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Nexus between Stock Market Prices and Some Macroeconomic Indicators in Nigeria

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ABSTRACT: The problem of identifying the relationship among macroeconomic variables have been a challenge in developing countries due to frequent changes in policy that alter their behaviors contrary to expectations. Thus, this study is aimed at empirically examining the link between stock market prices and some macroeconomic indicators in Nigeria covering the period January, 2004 to June, 2024. Results revealed that the variables were all integrated of order one, I(1) and a long-run stable equilibrium relationship existed among the variables. Exchange rate and money supply had significant positive impact on stock market prices while inflation rate and interest rate had significant negative impact on stock market prices in Nigeria. The error correction model showed a high speed of adjustment of 99.998% to achieving long-run equilibrium steady state in the Nigerian economic system. Results of the VAR Granger causality test revealed that exchange rate and money supply both have a one-way causative effect on stock prices and inflation rate. Furthermore, inflation rate Granger causes stock market prices, but stock prices do not influence inflation. Moreover, there is bidirectional causality between exchange rate and money supply, indicating that changes in each variable mutually affect the other. The study recommends the evolution of policies to stabilize the exchange rate and money supply, manage inflation and interest rates carefully, monitor the bidirectional relationship between exchange rate and money supply, and engage in long-term economic planning.

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Exchange rate is considered as one of the most critical factors of a country's economic wellbeing due to the impact of globalization leading to fast changing and increased trade worldwide stimulating capital and stock price movements (Sinha and Kohli, 2015). Basically, exchange rate is seen as the rate that the currency of a country is exchanged for the currency of another country. In Nigeria, United States Dollar is considered the most used currency in the stock exchange market. Several scholars including Odoyo *et al.* (2014), Fapetu *et al.* (2017) and Cakir (2021) have over the time investigated the relationships between stock market prices and exchange rate. William *et al.* (2016), Al-Naif (2017), Cai *et al.* (2021) among others studied the impact of interest rate on stock prices while Gunawardhana and Mustafa (2020) and also Taderera *et al.* (2021) investigated the relationship between stock prices and inflation rate just as Sinha and Kohli (2013), Mostafa and Gang (2017) as well as Ahmed and Oladotun (2019) investigated the link between money supply and stock prices. The study by Amata *et al.* (2016) examined the relationship between stocks market prices in relations to inflation and interest rate while Okechukwu *et al*. (2019) looked at stock market

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volatility in relation to exchange rate, interest rate and inflation rate. Sinha and Kohli (2013) using the Portfolio Balance Approach advocated that causality moves from exchange rate to stock prices and that any increase in money supply provides vital information for forex traders. Furthermore, they noted that inflation also has direct impact on the stock market prices in an economy as its impact on stocks tends to increase the equity market volatility and risk premium. William *et al*. (2016) also noted that the value of stocks do perform well in the period of high inflation periods but causes slow growth.

Cakir (2021) established significant positive association between exchange rate and volatility indicators in all the stock markets in Turkey. Fapetu *et al*. (2017) employed four different specifications of ARCH, GARCH, EGARCH and TARCH models in order to examine how exchange rate volatility affect performance of stock market in Nigeria which they found a significant positive relationship among the variables. In this study, empirical analysis is performed using statistical methods in order to establish the relationship existing between stock market prices and some macroeconomic indicators in Nigeria

MATERIALS AND METHODS

Source of Data: The data used in this research work are monthly secondary data on All Share Index (ASI) used as proxy for stock market prices, Naira/US Dollar Exchange Rate (USD) used as proxy for foreign exchange rate, Broad money supply (M2), inflation rate and interest rate. The data was obtained from Central Bank of Nigeria (CBN) website and spanned from January, 2004 to June, 2024. All the plots and statistical analysis were implemented using E-views version 10 software. The study variables are of different units of measurement and hence converted to a common unit of measurement using the logarithmic transformation:

$$Y_t' = \ln Y_t \qquad (1)$$

Summary statistics and Jarque-Bera test of normality: Summary statistics such as arithmetic mean and standard deviation as well as normality measures were employed to summarize the characteristics of the study variables. The mean for any given set of data is computed as:

$$\bar{y} = \frac{1}{n}\sum_{i=1}^{n} y_t \qquad (2)$$

The sample standard deviation of any given set of data over a given period of time is computed using the following formula:

$$\hat{\sigma} = \sqrt{\frac{1}{n-1}\sum_{t=1}^{n}(y_t-\bar{y})^2} \qquad (3)$$

Where $\bar{y}$ is the sample mean, n is the sample size.

