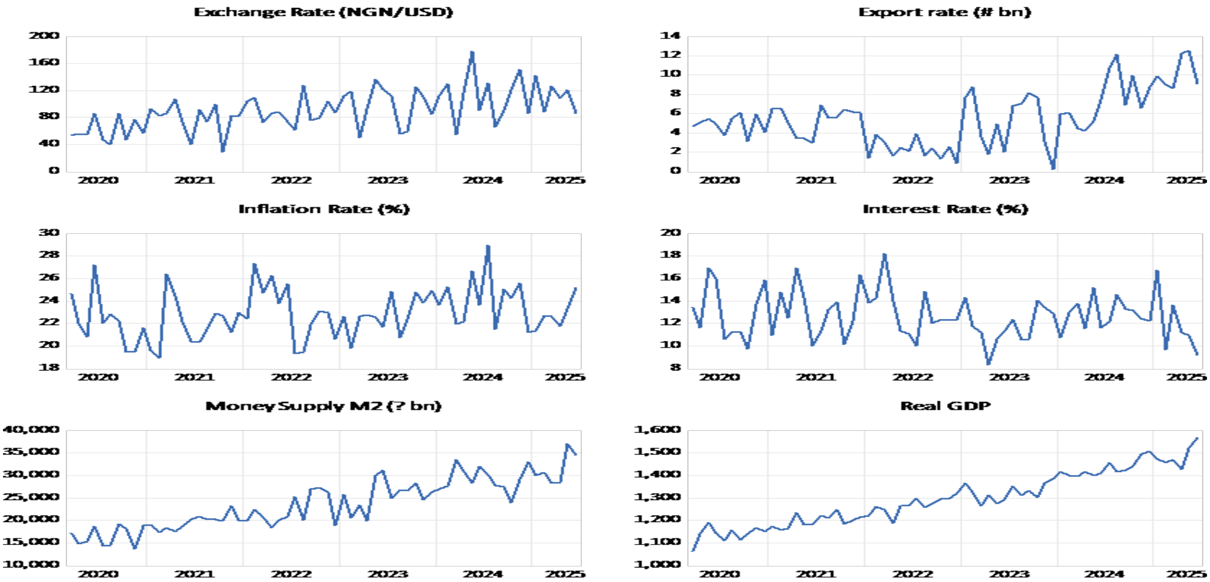

Figure 3: Trend Analysis of During COVID 19 period
Source: Author's Computation, 2026.

Table 12: Descriptive Analysis During COVID 19 period

Statistics	**EXR**	**INF**	**GDP**	**INT**	**EXPR**	**MS**
Mean	90.440	22.858	1295.630	12.647	5.493	23666.210
Median	86.466	22.639	1284.561	12.303	5.481	23361.570
Maximum	177.888	28.979	1567.992	18.225	12.524	36990.300
Minimum	28.415	18.892	1063.694	8.313	0.210	13617.570
Std. Dev.	30.114	2.190	119.913	2.094	2.898	5627.789
Skewness	0.281	0.426	0.252	0.488	0.455	0.234
Kurtosis	2.909	2.881	2.133	2.845	2.773	2.154
Jarque-Bera	0.867	1.976	2.682	2.603	2.349	2.494
P-value	0.648	0.372	0.262	0.272	0.309	0.287
Observations	64	64	64	64	64	64

Source: Author's Computation, 2026.

factors and the forecast horizon lengthens, the influence of other variables gradually becomes more significant

Figure 3 shows individual graphical illustrations of the variables used in this study, helping to indicate the general trend and providing details about the patterns of variability and volatility in the variables during the given period. The graphical illustration indicates that the variables have an upward trend.

