STATISTICAL INVESTIGATION OF THE EFFECTS OF MAIN MACROECONOMIC VARIABLES ON STOCK MARKET PERFORMANCE IN NIGERIA USING ARDL MODEL

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ABSTRACT

The effect of the main macroeconomic variables on the stock market performance has been of great concern recently. This has necessitated divers conference of researchers and government agencies reforms geared towards improving the stock market performance and a stable growth of the Nigeria economy. The study seeks to examine the effect of Inflation Rate, Interest Rate and Exchange Rate on the performance of the stock market using ARDL Model on data obtained from the Central Bank of Nigeria (CBN) statistical bulletin for the period of 1985-2018. The study employed the Augmented Dickey Fuller test to test for stationarity among the variables, Johensen cointegration technique is use to determine the order of cointegration. Granger causality test was used to check for causal relationship among the variables and then the Autoregressive Distribution Lag (ARDL) Model to check for a short-run or long-run relationship among the variables. The results indicate that all the variables are non-stationary at levels, but became stationary after first differencing. The three macroeconomic variables were also cointegrated. There is a causality runs among these variables. The ARDL Model suggested a short and long-run relationship between stock market performance and the three macroeconomic variables. The CUSUM and CUSUMSQ plots (serving as a stability test) are within the critical bounds meaning that the model is stable. The selected macroeconomic variables were found to have a significant effect on the Nigeria stock market performance. The implication of the findings is that a decrease in inflation rate and other variables will improve the performance of the stock market in Nigeria both in short term and long-term. The study therefore recommends among others that the investors should pay more attention to the macroeconomic variables and not only the stock market performance.

Keywords: Macroeconomic Variables, Stock Market Performance, ARDL Model.

INTRODUCTION

The stock market is a main component of financial sector of developing countries like Nigeria which serves a pivotal role in development and contribution to economic growth by pooling savings from investors and availing the savings to companies for utilization. The Nigerian stock market has recorded a tremendous growth over the years until its recent crash which has been exceptional in its historic evolution since 1960 till date. The growth in the stock market has been influenced by government economic reforms and the macroeconomic variables which enabled both private and public enterprise investors to be involved in stock market. All-Shares Index (ASI) which is the proxy of stock market performance is generally used to determine the growth of the stock market performance as it captures the total performance of the stock market in the area of market capitalization, market liquidity, and overall turnover ratio. Stock market performance is the major determinants of the

market size or capacity of any stock market exchange and its growth rate. Stock market performance without much ado, has a strong link with the development of the critical sectors of the economy and influences positively or negatively the growth and development of the economy of a nation (Emmanuel, 2019).

The future uncertainty of Nigeria economy requires that statisticians and policy makers have an in-depth knowledge of macroeconomic variables (such as inflation rate, unemployment rate, exchange rate, Gross Domestic Product etc) so that appropriate policies can be formulated to attain desired objectives (Shittu et al, 2012). Macroeconomic variables are signpost or indicators showing the current state or trend of the nation's economy. A good knowledge of the macroeconomic variables helps in macro-managing the economy of the nation. Macroeconomic practitioners in particular do prefer to forecast macroeconomic variables with robust statistical models to elucidate information from several variables (Koop and Korobilis, 2010). Onwukwe and Nwafor (2014) lend their voices among many other scholars in supporting the fact that the main macroeconomic variables in Nigeria are Inflation rate, Interest rate, Exchange rate and Unemployment rate. Macroeconomic variables of a nation's economy play a vital role in the stock market performance. They are the 'barometer' used in measuring and forecasting the viability of the stock market (Adenomon, 2017).