A normality test which is also a goodness-of-fit test of whether sample data have the skewness and kurtosis that match a normal distribution was proposed by Jarque and Bera (1980, 1987) called the Jarque Bera test of normality. The Jarque-Bera (JB) test tests the null hypothesis that a given data set is normally distributed. Given a series (y_t) the JB test statistic is defined as:

$$JB = \frac{T}{6}\left(g_1^2 + \frac{1}{4}(g_2-3)^2\right) \qquad (4)$$

Where g_1 is the sample kurtosis defined as

$$g_1 = \frac{\mu_3}{\mu_2^{2/3}}$$
$$= T^{1/2}\sum_{t=1}^{T}(y_t-\bar{y})^3 \Bigg/ \left(\sum_{t=1}^{T}(y_t-\bar{y})^2\right)^{3/2} \qquad (5)$$

and g_2 is the sample kurtosis defined as

$$g_2 = \frac{\mu_4}{\mu_2^2} = T\sum_{t=1}^{T}(y_t-\bar{y})^4 \Bigg/ \left(\sum_{t=1}^{T}(y_t-\bar{y})^2\right)^2 \qquad (6)$$

Where T is the number of observations and $\bar{y}$ is the sample mean. The normal distribution has a skewness equal to 0 with a kurtosis of 3. The JB test checks the following pair of hypothesis:

H_0: $\hat{\mu}_3 = 0$ and $\hat{\mu}_4 = 0$ (i.e., y_t is normally distributed) against the alternative
H_0: $\hat{\mu}_3 \neq 0$ and $\hat{\mu}_4 \neq 0$ (i.e., y_t is not normally distributed).

The null hypothesis is rejected if p-value of the JB test statistic is less than $\alpha = 0.05$ level of significance.

Graphical examination of the series: The study variables are first plotted against time to observe the pattern of trend movement and to see whether any structural breaks, outliers or data errors occur. It may also reveal whether there is a significant seasonal pattern in the study variables.

Augmented Dickey-Fuller (ADF) Unit root Test: Unit root test is a statistical test that converts non-stationary series to stationary series. This is performed in order to render a series stationary as Cointegration test can only be conducted on series of the same order.

Let $\{Y_t\}$ be a given time series, the Augmented Dickey-Fuller (ADF) unit root test is used to check whether the series contains a unit root or whether the given series is stationary or not (Dickey and Fuller, 1979). The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the series follows an AR(p) process and adding lagged difference terms of the dependent variable to the right-hand side of the test regression:

$$\Delta Y_t = \alpha Y_{t-1} + X_t'\delta + \beta_1 \Delta Y_{t-1} + \beta_2 \Delta Y_{t-2} + \cdots + \beta_p \Delta Y_{t-p} + \varepsilon_t \quad (7)$$

Where X_t are optional exogenous regressors that may consist of constant, or a constant and trend, α and δ are parameters to be estimated, and the ε_t is assumed to be white noise. The null and alternative hypotheses are written as:

$$H_0: \alpha = 0 \text{ versus } H_1: \alpha < 0 \qquad (8)$$

and evaluated using the conventional t −ratio for α:

$$t_\alpha = \hat{\alpha}/\{\text{se}(\hat{\alpha})\} \qquad (9)$$

Where $\hat{\alpha}$ is the estimate of α, and $\text{se}(\hat{\alpha})$ is the coefficient standard error. An important result obtained by Fuller is that the asymptotic distribution of the t −ratio for α is independent of the number of lagged first differences included in the ADF regression. Moreover, while the assumption that Y_t follows an autoregressive (AR) process may seem restrictive, Said and Dickey (1984) demonstrated that the ADF test is asymptotically valid in the presence of a moving average (MA) component, provided that sufficient lagged difference terms are included in the test regression. For more detail of the ADF test see (Davidson and MacKinnon, 1993; Hamilton, 1994 and Hayashi, 2000).

Johansen Cointegration Test: Two or more non-stationary series, I(1), are said to be cointegrated if their linear combination gives a stationary series, I(0). Johansen (1991, 1995) developed a methodology for testing for cointegration as follows:

Let $\boldsymbol{Y_t} = (y_{1t}, y_{2t}, \dots, y_{nt})'$ denote an $(n \times 1)$ vector of non-stationary I(1) time series variables. The basic Vector Autoregressive Model of order p, denoted VAR(p) is defined as

$$\boldsymbol{Y}_t = \boldsymbol{\alpha} + \boldsymbol{\phi}_1 \boldsymbol{Y}_{t-1} + \boldsymbol{\phi}_2 \boldsymbol{Y}_{t-2} + \cdots + \boldsymbol{\phi}_p \boldsymbol{Y}_{t-p} + \boldsymbol{BX_t} + \varepsilon_t, t = 1, 2, \dots, T \qquad (10)$$

Where $\boldsymbol{\alpha}$**:** is an $(n \times 1)$ vector of intercept, $\boldsymbol{\phi}_i$ $(i = 1, 2, \dots, p)$: is $(n \times n)$ coefficient matrices
$\boldsymbol{X_t}$ = d-vector of deterministic variables, ε_t: is an $(n \times 1)$ vector of unobservable error term with zero mean (white noise).

Equation (10) can be represented as

$$\Delta \boldsymbol{Y}_t = \boldsymbol{\Pi Y}_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta \boldsymbol{Y}_{t-i} + \boldsymbol{BX}_t + \varepsilon_t \quad (11)$$

Where

$$\boldsymbol{\Pi} = \sum_{i=1}^{p} \boldsymbol{\phi}_i - \boldsymbol{I}\,;\ \Gamma_i = -\sum_{j=i+1}^{p} \boldsymbol{\phi}_j \quad (12)$$