Based on the results in Table 12, the exchange rate has a mean of 90.44 and a median of 86.47, it indicates the existence of extreme values at the sample period which is common in the history of the exchange rate with hits of sharp depreciation. A high volatility is also further indicated by the fact that the highest value (177.89) was compared with a minimum (28.42). This is strengthened by the existence of a standard deviation (30.11), which implies broad variations about the mean. This value of positive skewness (0.28) and kurtosis (2.91) is platykurtic which has thin tail. Jarque-Bera value is also statistically insignificant (0.86, $p > .05$), meaning that exchange rate series is normally distributed.

There is a mean (22.86) and a median (22.64), which means that it appears to be fairly symmetric in its Centre. The inflation variable has a moderate variability, as the standard deviation of inflation is 2.19, as compared to other variables. The skew (0.43) shows that there is slight skewness to the right whereas the kurtosis (2.88) is almost near the normal distribution standard of 3. Nonetheless, the Jarque-Bera test is statistically insignificant (1.98, $p > .05$), meaning that inflation does follows normality.

The GDP shows a mean (1295.63) and a median (1284.56), indicating an increasing trend in Nigeria's economic output over the years. The difference between the minimum (1063.69) and maximum (1567.99) values is not too wide, which means that there has been a slight increase in the economy over the term. An existing dispersion is verified by the standard deviation (119.91). GDP is skewed in the positive (0.25), and the kurtosis (2.13) which is platykurtic. The Jarque-Bera statistic is insignificant (2.68, $p > .05$), which means that the GDP data is normally distributed.

The interest rate has a mean (12.65) and a median (12.30) indicating that there is stability on the central value. The standard deviation (2.09) is fairly low and the skewness (0.49) and kurtosis (2.85) values show that the distribution is somewhat symmetric and platykurtic is moderate. However, Jarque-Bera test at the level of 5 percent (2.60, $p > .05$) indicating that interest rates data is normally distributed.

The mean of export is 5.49 and median is 5.48, which demonstrates that some extreme export values were produced at some point. The highest value (12.52) compared to the lowest value (0.21) is an indication a slight volatility in the performance of exports. A skew of the data (0.46) and a kurtosis (2.77) are an indicator of a skewed and platykurtic distribution. The Jarque-Bera (2.35, $p > .05$) shows that the export rate is normally distributed.

Money supply has the largest mean (23666.21) and also a very high standard deviation (5627.79) meaning that the monetary growth is also very high during the study period and has a median (23361.57) and the maximum (36990.30) are also the indicators of high growth and volatility. Its skewness is positive (0.23) with a kurtosis (2.15) and the Jarque-Bera test does not violates the assumption of normality (2.45, $p > .05$).

Generally, it is possible to conclude that the variables show normally distributed assumption is satisfied and they all showed a volatility and skewness, which is typical of macroeconomic time-series data.

Table 13: Unit Root Test During COVID-19 period

At Level						At First Difference				
Variables	**ADF Statistic**	**5 % Crit. Value**	**Prob.**	**KPSS Statistic**	**5 % Crit. Value**	**ADF Statistic**	**5 % Crit. Value**	**Prob.**	**KPSS Statistic**	**5 % Crit. Value**
EXR	0.999	-1.947	0.915	1.155	0.463	-8.048	-1.947	0.000	0.439	0.463
INF	-0.141	-1.947	0.631	0.316	0.463	-13.495	-2.909	0.000	-	-
GDP	0.446	-2.912	0.983	1.015	0.463	-6.737	-2.912	0.000	0.162	0.463
INT	-0.834	-1.946	0.351	0.223	0.463	-7.210	-1.946	0.000	-	-
EXP	-1.356	-1.946	0.161	0.574	0.463	-10.231	-1.946	0.000	0.347	0.463
MS	-1.411	-2.909	0.571	1.014	0.463	-11.992	-2.909	0.000	0.455	0.463

Source: Author's Computation, 2026.

The ADF result in Table 13 shows that all variables are non-stationary at the level. This is evidenced by their probability values greater than the level of significance at 5%. Implying that the null hypothesis cannot be rejected. At first difference, all variables became stationary, as their probability values are statistically significant at 5%. level of significance, indicating that the p-value is less than the level of significance, implying that the null hypothesis can be rejected.