Inflation rate as defined by (Mbah, Okoli and Amassoma, 2017) is the change (percentage) in the price of goods and services over a specified period of time. It is the continuous rise in the general price level over a time (Adenomon and Ojo, 2020). Periods in which the nation's economy experience high inflation rate always translate to diminishing value of the nation's currency. Owing to the adverse effect of inflation on the citizenry and the economy, it is always the focus point of the government, econometricians, statisticians and other researchers to proffer solution to the adverse effect of inflation. It is one of the greatest challenge bedeviling the Nigeria economy and by extension the world economic environment. In recent times, the Nigeria economy has suffered from high inflation rate which was caused partly by high exchange rate, unemployment rate and government policies (Adenomon, 2017). Nigeria inflation rate is15.99% in the month of October, 2021. Exchange rate can be seen as the rate at which the nation's currency is exchanged for another country's currency. The exchange rate is a reflection of the economic condition of the country. According to Acha (2019), interest rate can be seen as the 'due' paid on money lend which is fractional part of the amount lent. It is also the reward of abstinence and it is time bound. Past Nigeria administration adopted the interest rate repressive scheme for effective management of interest rate in Nigeria. according to her, interest rate repressive scheme helps to keep the interest rate lower than the inflation rate. This enables the government and private sectors to borrow at lower interest rate to execute developmental projects. Studying the relationship between the main macroeconomic variables and the performance of the stock market is necessary since it can be used as a barometer to measure the future growth of a nation's economy (Mbah, Okoli & Amassan, 2017). Also, an understanding of the relationship between the selected macroeconomic variables and how they affect the stock market performance will be of great benefits to the stock brokers and the policy makers.

Stock market performance generally galvanizes the economic growth and development of a nation. The stock market

performance is not immune of the effect of changes associated with the macroeconomic variables (Adenomon & Ojo, 2020). These prevailing influence of the macroeconomic variables on the stock mark performance led to the global financial meltdown in 2008. Against this backdrop, and the fact that the macroeconomic variables have a great effect on stock market performance leads to these questions being asked: is there a significant long run relationship between the main macroeconomic variables (Inflation Rate, Interest Rate and Exchange Rate) on stock market performance in Nigeria? what is the effect of the macroeconomic variables on the performance of the stock market in Nigeria? etc.

Autoregressive Distributed Lag (ARDL) Model is used to determine long run interrelationship between series that are non-stationary (Chinenye and Acha, 2018). It is used to investigate the co-integration among variables. Co-integration exits between two or more variables if there is a form of equilibrium relationship on a long-run. ARDL test is guided by the assumption of stationary variables at level I(0), at first difference I(1) and not at second difference I(2). The ARDL can be specified when the macroeconomic variables are integrated of different order. The ARDL model permit the explanation of dependent variable by the independent variables and their lags and its own lag.

Ditimi et al. (2018) explored the dynamism between macroeconomic variables and stock market performance in Nigeria from 1980- to 2016 using the co-integration test and error correction model. The study among others revealed that there exit both short and long term relationship between the selected macroeconomic variables and stock market performance. From the study, it was recommended that government should put in place macroeconomic policies capable of stimulating better stock market performance. Furthermore, Kolapo et al (2018) investigated contribution of macroeconomic fundamentals on stock market performance in Nigeria ranging from 1986 to 2015 using the Autoregressive Distributed Lag (ARDL) Model. It was recommended that the government should pay a critical attention to unemployment and interest rate.

This study aims to examine the effects of the main macroeconomic variables (Inflation Rate, Interest Rate and Exchange Rate) on the performance of stock market using Autoregressive Distributed Lag (ARDL) Model.

MATERIALS AND METHODS

Secondary data were used in this study and it was obtained from the Central Bank of Nigeria (CBN) statistical bulletin. The data spans the period of 1986 to 2018. The data was transformed into Natural Logarithm as the Natural logarithm of Stock Market Performance is (InSPM), the Natural logarithm of Inflation Rate is (InIFR), the Natural logarithm of Interest Rate is (InINR) and the Natural logarithm of Exchange Rate is (InEXR). E-View version 9 statistical software was used for the analysis.

Model Specification

The ARDL model used in this research work may be expressed as:

$$\text{SMP}_t = f(INFR_t, INTR_t, EXR_t, \varepsilon_t) \tag{1}$$

Where SMP is Stock Market Performance, INFR is the inflation rate, INTR is the interest rate, EXR is the exchange rate, ε is the error term and t is the time.