Granger's representation theorem asserts that if the coefficient matrix $\boldsymbol{\Pi}$ has reduced rank $r < k$, then there exist $k \times r$ matrices α and β each with rank r such that $\boldsymbol{\Pi} = \alpha\beta'$ and $\beta' \boldsymbol{Y}_t$ is I(0), where r is the number of cointegrating relations (the cointegrating rank) and each column of β is the cointegrating vector. Johansen cointegration test computes two statistics: trace statistic and maximum eigenvalue statistic that are also used in this study. The trace statistic for the null hypothesis of r cointegrating relations is computed as:

$$LR_{tr}(r|k) = -T \sum_{i=r+1}^{k} \log(1 - \lambda_i) \quad (13)$$

The maximum eigenvalue test statistic is computed as:

$$LR_{max}(r|r+1) = -Tlog(1 - \lambda_{r+1}) = LR_{tr}(r|k) - LR_{tr}(r+1|k) \quad (14)$$

$r = 0, 1, 2, \dots, k-1$ where λ_i is the i-th largest eigenvalue of the $\boldsymbol{\Pi}$ matrix,

Cointegrating Regression Model Specification: To specify a model describing a long-term relationship existing among the study variables, let ASI be mathematically expressed as a function of exchange rate, inflation rate and money supply given as:

$$ASI = f[EXR, M2, INF, INT] \qquad (15)$$

Since the four variables have different units of measurement, they are transformed in order to stabilize their variances. Thus, the model under data transformation is:

$$\ln ASI_t = \beta_0 + \beta_1 \ln EXR_t + \beta_2 \ln M2_t + \beta_3 \ln INF_t + \beta_4 \ln INT_t + \varepsilon_t \quad (16)$$

Where $\ln ASI_t$ represents natural log of ASI at time t proxied for stock market prices; $\ln EXR_t$ represents natural log of exchange rate at time t; $\ln M2_t$ represents natural log of money supply at time t; $\ln INF_t$ represents natural log of inflation rate at time t; $\ln INT_t$ represents natural log of interest rate at time t; ε_t is the error term assumed to be normally and independently distributed with zero mean and constant variance, which captures all other explanatory variables that influence stock market prices but are not captured in the model; β_0 is the intercept of the regression model which represents the predictive value of the dependent variable when all the independent variables are kept constant; $\beta_1, \beta_2, \beta_3, \beta_4$ are the partial elasticity of stock market prices with respect to EXR, M2, INF and INT respectively.

Vector error correction model (VECM): The vector error correction model lagged by one period, integrates short-run dynamics in the long-run relationship given by:

$$\nabla \ln \mathrm{ASI_t} = \alpha_1 + \sum_{i=1}^{p} \phi_{1i} \nabla \ln ASI_{t-1} + \sum_{i=1}^{p} \beta_{2i} \nabla \ln EXR_{t-1} + \sum_{i=1}^{p} \varphi_{3i} \nabla \ln M2_{t-1} + \sum_{i=1}^{p} \theta_{4i} \nabla \ln INF_{t-1} + \sum_{i=1}^{p} \pi_{5i} \nabla \ln INT_{t-1} + \lambda_6 EC_{t-1} + \varepsilon_{1t} \quad (17)$$

where EC_{t-1} is the error correction term (the residuals that are obtained from the estimated co-integrating model of Equation (17). ε_{1t} is the error term. The symbol ∇ represents the first-differenced form of the variables in the model. The coefficient of the various explanatory variables, $\phi_{1i}, \beta_{2i}, \varphi_{3i}, \theta_{4i}, \pi_{5i}$ are the impact multipliers that measure the immediate impact that a change in the explanatory variable has on a change in the dependent variable. λ represents the speed of the adjustment parameter. The value of λ must lie between the range $-1 \leq \lambda \leq 0$ and must be statistically significant.

Ljung-Box Q-statistic test: The Ljung-Box Q-statistic test is a test used to investigate the presence of serial correlation or autocorrelation in the residuals of a series. The test checks the following pairs of hypotheses:
$H_0: \rho_{k,1} = \rho_{k,2} = \cdots = \rho_{k,T} = 0$ (all lags correlations are zero)
$H_1: \rho_{k,1} \neq \rho_{k,2} \neq \cdots \neq \rho_{k,T} \neq 0$ (there is at least one lag with non-zero correlation).
The test statistic is given by:

$$Q^{(LB)} = T(T+2) \sum_{k=1}^{h} \frac{\hat{\rho}_k^2}{T-k} \qquad (18)$$

where

$$\hat{\rho}_k^2 = \frac{T}{T-k} \left(T \sum_{t=k+1}^{T} (\hat{\varepsilon}_t^2 - \bar{\varepsilon})(\hat{\varepsilon}_{t-k}^2 - \bar{\varepsilon}) \Big/ \sum_{t=1}^{T} (\hat{\varepsilon}_t^2 - \bar{\varepsilon})^2 \right);$$

$\bar{\varepsilon} = T^{-1} \sum_{t=1}^{T} \varepsilon_t^2$ denotes the autocorrelation estimate of squared standardized residuals at k lags. T is the sample size, Q is the sample autocorrelation at lag k. We reject H_0 if p-value is less than $\alpha = 0.05$ level of significance (Ljung and Box, 1978).