The KPSS results in Table 13 reveal that the KPSS statistics for variables exceed the 5% critical value of 0.463. This indicates that the null hypothesis of stationarity is rejected, confirming that the variables are non-stationary at the level. At first difference, the KPSS statistics for all variables are less than the 5% critical value, implying that the null hypothesis of stationarity cannot be rejected.

Table 14: Lag Order Selection During COVID 19 period

Lag	**LogL**	**AIC**	**SC**
0	-1488.791	53.385	53.602
1	-1400.748	51.527	53.046*
2	-1372.670	51.809	54.631
3	-1335.427	51.765	55.888
4	-1294.088	51.575	56.999
5	-1266.693	51.882	58.609
6	-1221.913	51.568	59.597
7	-1172.614	51.093	60.424
8	-1073.592	48.843*	59.476

Source: Author's Computation, 2026.

Table 14 reveals that the lag length selection relies on the outcomes of the various information criteria, of which the Akaike information criterion suggests lag 8 while the Schwarz information criterion suggests lag 2. SIC suggested a minimum lag of 1, which is likely better to avoid overfitting and maintain simplicity.

Table 15: Unrestricted Cointegration Rank Test (Trace and Max-Eigen) During COVID-19 period

	Cointegration Rank Test (Trace)				Cointegration Rank Test (Max-Eigen)			
Hypothesized No. of CE(s)	**Eigenvalue**	**Trace Statistic**	**5% Crit. Value**	**Prob.**	**Eigenvalue**	**Max-Eigen Statistic**	**5% Crit. Value**	**Prob.**
None*	0.627	142.314	95.754	0.000	0.627	60.079	40.078	0.000
At most 1*	0.420	82.234	69.819	0.004	0.420	33.256	33.877	0.059
At most 2*	0.333	48.978	47.856	0.039	0.333	24.667	27.584	0.113
At most 3	0.208	24.312	29.797	0.188	0.207	14.222	21.132	0.347
At most 4	0.141	10.089	15.495	0.274	0.141	9.243	14.265	0.267
At most 5	0.014	0.847	3.841	0.357	0.014	0.847	3.841	0.357

Source: Author's Computation, 2026.

*indicates the rejection of the hypothesis at the 0.05 level.
The results in Table 15 reveals that the trace show that there are at most three cointegrating equations that are also rejected as the p-value (0.188) is less than the significance level at 5%. However, the null hypothesis of at most three cointegrating equations cannot be rejected as the p-value (0.188) is greater than the significance level at 5%.

The results in Table 15 reveal that the Max-eigenvalue at most one cointegrating equations are also rejected as the p-value (0.000) is less than the 0.05 significance level. However, the null hypothesis of at most one cointegrating equations cannot be rejected as the p-value (0.059) is greater than the 0.05 significance level. The Maximum

Table 16: Long-run Coefficient of the Cointegrating Vector During COVID-19 period

Variables	CointEq1	CointEq2	CointEq3
EXR (-1)	1	0	0
INF (-1)	0	1	0
GDP (-1)	0	0	1
INT (-1)	-1.652 (1.420) [-1.163]	-1.569 (0.266) [-5.899]**	-3.429 (4.673) [-0.734]
EXPR (-1)	1.405 (0.884) [1.588]	0.059 (0.166) [0.381]	-7.929 (2.909) [-2.725]**
MS (-1)	-0.004 (0.000) [-8.069]**	-0.000 (8.4E-05) [-2.705]**	-0.021 (0.001) [-14.216]**
C	7.689	2.153	-712.757

Source: Author's Computation, 2026.