The ARDL framework pertaining to the macroeconomic variables used in this study is:

$$\Delta \text{InSMP}_t = \alpha_0 + \sum_{i=1}^{n} \beta_1 \Delta \text{InIFR}_{t-1} + \sum_{i=1}^{n} \beta_2 \Delta \text{InINR}_{t-1} + \sum_{i=1}^{n} \beta_3 \Delta \text{InEXR}_{t-1} + \varepsilon_t \qquad (2)$$

Where the parameter α_0 is the corresponding long run multiplier, β_i for i=1,2,3,4 are the short run dynamic coefficient of the Autoregressive Distributed Lag (ARDL) Model, ε is serially uncorrelated disturbance with mean zero and constant variance and Δ is the first difference operator.

Unit Root Test

Time series data is stationary when its value tends to revert back to the long run mean value and the variance and the covariance of the time series is time invariant (Adenomon and Ojo, 2020). Naturally, most economic variables are not stationary at first level, but become stationary at first difference. Therefore, there is need to test for the presence of unit roots. The common method for testing unit root is Augmented Dickey Fuller (ADF) test and is given as:

$$\Delta y_t = \varphi + \beta y_{t-1} + \sum_{i=1}^{k} \beta_i \Delta y_{t-1} + \varepsilon_t \qquad (3)$$

Where Δy_{t-1} is the first difference and ε_t is the error term. The ADF used follows as explained in Adenomon and Ojo (2020).

Test of Cointegration

Cointegration between two or more variables exist if there is an equilibrium relationship spanning at long-run (Adenomon and Ojo, 2020). Modeling and forecasting time series in order to retain their long-run information is achieved through cointegration. Cointegration becomes a necessary requirement for any economic model when we are using non stationary time series data. Besides, spurious regression might have occurred and econometric analysis meaningless if the underlying data for the analysis are not cointegrated. In essence, two or more variables are cointegrated if they have a long-run relationship and interdependency between them. Testing for cointegration is a mandatory test to establish if a model empirically exhibits meaningful long run equilibrium relationships. The assumption guiding cointegration test of stationary variables are at level I(0), at first difference I(1) and not at second difference I(2) (Adenomon and Ojo, 2020).

ARDL Bound Test

The general ARDL (p,q) is given as:

$$y_t = \delta_0 + \sum_{i=1}^{p} \beta_{1i} y_{t-1} + \sum_{i=1}^{q} \beta_{2i} x_{t-1} + \varepsilon_t \qquad (4)$$

Where y_t is the dependent variable, x is the independent variable(s), δ_0 is the constant, y_{t-1} is the lag dependent variable, x_{t-1} is the lag of independent variable(s), β_{1i} is the coefficient of dependent variable, β_{2i} is the coefficient of independent variable, p is the optimal lag of dependent variable, q is the optimal lag of independent variable and ε_t is the error term.

The ARDL model used in this research work may be expressed and specified as:

InSMP$_t = F(InIFR_t, InINR_t, InEXR_t, \varepsilon_t)$ \qquad (5)

Where SMP is Stock Market Performance, IFR is the Inflation rate and INR is the Exchange rate, EXR is Exchange rate ε is the error term and t is the time. The ARDL framework specified for the macroeconomic variables used in this research is:

$$\Delta \text{InSMP}_t = \alpha_0 + \sum_{i=1}^{n} \beta_1 \Delta \text{InIFR}_{t-1} + \sum_{i=0}^{n} \beta_2 \Delta \text{InINR}_{t-1} + \sum_{i=0}^{n} \beta_3 \Delta \text{InEXR}_{t-1} + \varphi_1 \text{InIFR}_{t-1}$$
$$+ \varphi_3 \text{InINR}_{t-1} + \varphi_3 \text{InEXR}_{t-1} + \varepsilon_t \tag{6}$$

Where the parameter $\varphi_i \ \forall \ i = 1, 2, \ldots, n$ is the corresponding long run multiplier, β_i for i=1, 2, …, n are the short run dynamic coefficient of the Autoregressive Distributed Lag (ARDL) Model, ε is serially uncorrelated disturbance with mean zero and constant variance and Δ is the first difference operator.

For the joint significance of the coefficients of the lagged levels of the variables of the model, we have;

H$_o$: μ$_1$ = μ$_2$ = μ$_3$ = μ$_{4}$ = 0

H$_1$: μ$_1$ ≠ μ$_2$ ≠ μ$_3$ ≠ μ$_4$ ≠ 0

The null hypothesis implies there is no co-integration while the alternative hypothesis implies there is co-integration.