Granger causality test based on modified Wald test: The study employs Granger causality test procedure due to Toda and Yamamoto (1995) in order to determine the direction of causality among the study variables. Toda and Yamamoto procedure uses a Modified Wald (MWALD) test for restrictions on the parameters of the VAR (k) model. The model is specified as follows:

$$ASI_t = \alpha_1 + \sum_{i=1}^{k+d} \phi_{1i} ASI_{t-i} + \sum_{t-i}^{k+d} \phi_{2i} EXR_{t-i} + \sum_{t-i}^{k+d} \phi_{3i} M2_{t-i} + \sum_{t-i}^{k+d} \phi_{4i} INF_{t-i} + \sum_{t-i}^{k+d} \phi_{5i} INT_{t-i} + \varepsilon_{vt} \qquad (19)$$

$$EXR_t = \alpha_2 + \sum_{i=1}^{k+d} \beta_{1i} EXR_{t-i} + \sum_{t-i}^{k+d} \beta_{2i} ASI_{t-i} + \sum_{t-i}^{k+d} \phi_{3i} M2_{t-i} + \sum_{t-i}^{k+d} \beta_{4i} INF_{t-i} + \sum_{t-i}^{k+d} \phi_{5i} INT_{t-i} + \varepsilon_{wt} \qquad (20)$$

$$M2_t = \alpha_3 + \sum_{i=1}^{k+d} \varphi_{1i} M2_{t-i} + \sum_{t-i}^{k+d} \varphi_{2i} ASI_{t-i} + \sum_{t-i}^{k+d} \varphi_{3i} EXR_{t-i} + \sum_{t-i}^{k+d} \varphi_{4i} INF_{t-i} + \sum_{t-i}^{k+d} \varphi_{5i} INT_{t-i} + \varepsilon_{xt} \quad (21)$$

$$INF_t = \alpha_4 + \sum_{i=1}^{k+d} \theta_{1i} INF_{t-i} + \sum_{t-i}^{k+d} \theta_{2i} ASI_{t-i} + \sum_{t-i}^{k+d} \theta_{3i} EXR_{t-i} + \sum_{t-i}^{k+d} \theta_{4i} M2_{t-i} + \sum_{i=1}^{k+d} \theta_{5i} INT_{t-i} + \varepsilon_{yt} \quad (22)$$

$$INT_t = \alpha_5 + \sum_{i=1}^{k+d} \pi_{1i} INT_{t-i} + \sum_{t-i}^{k+d} \pi_{2i} ASI_{t-i} + \sum_{t-i}^{k+d} \pi_{3i} EXR_{t-i} + \sum_{t-i}^{k+d} \pi_{4i} M2_{t-i} + \sum_{t-i}^{k+d} \pi_{5i} INF_{t-i} + \varepsilon_{zt} \quad (23)$$

Where $k$the optimal is lag order; d is the maximal order of integration of the series in the system; $\varepsilon_{vt}, \varepsilon_{wt}, \varepsilon_{xt}, \varepsilon_{yt}$ and ε_{zt} are error terms which are assumed to be white noise. The usual Wald test is then applied to the first k coefficient matrices using the standard χ^2-statistics. The test checks the following pairs of hypotheses: for instance, ASI_t "Granger causes" EXR_t if $\phi_{1i} \neq 0$ in Equation (19) against EXR_t "Granger causes" ASI_t if $\beta_{2i} \neq 0$ in Equation (20) and vice versa.

RESULTS AND DISCUSSION

The time plots of the monthly all share index, exchange rate, money supply, inflation rate and interest rate in Nigeria, as shown in Figures 1-5 respectively, reveal the presence of trend in the series indicating that their means and variances change over time which suggests that the series are non-stationary. However, the time plots of the first differences of these series, shown in Figures 6-10, oscillate about a stable mean indicating that the differenced series are covariance stationary.

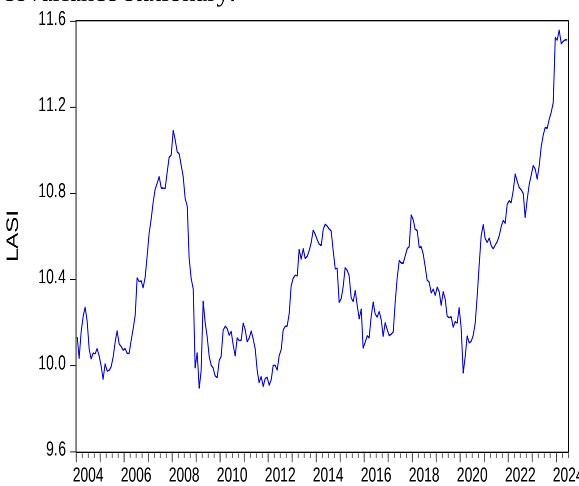

Fig. 1: Time Plot of All Share Index in Nigeria (Natural Log)

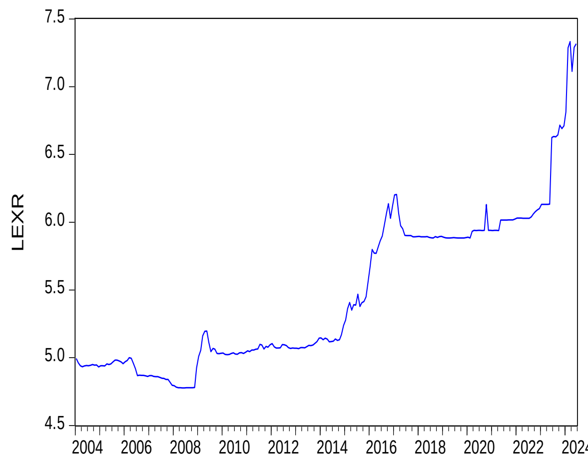

Fig. 2: Time Plot of Exchange Rate in Nigeria (Natural Log)