Eigenvalue test indicates 1 cointegrating equations at the 0.05 level.
*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%
Table 16 reveals the existence of stable long-run relationships among the variables. Money supply emerges as a key determinant of exchange rate and economic growth, while interest rate significantly influences inflation. However, the negative impact of exports and money supply on economic growth suggests the presence of structural inefficiencies within the economy, which may limit the effectiveness of macroeconomic policies.

Table 17: Speed of Adjustment During COVID-19 period

Variables	D(EXR)	D(INF)	D(GDP)	D(INT)	D(EXP)	D(MS)
ECM	-1.567 (0.224) [-7.002]**	-0.005 (0.020) [-0.258]	0.442 (0.289) [1.523]	-0.022 (0.019) [-1.146]	-0.017 (0.021) [-0.804]	35.636 (24.235) [1.470]

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%
The error correction results in Table 17 indicate that exchange rate is the only variable that exhibits a statistically significant and negative adjustment coefficient, implying a strong speed of adjustment to long-run equilibrium. This suggests that exchange rate plays a central role in restoring equilibrium in the short run. Inflation, economic growth, interest rate, exports, and money supply do not show statistically significant adjustment, indicating weak short-run dynamics among these variables. This may reflect structural rigidities and inefficiencies within the economy,

Table 18: Short-run dynamics During COVID-19 period

Variables	D(EXR)	D(INF)	D(GDP)
D(EXR(-1))	-	0.0023 (0.0131) [0.1789]	-0.2367 (0.1873) [-1.2636]
D(INF(-1))	-0.2797 (1.4162) [-0.1975]	-	-0.5367 (1.8320) [-0.2929]
D(GDP(-1))	-0.0139 (0.0988) [-0.1407]	-0.0125 (0.0089) [1.3954]	-

Source: Author's Computation, 2026.

limiting the responsiveness of key macroeconomic indicators to disequilibrium.

Table 18 show the results of short-run dynamic and indicate that the lagged values of exchange rate, inflation, and economic growth do not exert statistically significant effects on one another. This suggests weak short-run interdependence among the variables. In other words, changes in one macroeconomic variable do not immediately translate into changes in others within the short-run period. This finding implies that the adjustment process in the economy is not instantaneous but occurs gradually through long-run equilibrium mechanisms rather than short-run interactions.

Table 19: Goodness of Fit During COVID-19 period

Variables	D(EXR)	D(INF)	D(GDP)	D(INT)	D(EXPR)	D(MS)
R-square	0.6376	0.4230	0.3378	0.4901	0.2106	0.4843
Adj. R-square	0.5749	0.3232	0.2232	0.4018	0.0739	0.3949
F-statistic	10.1675***	4.2362**	2.9475**	5.5531**	1.5414	5.4252**

Source: Author's Computation, 2026.

*indicates significance at 1%, **indicates significance at 5%, ***indicates significance at 10%

Table 19 shows the goodness-of-fit statistics indicate that the exchange rate equation exhibits the highest explanatory power, with an R-squared value of 0.6376, suggesting that approximately 64% of its variation is explained by the model. Similarly, the interest rate and money supply equations demonstrate moderate explanatory power and are statistically significant. Moreover, the inflation and economic growth equations show moderate to weak explanatory power, although they remain statistically significant. However, the export equation exhibits low explanatory power and is not statistically significant, indicating that the model does not adequately explain variations in exports.

Table 20: Residual Covariance and Stability During COVID-19 period

Determinant residual covariance	1.37E+14
Log likelihood	-1536.827
AIC	52.0912
SIC	54.7673

Source: Author's Computation, 2026.