Granger Causality Test

Granger causality was used in the study to ascertain the direction of the causal effect of the selected macroeconomic variables and stock market performance. The null hypothesis of the granger causality test is rejected at 5% level of significance.

If SMP is the Stock market performance, INF is the inflation rate, INR is the interest rate and EXR is the exchange rate, the standard Granger-causality test specified for the estimation of the parameters of the model are as follows:

$$\text{STP}_t = \delta_0 + \sum_{i=1}^{n} \beta_{1i} \, \text{IFR}_{t-1} + \sum_{i=1}^{n} \beta_{2i} \, STP_{t-1} + \varepsilon_t \tag{7}$$

$$\text{STP}_t = \delta_0 + \sum_{i=1}^{n} \beta_{3i} \, \text{INR}_{t-1} + \sum_{i=1}^{n} \beta_{4i} \, STP_{t-1} + \varepsilon_t \tag{8}$$

$$\text{STP}_t = \delta_0 + \sum_{i=1}^{n} \beta_{3i} \, \text{EXR}_{t-1} + \sum_{i=1}^{n} \beta_{4i} \, STP_{t-1} + \varepsilon_t \tag{9}$$

Where t denotes time, ε is a white noise error and δo is the growth rate of EXR, INR and IFR.

RESULTS AND DISCUSSION

The study seeks to examine the effect of Inflation Rate, Interest Rate and Exchange Rate (main macroeconomic variables) on the performance of the stock market using Autoregressive Distributed Lag (ARDL) Model on data obtained from the Central Bank of Nigeria (CBN) statistical bulletin for the period of 1985-2018. The analysis was carried out using the E-View statistical software. As had been stated before, All Share Index was used as a proxy for stock market performance

Table 1: Descriptive Statistics

	EXC	INT	LOGASI	LOGINF
Mean	98.88029	-0.313353	11.16104	2.672672
Median	114.8900	3.230000	11.78000	2.497726
Maximum	306.1000	25.28000	13.31314	4.288265
Minimum	0.890000	-43.57000	7.249499	1.682688
Std. Dev.	86.41793	17.52288	1.936381	0.726477
Skewness	0.687862	-0.785815	-0.779334	0.906023
Kurtosis	2.902842	3.270911	2.204993	2.748691
Jarque-Bera	2.694577	3.603165	4.337103	4.741116
Probability	0.259944	0.165037	0.114343	0.093429
Sum	3361.930	-10.65400	379.4754	90.87086
Sum Sq. Dev.	246445.9	10132.69	123.7358	17.41638
Observations	34	34	34	34

From the above table, it is evident that exchange rate has the highest standard deviation, it is more stable than other macroeconomic variables selected. With the Jarque-Bera test values greater than 0.05, the variables show normality (normally distributed). This shows that a positive increment on interest rate will have a multiplier effects on the other selected macroeconomic variables and the performance of the stock market.

Graphical Movement of the Macroeconomic Variables

In fig 1 below, it is observed that there is fluctuation in Exchange Rate while Interest Rate, Inflation Rate and All Share Index are stable which serves as a proxy of Stock Market Performance are a bit steady over the years.
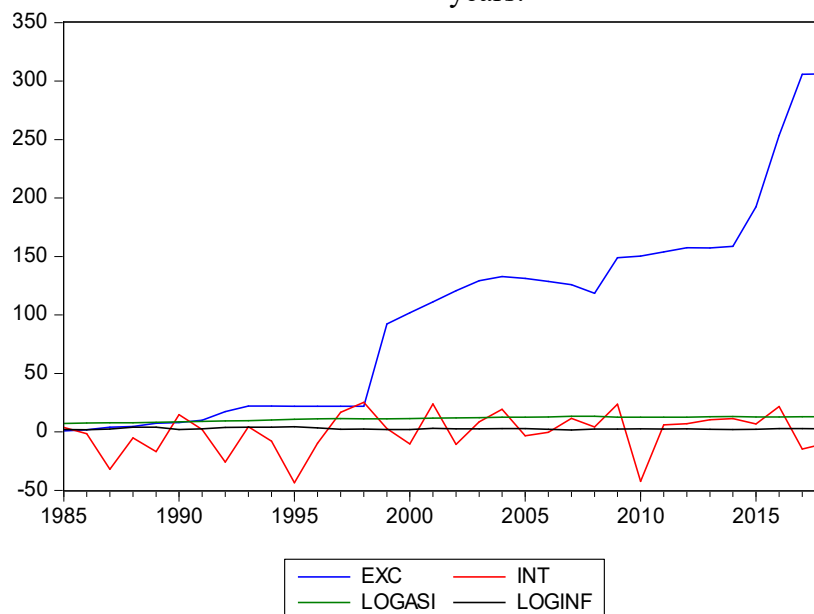