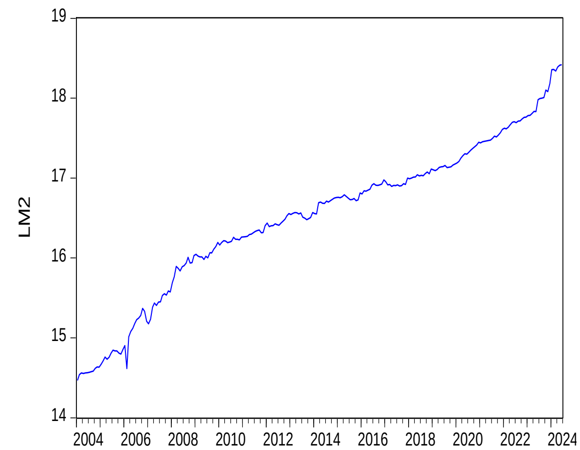

Fig. 3: Time Plot of Money Supply in Nigeria (Natural Log)

The summary statistics and normality measures reported in Table 1 show that the monthly means of the study variables are all positive but with high standard deviations except for interest rate which indicates a significant dispersions from the monthly average values of the variables. The wide gaps between the maximum and minimum values of the variables further support the high levels of variability over the period.

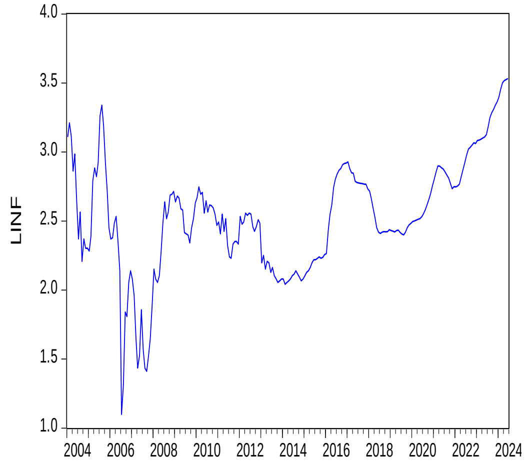

Fig. 4: Time Plot of Inflation Rate in Nigeria (Natural Log)

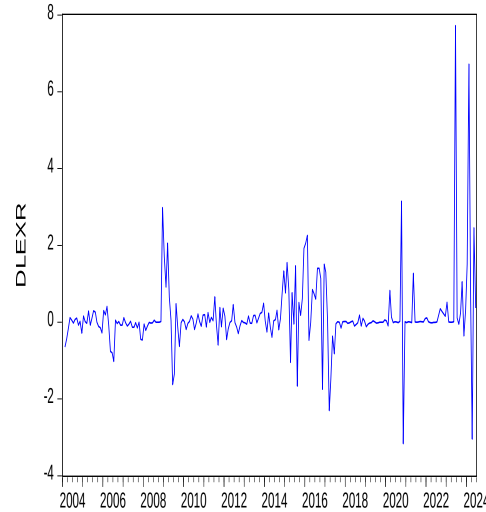

Fig. 7: Time Plot of Exchange Rate in Nigeria at First Difference

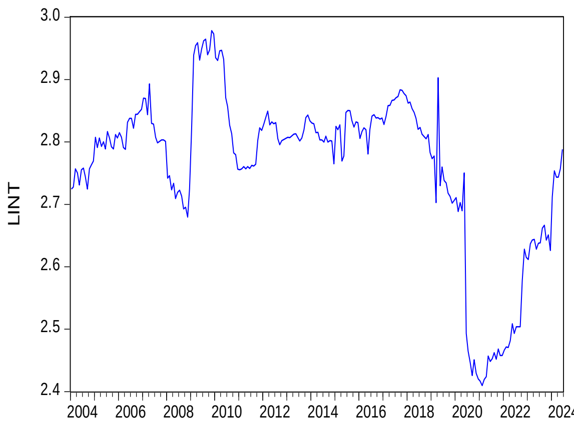

Fig. 5: Time Plot of Interest Rate in Nigeria (Natural Log)