Table 20 shows the low determinant of the residual covariance matrix, and reasonable information criteria

Table 21: Granger-causality Test During COVID-19 period

Dependent Variables	Exchange rate D(EXR)			Inflation rate D(INF)			Economic growth D(GDP)		
Variables Excluded	Chi-square statistic	df	Prob.	Chi-square statistic	df	Prob.	Chi-square statistic	df	Prob.
D(EXR)	-	-	-	0.0319	1	0.8580	1.5968	1	0.2064
D(INF)	0.0390	1	0.8434	-	-	-	0.0858	1	0.7696
D(GDP)	0.0198	1	0.8881	1.9471	1	0.1629	-	-	-
D(INT)	1.4384	1	0.2304	2.8786	1	0.0898	0.5998	1	0.4387
D(EXPR)	0.7364	1	0.3908	0.3783	1	0.5383	8.5845	1	0.0034
D(MS)	0.0462	1	0.8299	2.6149	1	0.1059	0.0214	1	0.8836
All	2.5351	5	0.7712	6.2336	5	0.2841	11.8676	5	0.0366

Source: Author's Computation, 2026.

values indicate that the VECM is well specified, stable, and dynamically consistent.

Table 21 explains that the causality results indicate that exports have a statistically significant causal effect on economic growth, suggesting that changes in export performance play a crucial role in driving short-run economic growth. Furthermore, the joint significance of all variables in the GDP equation confirms that macroeconomic variables collectively influence economic growth.

However, no significant causality is observed for exchange rate and inflation, indicating that these variables are not strongly driven by the included macroeconomic factors in the short run. This suggests that external factors or structural dynamics may play a more dominant role in determining exchange rate and inflation behavior.