Figure 1. Trend Movement of Exchange Rate, Inflation Rate, Interest Rate and All Share Index in Nigeria from 1985 – 2018.

Figure 1 shows the graph of the steady growth rate of the macroeconomic variables and All Share Index. The graph reveals the upward and downward movement of the macroeconomic variables. The graph also shows the effects of the variables under consideration on Stock Market Performance within the study period. It is revealed from the graph that inflation exhibits a strong degree of inertia. This agrees with Amalahu and Acha, (2018) in their empirical investigation of selected macroeconomic variables using ARDL Model.

Table 2: ADF Unit Root Test

Variables	Order of Integration	T-Statistics ADF	Critical ADF Statistics
INT	I (0)	-5.758603	-2.954021 at 5%
LASI	I (1)	-3.905783	-2.960411 at 5%
LINF	I (1)	-3.540497	-2.971853 at 5%
EXC	I(1)	-4.036852	-2.957110 at 5%

Table 2 shows the ADF test statistics for all the selected variables. The table shows that at 5% confidence interval, all the variables are integrated either at levels or at the first difference, i.e. I (0) or I (1). This implies that there is an absence of unit root and we can boldly apply the ARDL model.

Bounds Test

Table 3: Results from ARDL Bounds Test

ARDL Bounds Test
Date: 12/13/21 Time: 00:05
Sample: 1985- 2018
Included observations: 31

Null Hypothesis: No long-run relationships exist

Test Statistic	Value	K
F-statistic	4.873507	2

Critical Value Bounds

Significance	I0 Bound	I1 Bound
10%	3.17	4.14
5%	3.79	4.85
2.5%	4.41	5.52
1%	5.15	6.36

From Table 3 above, reveals that the F-statistic for the Bounds Test is 4.87, and this clearly exceeds the 5% critical value for the upper bound 4.85. Accordingly, the null hypothesis of no long-run relationship is rejected, implying that long-run cointegration relationships amongst the variables exist. This correspond to Kolapo, et al (2018) assertion that there is a long run equilibrium relationship between the selected macroeconomic variables and stock market performance in Nigeria.

Error Correction Model (ECM) Representation
Table 4: Error Correction Model Representation for the Selected ARDL Model

Dependent Variable: LASI
Selected Model: ARDL(1, 1, 0, 0)
Date: 12/13/21   Time: 00:10
Sample: 1985- 2018
Included observations: 33

Cointegrating Form

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXC)	-0.005680	0.002480	-2.290554	0.0300
D(INT)	-0.001495	0.002945	-0.507475	0.6159
D(LINF)	0.038869	0.071233	0.545653	0.5898
ECM (-1)	-0.063544	0.042835	-2.483436	0.0095

ECM = LASI - (0.0118*EXC -0.0235*INT + 0.6117*LINF + 11.9264)

R-squared   = 0.984037
Adjusted R-squared = 0.981081
S.E. of regression   = 0.252656
Sum squared resid   = 1.723550
F- statistic = 332.8837 [0.000000]
Akaike info criterion = 0.249392
Durbin-Watson stat   = 1.856267
Schwarz criterion   = 0.527115

An examination of the estimated result above (table 4) shows that the overall fit of the model is acceptable at the value of R^2 = 0.984037 (98%). This shows that the independent variables used in our model jointly accounted for 98.4% of the total variation in All Share Index which is a proxy of the stock market performance. The lagged value of exchange rate is found to be positively significant in explaining stock market performance in Nigeria at 5% level of significance, one lagged value of interest rate and inflation rate are not significant at 5% level. This agreed with Emmanuel (2019) which says that macroeconomic variables accounts for the significant changes associated with stock market performance and influence the viability of SMP.