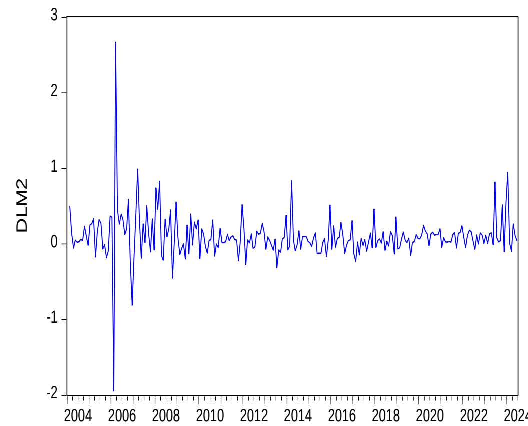

Fig. 8: Time Plot of Money Supply in Nigeria at First Difference

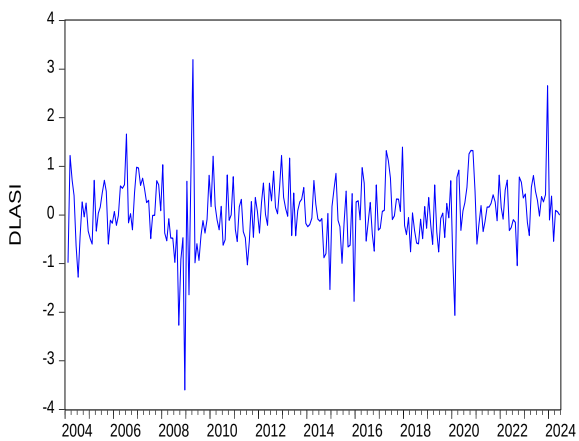

Fig. 6: Time Plot of All Share Index in Nigeria at First Difference

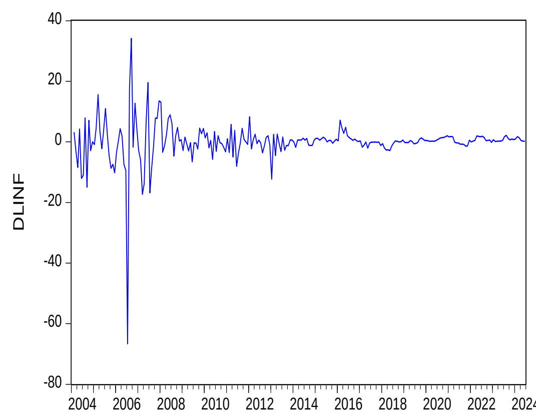

Fig. 9: Time Plot of Inflation Rate in Nigeria at First Difference

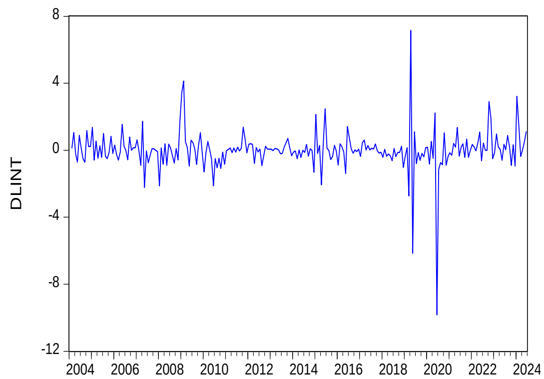

Fig. 10: Time Plot of Interest Rate in Nigeria at First Difference

The skewness coefficients for the all share index (ASI), exchange rate (EXR), money supply (M2), and inflation rate (INF) are positive, indicating substantially positively skewed distributions. In contrast, the skewness coefficient for the interest rate (INT) is negative, indicating a substantially negatively skewed distribution. Kurtosis measures the thickness of the tail of a distribution, which is approximately 3 for a normal distribution. In this study, all the variables exhibit kurtosis coefficients greater than 3. This indicate that the distributions of ASI, EXR, M2, INF, and INT in Nigeria during the study period do not follow normal distributions. Consequently, the Jarque-Bera test results reject the null hypothesis of normality at a 1% level of significance, as the p-values for all the variables.

Augmented Dickey-Fuller (ADF) Unit Root Tests: The ADF unit root test results (Table 2) reported in the upper panel indicates that all the study variables are non-stationary in their levels, as evidenced by the ADF test statistics being higher than the corresponding critical values at the 5% significance level. Conversely, the ADF unit root test results for the first differences of the series indicate that the differenced series are stationary. This is demonstrated by the ADF test statistics being lower than the corresponding critical values at the 5% significance level, and their p-values being highly statistically significant ($p < 0.05$). Therefore, it can be concluded that the monthly ASI, EXR, M2, INF, and INT in Nigeria are non-stationary in their levels but stationary in their first differences and are all integrated of order one, I(1).

Table 1: Statistical Data evaluation

Variable	**ASI**	**EXR**	**M2**	**INF**	**INT**
Mean	35948.62	286.8592	21917942	13.6171	15.9152
Maximum	104562.1	1530.100	99756352	34.1900	19.6600
Minimum	1985.89	118.7000	1917503	3.00000	11.1300
Std. Dev.	16058.39	225.7568	19540625	5.7719	1.9040
Skewness	2.1079	3.0964	1.810179	1.2257	-0.9239
Kurtosis	8.4045	15.5735	6.7315	4.9188	3.5683
Jarque-Bera	481.5695	2013.550	227.0705	99.3406	38.3091
p-value	0.0000	0.0000	0.0000	0.0000	0.0000
N	246	246	246	246	246

Table 2: Augmented Dickey-Fuller (ADF) Unit Root Test Result

Variable	Option	ADF Test Statistic	p-value	5% Critical Value
		Level Series		
LASI	Intercept only	-0.7507	0.8304	-2.8732
	Intercept & trend	-1.3348	0.8768	-3.4283
LEXR	Intercept only	2.2603	1.0000	-2.8732
	Intercept & trend	-0.2302	0.9921	-3.4283
LM2	Intercept only	-0.6178	0.8629	-2.8732
	Intercept & trend	-2.0449	0.5734	-3.4283
LINF	Intercept only	-2.4933	0.1183	-2.8732
	Intercept & trend	-2.5767	0.1339	-3.4283
LINT	Intercept only	-1.6408	0.4601	-2.8723
	Intercept & trend	-1.9875	0.6048	-3.4283
		First Difference Series		
DLASI	Intercept only	-13.3333	0.0000	-2.8732
	Intercept & trend	-13.3588	0.0000	-3.4283
DLEXR	Intercept only	-5.8608	0.0000	-2.8734
	Intercept & trend	-6.2658	0.0000	-3.4287
DLM2	Intercept only	-18.3681	0.0000	-2.8732
	Intercept & trend	-18.3325	0.0000	-3.4283
DLINF	Intercept only	-13.6351	0.0000	-2.8732
	Intercept & trend	-13.7214	0.0000	-3.4283
DLINT	Intercept only	-18.9426	0.0000	-2.8723
	Intercept & trend	-18.9042	0.0000	-3.4283