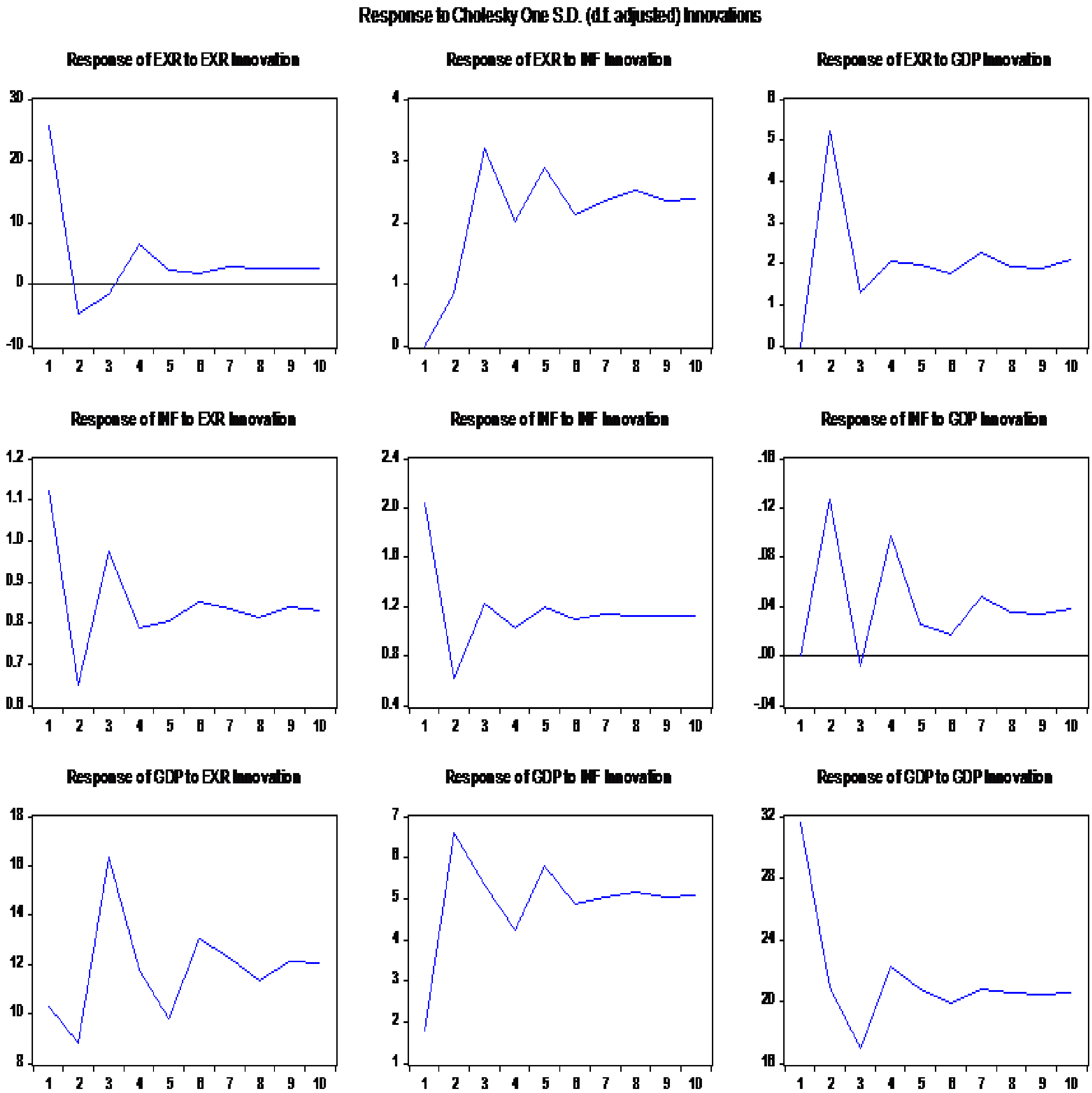

Figure 4: Impulse Response Function During COVID-19 period
Source: Author's Computation, 2026.

Fig. 4 impulse response functions reveal that most variables exhibit short-run fluctuations following shocks but gradually converge to equilibrium over time, which means there is a delay in response to shock and not spontaneous. This indicates that the effects of shocks are temporary and that the system possesses a stable adjustment mechanism. Exchange rate demonstrates strong short-run responsiveness but quickly stabilizes, confirming its role as a key adjustment variable. Other variables, including inflation and economic growth, show relatively mild responses, suggesting limited short-run volatility.

Overall, the results support the presence of long-run stability in the system, as all variables eventually return to

Table 22: Variance Decomposition During COVID-19 period

Variance Decomposition of EXR										
Period	1	2	3	4	5	6	7	8	9	10
EXR	100.00	93.55	92.04	91.08	89.62	88.35	87.22	86.12	85.05	84.05
INF	0.00	1.09	1.34	1.32	1.29	1.27	1.25	1.23	1.21	1.20
GDP	0.00	5.36	6.63	7.60	9.09	10.37	11.53	12.66	13.74	14.75
Variance Decomposition of INF										
Period	1	2	3	4	5	6	7	8	9	10
EXR	13.73	14.43	16.48	16.46	16.44	16.47	16.48	16.47	16.48	16.48
INF	86.27	84.83	82.78	82.42	82.25	82.02	81.82	81.62	81.42	81.24
GDP	0	0.74	0.74	1.12	1.31	1.51	1.71	1.91	2.09	2.28
Variance Decomposition of GDP										
Period	1	2	3	4	5	6	7	8	9	10
EXR	9.16	9.46	15.83	16.40	16.41	16.76	16.94	17.06	17.17	17.26
INF	0.20	0.86	0.62	0.50	0.42	0.36	0.32	0.28	0.26	0.23
GDP	90.64	89.67	83.54	83.10	83.18	82.88	82.74	82.66	82.57	82.50

Source: Author's Computation, 2026.

their equilibrium paths after experiencing shocks.

The variance decomposition results presented in Table 22 indicate that each variable is largely driven by its own shocks, particularly in the short run. However, over time, the influence of other variables becomes more pronounced. Exchange rate is predominantly self-explanatory, although the contribution of economic growth increases steadily, reaching approximately 15% in the long run. Inflation contributes minimally to exchange rate fluctuations. Inflation is largely explained by its own innovations, with exchange rate accounting for about 16% of its variation, suggesting the presence of exchange rate pass-through effects. Economic growth is mainly self-driven; however, the contribution of exchange rate increases significantly over time, indicating that exchange rate dynamics play an important role in influencing growth.