The speed of adjustment to equilibrium is given by the coefficient of ECM (-1) as -0.06. This indicates that a deviation in all share index (a proxy of Stock Market Performance) from equilibrium is corrected by as high as 6% the following year. The F-statistic of 332.8837 is significant at 5% level, as the P-value estimate of 0.0000 has indicated. It shows that there is a strong and robust linear relationship between the dependent variable and at least one of the independent variables. Thus, it will rightly act to correct any deviations from long-run equilibrium. The Durbin Watson statistics of 1.856267 indicates that there is absence of serial autocorrelation. This implies that the statistical estimates can be relied upon in making a valid and reliable prediction, estimation and conclusion.

Estimated Long Run Coefficients

Table 5: Estimated Long Run Coefficients using the ARDL Approach

Dependent Variable: LASI

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Remarks
EXC	0.017365	0.002502	6.941594	0.0000	Significant
INT	0.016781	0.013092	1.281718	0.2098	Not Significant
LINF	0.016522	0.325319	0.050787	0.9598	Not Significant
C	9.405037	0.980095	9.596042	0.0000	

The estimated long run result in Table 5 shows that exchange rate (EXC) is significant while interest rate (INT) and inflation rate (INF) are insignificant to All Share Index (proxy of Stock Market Performance) with p-value of (0.2098 and 0.9598) respectively.

Diagnostic Test

Table 6: Results of diagnostic tests

	X^2-statistic	Probability
Breusch-Godfrey Serial Correlation LM Test	0.522348	0.6006
Heteroskedasticity Test: Breusch-Pagan-Godfrey	0.502097	0.9144
Jarque-Bera test	0.031832	0.9842

From Table 6 above, the test of serial correlation was carried out on the model; the result revealed that there is no serial correlation, since the (Prob- value = 0.6006 > 0.05). The implication is that the All Share Index model is good for forecasting. Also, the Heteroskedasticity test which is used to investigate the presence or otherwise of variance of error was carried out on the model, the result shows that the variance of the residual is constant, since the (Prob-value= 0.9144 > 0.05). Jarque-Bera test is a test of normality, since the (Prob-value = 0.9842 > 0.05). We conclude that variables are normally distributed.

Table 7: Granger Causality Test Results

Pairwise Granger Causality tests

Date: 12/13/21 Time: 00:15

Sample: 1985 -2018

Lag: 2

Hypothesis	F-statistic	Probability
IFR does not Granger Cause SMP	5.522348	0.6006
SMP does not Granger Cause IFR	0.502097	0.1144
INR does not Granger Cause SMP	0.031832	0.9842
SMP does not Granger Cause INR	0.456789	0.9878
EXR does not Granger Cause SMP	7.45665 6	0.1254
EXR does not Granger Cause LSMP	6.987654	0.91827

The table above on the Granger Causality on the macroeconomic variables reveals that there is a unidirectional relationship between inflation rate and stock Market Performance. This result agreed with that of Adenomon (2017). Also, there is a bi-directional relationship between exchange rate and stock market performance.
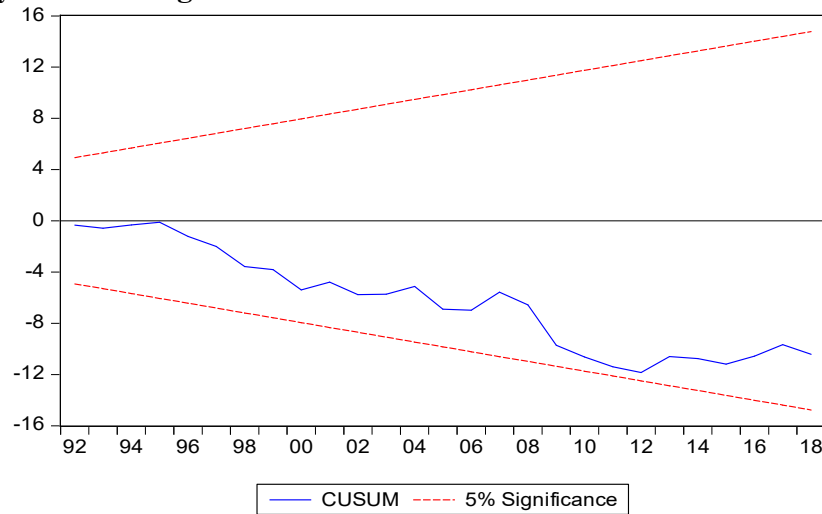
Test of Stability for the Long-Run Model