Johansen Cointegration Test: To determine the impact of exchange rate, money supply, inflation rate, and interest rate on the stock market prices in Nigeria, a multiple cointegrating regression model using the fully modified ordinary least squares (FMOLS) method was performed. The results of the unrestricted cointegration rank test reported in Table 3 shows that both the trace and maximum eigenvalue tests identified five (5) co-integrating equations at the 5% significance level among the study variables. These results suggest the presence of a long-run stable equilibrium co-integration relationship among the study variables. In other words, the variables share a common stochastic trend, move together, and will not diverge from one another in the long run. The estimated co-integrating regression results reported in Table 4 shows that the intercept of the regression model is positively related to the log of stock market prices (LASI) and is statistically significant at the 1% level. The intercept represents the predicted value of the dependent variable when all independent variables are held constant. This result indicates that the predicted value of stock prices is 9.936254 units in log form (i.e., 20,666.18 billion) when all independent variables in the model are constant. The slope coefficients for the natural log of the exchange rate (LEXR) and broad money supply (LM2) are positively related to the log of stock market prices (LASI) and are statistically significant at the 1% level ($p < 0.01$). Specifically, a unit increase in LEXR and LM2 corresponds to increases of 0.287259 and 0.249845 units in log form (i.e., 1.332769 and 1.283826 billion) in stock market prices, respectively. This indicates that both the exchange rate and money supply have a positive and significant impact on stock market prices in Nigeria.

Table 3: Unrestricted Cointegration Rank Tests

Trace Test						
Hypothesized No. of CE(s)	H_0	H_1	Eigenvalue	Trace statistic	5% Critical Value	P-value**
None*	$r = 0$	$r \geq 0$	0.256896	217.8335	69.81889	0.0000
At most 1*	$r \leq 1$	$r \geq 1$	0.169749	146.5730	47.85613	0.0000
At most 2*	$r \leq 2$	$r \geq 2$	0.152649	101.9264	29.79707	0.0000
At most 3*	$r \leq 3$	$r \geq 3$	0.137186	62.17288	15.49471	0.0000
At most 4*	$r \leq 4$	$r = 4$	0.105506	26.75934	3.841466	0.0000
Maximum Eigenvalue Test						
Hypothesized No. of CE(s)	H_0	H_1	Eigenvalue	Max-Eigen statistic	5% Critical Value	P-value**
None*	$r = 0$	$r = 1$	0.256896	71.26049	33.87687	0.0000
At most 1*	$r \leq 1$	$r = 2$	0.169749	44.64659	27.58434	0.0001
At most 2*	$r \leq 2$	$r = 3$	0.152649	39.75354	21.13162	0.0001
At most 3*	$r \leq 3$	$r = 3$	0.137186	35.41354	14.26460	0.0000
At most 4*	$r \leq 4$	$r = 4$	0.105506	26.75934	3.841466	0.0000

*Note: Trace test indicates 5 cointegrating equations at the 0.05 level; Max-eigenvalue test indicates 5 cointegrating equations at the 0.05 level; * denotes rejection of the null hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values.*

Table 4: Parameter Estimates of Cointegrating Regression Results

Variable	Coefficient	Std. Error	t-Statistic	P-value
C	9.936254	0.761559	13.04726	0.0000
LEXR	0.287259	0.079411	3.617381	0.0004
LM2	0.249845	0.041629	6.001706	0.0000
LINF	-0.196485	0.064754	-3.034347	0.0027
LINT	-0.513739	0.172755	-2.973801	0.0032
R-squared	0.695571	F-statistic	27.77958	
R2-Adjusted	0.604211	Prob(F-stat.)	0.000000	
		Durbin-Watson	2.067569	

Conversely, the slope coefficients for the natural log of the inflation rate (LINF) and interest rate (LINT) are negatively related to the log of stock market prices (LASI) and are statistically significant at the 1% level ($p < 0.01$). Specifically, a unit increase in LINF and LINT results in decreases of 0.196485 and 0.513739 units in log form (i.e., 1.217117 and 1.671529 billion) in stock market prices, respectively. This indicates that both inflation rate and interest rate have a significant negative impact on stock market prices in Nigeria.

Error Correction Model (ECM): The results from the error correction model, reported in Table 5 showed the slope coefficients of DLASI(-1), DLEXR(-2), DLM2(-2), DLINF(-2), and DLINT(-2) providing the speed at which the system corrects previous period disequilibrium. Specifically, the system adjusts at a rate of 9.52% for stock prices with a one-month lag, 7.03% for stock prices with a two-month lag of the exchange rate, 16.79% for stock prices with a two-month lag of the money supply, 0.08% for stock prices with a two-month lag of inflation, and 1.29% for stock prices with a two-month lag of the interest rate. The smaller percentages suggest a slower rate of adjustment to previous period's disequilibrium.