Comparative discussion between pre-COVID-19 and during COVID-19 periods

The comparative analysis between the pre-COVID-19 and during COVID-19 regimes provides important insights into how the pandemic altered the structure, behavior, and transmission of macroeconomic shocks in Nigeria. The results reveal that the COVID-19 pandemic created significant structural changes in the Nigerian economy, affecting both the short-run dynamics and long-run equilibrium relationships among exchange rate, inflation, economic growth, interest rate, exports, and money supply.

A major difference observed between the two periods relates to the behavior of exchange rate volatility. During the pre-COVID-19 period, the exchange rate already exhibited substantial volatility, but the post-pandemic period recorded far more severe depreciation pressures and wider fluctuations. The mean exchange rate increased dramatically from approximately 13.41 in the pre-pandemic era to about 90.44 in the during pandemic period. This sharp increase reflects the significant depreciation of the Nigerian currency following the COVID-19 crisis. The depreciation was largely driven by declining oil export revenues, capital flight, reduced foreign direct investment inflows, depletion of foreign reserves, and increased demand for foreign exchange during the pandemic period.

The comparative results further revealed important changes in the distributional properties of macroeconomic variables. In the pre-COVID-19 period, most variables exhibited strong non-normality, high skewness, and leptokurtic behavior, indicating persistent macroeconomic instability and frequent extreme fluctuations. However, the during COVID-19 results showed relatively improved normality conditions and lower skewness across most variables. This apparent improvement does not necessarily imply stronger economic performance; rather, it may reflect the shorter sample period and the stabilization effects of emergency policy interventions implemented during and after the pandemic. The aggressive monetary and fiscal responses introduced by the Central Bank of Nigeria and the Federal Government helped moderate some macroeconomic fluctuations temporarily.

Before the COVID-19 pandemic, the Nigerian economy exhibited stronger long-run macroeconomic relationships and relatively more stable adjustment mechanisms despite the presence of volatility. The pre-pandemic results showed the existence of five cointegrating equations, indicating a strong and stable long-run relationship among the macroeconomic variables. This suggests that macroeconomic variables moved together over time and that shocks were eventually corrected through long-run equilibrium adjustments. However, in the during COVID-19 period, the number of cointegrating relationships reduced significantly. The trace and maximum eigenvalue tests revealed weaker long-run integration among the variables after the pandemic. This structural weakening can largely be attributed to the severe economic disruptions caused by the COVID-19 crisis, including lockdown measures, supply chain disruptions, reduced international trade, oil price collapse, and declining foreign exchange earnings.

Another major structural difference lies in the speed of adjustment toward long-run equilibrium. During the pre-COVID-19 period, exchange rate, exports, and money supply exhibited statistically significant error correction mechanisms, indicating relatively stronger adjustment processes whenever disequilibrium occurred. In contrast, after the pandemic, exchange rate became the only variable with a statistically significant adjustment coefficient. Inflation, economic growth, exports, interest rate, and money supply all displayed weak and insignificant adjustment processes. This suggests that the pandemic weakened the economy's ability to self-correct after macroeconomic shocks.

Several reasons may explain this weakened adjustment mechanism in the post-pandemic period. First, the pandemic generated unprecedented uncertainty in both domestic and global markets, reducing the effectiveness of traditional monetary and fiscal policy tools. Second, disruptions to production activities, logistics, and international trade reduced the responsiveness of key macroeconomic variables to policy adjustments. Third, structural weaknesses such as low industrial productivity, import dependency, weak infrastructure, and insecurity further constrained economic recovery efforts.