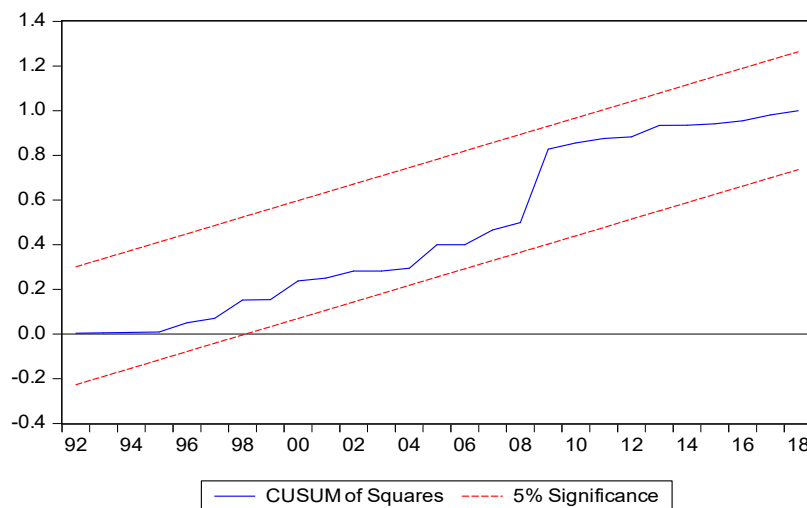**Figure 1:** Plot of CUSUM Test for Coefficients Stability of ARDL Long-Run

Figure 2: Plot of CUSUMSQ Test for Coefficients Stability of ARDL Long-Run

The cumulative sum of recursive residuals (CUSUM) and the CUSUM of square (CUSUMSQ) tests above are used to evaluate the stability of the model when applied on the residuals. It is done to ascertain the systematic change associated with the coefficient of the regression (Adenomon & Ojo, 2020). It is expected that both CUSUM and CUSUMSQ plots should be within the critical bounds at 5% significant level for the model to be accepted as being stable. From Fig. 2 and Fig. 3, both plots are within the critical bounds meaning that the model is stable, and

therefore the model can be used for statistical analysis and policy formulation.

CONCLUSION AND RECOMMENDATIONS

The study explored the relationship between the selected macroeconomic variables and the Nigeria stock market performance. The Nigeria stock market performance is the dependent variable and the macroeconomic variables (inflation rate, interest rate and exchange rate) are the independent variables. The normality test reveals that the variables are normally distributed. The result revealed

that the main macroeconomic variables greatly influence the stock market performance in Nigeria and there is a long run relationship among the variables. In conclusion, inflation rate and other variables should serve as main 'barometer' to monitor stock market performance in Nigeria. Based on the findings of the research work, the following recommendation were made:

1. The Nigeria stock market should be made attractive and reliable to sustain investor's confidence. This will enable them to invest their money on a long-run which can bring a better returns and stability to the stock market.

2. There is need for the government and its agencies saddled with the responsibility of policy formation to design robust policy(ies) which are capable of reducing the effects of the macroeconomic variables on the performance of the stock market.

3. There is need for investor to monitor the macroeconomic variables as investment strategy. These macroeconomic variables are signpost of the performance of the stock market in Nigeria. There should be stability in the variables so as to enjoy the confidence of the investors and also allow their investment for a long period of time. Investors should pay more attention to the macroeconomic variables environment and not only the stock market performance only. This will promote the viability of the stocks.

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