Table 5: Vector Error Correction Estimates

Variable	Coefficient	Std. Error	t-Statistic	P-value
C	-0.051472	0.167432	-0.008618	0.7543
DLASI(-1)	0.095213	8.3E-07	76982.6	<0.0001
DLEXR(-2)	0.070316	7.0E-07	99748.1	<0.0001
DLM2(-2)	-0.167894	2.7E-06	-63292.2	<0.0001
DLINF(-2)	0.007946	9.9E-08	79900.7	<0.0001
DLINT(-2)	0.012946	6.1E-07	21370.5	<0.0001
EC(-1)	***-0.99998***	8.1E-07	-1233495	<0.0001
R-squared	0.622101	F-statistic	10.164457	
R^2-Adjusted	0.601516	Prob(F-stat.)	0.000437	
Durbin Watson	2.164268			

Table 6: VEC Residual Portmanteau Tests for Autocorrelations (up to lag 8)

Lags	Q-Stat.	P-value	Adj Q-Stat.	P-value	df
1	51.44626	0.2361	51.65798	0.2298	45
2	73.06672	0.3776	73.45711	0.3656	70
3	96.20190	0.4462	96.88028	0.4271	95
4	123.0950	0.4048	124.2216	0.3774	120
5	153.2909	0.3026	155.0492	0.2690	145
6	168.2881	0.5227	170.4245	0.4764	170
7	197.7258	0.4321	200.7317	0.3741	195
8	241.9438	0.1481	246.4486	0.1065	220

The one-period lag error correction term, represented by EC(-1), helps guide the independent variables (DLASI(-1), DLEXR(-2), DLM2(-2), DLINF(-2), and DLINT(-2)) back to equilibrium or correct disequilibrium. For effective adjustment, the slope coefficient of EC(-1) is usually expected to be negative and significant. In this model, the slope coefficient of EC(-1) is -0.99998 and statistically significant at the 5% level, indicating a rapid correction rate of 99.998% monthly. Thus, there is a very high speed of adjustment, achieving long-run equilibrium almost immediately. The Durbin-Watson (DW) statistic value of approximately 2 provides an indication that the model is good for the data. The diagnostic check for the estimated ECM model showed that all the p-values are greater than 0.05 level of significance. Similarly, the VEC residual Portmanteau tests shows no residual autocorrelation up to lag h.

Granger Causality Test Result: To investigate the direction of the causal relationship among the study variables, the vector autoregressive (VAR) Granger causality test results are presented in Table 7. This result reveals several key causal relationships: There is a unidirectional causality from the exchange rate to both stock prices and inflation whereby changes in the exchange rate have a significant influence on stock market prices and inflation rates in Nigeria, but the reverse is not observed. Similarly, there is a one-way causality from the money supply to stock prices and inflation suggesting that variations in the money supply affect stock market prices and inflation rates, but these variables do not significantly influence the money supply. Again, inflation Granger causes stock market prices, meaning changes in inflation precede and significantly influence movements in stock prices. However, a reverse-stock market prices influencing inflation is not observed.

Table 7: VAR Granger Causality/Block Exogeneity Wald Tests

Excluded	Chi-sq	Df	P-value
Dependent variable: DLASI			
DLEXR	4.378182	2	0.1120
DLM2	1.900580	2	0.3866
DLINF	1.846873	2	0.3972
DLINT	0.599056	2	0.7412
All	7.958672	8	0.4375
Dependent variable: DLEXR			
DLASI	11.193056	2	0.0040*
DLM2	6.644328	2	0.0361*
DLINF	8.923155	2	0.0106*
DLINT	2.132654	2	0.3443
All	14.11015	8	0.0789
Dependent variable: DLM2			
DLASI	7.349232	2	0.0254*
DLEXR	9.131961	2	0.0078*
DLINF	8.049972	2	0.0153*
DLINT	2.083308	2	0.3529
All	13.29579	8	0.1021
Dependent variable: DLINF			
DLASI	9.401767	2	0.0075*
DLEXR	2.828802	2	0.2431
DLM2	0.186868	2	0.9108
DLINT	1.190212	2	0.5515
All	13.18470	8	0.1057
Dependent variable: DLINT			
DLASI	2.505218	2	0.2858
DLEXR	1.661654	2	0.4357
DLM2	0.822085	2	0.6630
DLINF	3.917980	2	0.1410
All	9.487942	8	0.3028

**denotes rejection of the null hypothesis at the 5% level of significance*

There is a bidirectional causality between the exchange rate and the money supply which implies that changes in the exchange rate influences money supply, and conversely, variations in the money supply also affect the exchange rate. These findings imply that in Nigeria, both exchange rate and the money supply are significant determinants of stock market prices and inflation. Moreover, inflation affects stock prices but not the other way around. The reciprocal relationship between the exchange rate and money supply highlights the interconnected nature of these variables in the Nigerian economic context.

Conclusion: In this study, a cointegrating relationship is established among the macroeconomic variables despite the non-normality and non-stationary behaviours exhibited over the time which demands tuning the policies generating these series. The study therefore, recommends policy adjustment by implementing measures to stabilize the Naira/US Dollar exchange rate and manage broad money supply to positively influence stock market prices. There is need for inflation management, interest rate regulation, monitoring bi-directional effects and implementing long-term economic planning as strategies for achieving a stable economy and thus, promote stock market patronage.

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