The short-run dynamics also changed substantially across the two regimes. Before COVID-19, GDP significantly influenced exchange rate and inflation dynamics in the short run, indicating stronger macroeconomic interdependence. However, during the COVID-19 period, the short-run interactions among exchange rate, inflation, and economic growth became statistically insignificant. This implies that the transmission of shocks across macroeconomic variables weakened after the pandemic.

This weakening may be attributed to several pandemic-related disruptions. The COVID-19 crisis severely reduced economic activities due to lockdown measures, business closures, and declining household consumption. Consequently, the normal transmission channels through which macroeconomic variables influence one another became less effective. In addition, heightened uncertainty caused economic agents to respond cautiously to policy changes, thereby reducing the short-run effectiveness of stabilization policies.

The Granger causality results also revealed notable regime differences. In the pre-pandemic period, GDP and money supply significantly influenced exchange rate movements, while exchange rate, interest rate, and exports significantly affected inflation. This indicates that macroeconomic fundamentals played stronger explanatory roles before the pandemic. However, in the post-pandemic period, exports emerged as the major variable influencing economic growth, while exchange rate and inflation became less responsive to domestic macroeconomic variables.

This shift reflects the increasing dominance of external shocks and structural constraints during COVID-19. During the pandemic, the Nigerian economy became more vulnerable to global developments such as oil price fluctuations, disruptions in global supply chains, rising import costs, and external financial instability. As a result, domestic macroeconomic variables lost part of their explanatory power over exchange rate and inflation dynamics.

The variance decomposition analysis further supports the existence of regime differences between the two periods. Before the pandemic, macroeconomic variables were largely explained by their own shocks, with relatively smaller contributions from other variables over time. In the post-pandemic period, however, exchange rate contributed more strongly to variations in inflation and economic growth. This suggests stronger exchange rate pass-through effects after the pandemic.

The increased influence of exchange rate shocks on inflation and growth can be explained by Nigeria's high import dependency. Following the COVID-19 pandemic, exchange rate depreciation significantly increased import costs, which transmitted directly into higher domestic prices and production costs. This further intensified inflationary pressures and constrained economic growth.

Overall, the regime comparison demonstrates that the COVID-19 pandemic significantly altered the macroeconomic structure of Nigeria. The pre-COVID-19 period was characterized by stronger long-run relationships, more effective adjustment mechanisms, and greater macroeconomic interdependence. In contrast, the during COVID-19 period experienced weaker equilibrium relationships, slower adjustment processes, stronger exchange rate dominance, and reduced effectiveness of macroeconomic policy transmission mechanisms.

The findings therefore suggest that the pandemic not only generated temporary economic disruptions but also created bigger structural changes within the Nigerian economy. These structural changes highlight the urgent need for economic diversification, stronger institutional reforms, improved domestic production capacity, and more resilient macroeconomic policy frameworks capable of withstanding future global shocks.

CONCLUSION

This study investigated the transmission of macroeconomic shocks in Nigeria by comparing the pre-COVID-19 and COVID-19 periods using the Vector Error Correction Model (VECM). The results confirmed the existence of long-run relationships among key macroeconomic variables in both periods, although the strength and dynamics of these relationships changed significantly during the pandemic.

The findings showed that the pre-COVID-19 period was characterized by stronger cointegration, faster adjustment to equilibrium, and greater interaction among macroeconomic variables. In contrast, the COVID-19 period exhibited weaker long-run integration, slower adjustment mechanisms, and delayed responses to shocks. The exchange rate emerged as the most important adjustment variable during the pandemic, exerting stronger effects on inflation and economic growth. This highlights Nigeria's increased vulnerability to external shocks, exchange rate pressures, and import dependence during crisis periods.

The study concludes that COVID-19 was not only a temporary economic disturbance but also a structural event that altered the transmission mechanism of macroeconomic variables in Nigeria. Based on these findings, the study recommends strengthening exchange rate stability, promoting export diversification, improving domestic productive capacity, and enhancing coordination between fiscal and monetary policies to improve economic resilience and ensure sustainable long-term growth.

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