

ARDL Inference for Some Macroeconomic Variables on Nigerian Stock Prices

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Abstract

This study presents inferences about the effect of quarterly returns of some macroeconomic variables on Nigerian stock prices (NSP) by means of the autoregressive distributed lag (ARDL) model. Four models were studied using NSP, inflation rate (IFR), broad money supply (BMS), and exchange rate (EXR) data that spanned from 1999 to 2021. The rolling correlation was first carried out to test the significance of signals between each input variable and NSP. In testing for co-integration existence and to account for short- and long-term relationships between the study variables, the ARDL bounds test and error correction model (EMC) were utilized, respectively. Also, in determining the stability of the estimated parameters, the recursive cumulative sum (RCUSUM), RCUSUM of squares, and recursive moving sum (RMOSUM) charts were applied. The first model results revealed that at 5% IFR, it has no influence on NSP, both in the long run and short run. However, the second model revealed that BMS has a significant positive effect, both in the long run and short run, on NSP. The third model results showed that the EXR effect on NSP is not significant at 5% in the long run, but in the short run, it significantly negatively affects NSP in the second and third lags. Results from the fourth model revealed that IFR at lag one and BMS are positive and significant in influencing NSP in the long run. In contrast, EXR has a significant negative influence on NSP in the short run, but BMS has a positive and significant effect on NSP in the short run at 5%. The RCUSUM, RCSUMS, and RMOSUM charts revealed that the estimated parameters for the respective models are stable. The study concludes that NSP is influenced negatively by EXR and positively by IFR and BMS. The study recommends that the monetary policy rate should be controlled to lower the cost of borrowings, enhance liquidity levels in the stock market, and develop policies that can have a combined positive impact on stock prices.

Keywords: Macroeconomic variables; Autoregressive distributed lag; Bounds test; Co-integration; Error correction model; Nigeria stock price

1 Introduction

One can describe the stock exchange as the entirety of buyers and sellers of equity and loan stocks, their instruments of trade, and the enabling basic conceptual structure. The stock exchange is an apex financial market for the sales and purchase of securities and all the allied activities that accompany trading. It is purely a forum for financial dealings comprising the primary and secondary stock markets. The primary market is for the new issue of shares, and the secondary market is for the exchange of already quoted shares. According to (Azubuike, 2017), the mechanism of the stock exchange came into existence to enable inherently illiquid investments to become

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liquid. This occurs through re-conversion into cash at the investor's discretion without inconveniencing the borrower. He also stated that the stock market is the pivot upon which economies revolve because it creates, mobilizes, and rations long-term funds for economic growth and development. It can also be seen that the stock market is a platform where long-term capital for financing new projects and expanding and modernizing industrial and commercial concerns is created by the government and private sectors. Hence, the stock market is an economic institution that promotes efficiency in capital formation and allocation (Ohiomu, Enabulu, 2011). However, it is worth determining the inference of some macroeconomic variables' effect on the Nigerian stock market. The reason is that all market structures are affected positively or negatively by various factors in and outside the market. One such factor is information spread about stocks in the market, which many use as a yardstick for buying or selling stocks in the stock exchange market. Macroeconomic variables play their own roles in how a country's stock exchange market can be seen. For instance, a high inflation rate could raise some concerns about the stock market, interest rates, and exchange rates (Javangwe, Takawira, 2022).

The Nigerian Stock Exchange was established on September 15, 1960, as the Lagos Stock Exchange. In 1977, it became the Nigerian Stock Exchange (NSE), with branches in some major commercial cities, while Lagos became its head office (Olusegun *et al.*, 2011). This was created to give businesses and investors reliable access to capital and provide secure saving systems and structures for effective and efficient business operations. The Nigerian stock market started operations with 19 securities listed for trading in 1961. In 2018, the NSE had over 169 companies listed, with a total market capitalization of over N13 trillion. To avoid breaches of market rules and other unfair manipulations, the Securities and Exchange Commission regulates the operations of the NSE. The NSE has been the bedrock for capital mobilization and investment in the Nigerian economy (NSE, 2012). In this research, the aim is to draw inferences from autoregressive distributed lag analysis about the effect of inflation rates (IFR), broad money supply (BMS), and exchange rates (EXR) on Nigeria's stock price (NSP). The objectives are to determine the independent and combined effects of IFR, BMS, and EXR on NSP. The research hypotheses are as follows:

1. H_{01} : IFR movements have no significant influence on NSP.
2. H_{02} : BMS movements have no significant sensitivity on NSP.
3. H_{03} : EXR movements have no significant impact on NSP.
4. H_{04} : IFR, BMS, and EXR combined movements do not significantly affect NSP.

2 Theory and Literature Reviews

2.1 Theoretical Review

The stock market efficiency has been characterized into three systems, that is, weak market efficiency, which uses historical prices as the needed information to determine current prices; semi-strong market efficiency, which relies on publicly available information and historical prices, implying that all public information is incorporated into the present prices of stocks and this is a stage where only non-public available information can be used to make irregular stocks gains. The third form is the strong market efficiency that uses all available information, both private and public. All these three forms of the stock market are influenced by macroeconomic variables like inflation rate, exchange rate, broad money supply, interest rate, export, import, etc. However the degree of impact varies likewise the direction of the impact. This notion is clearly a *classical theory* because consistent and convincing estimations of the sensitivity of stock prices to the changes in BMS, IFR, and EXR are fundamental variables in their exposure management and government policies implementation towards financial markets in a country (Alam *et al.*, 2011).

According to (Petros, 2012), the stock market is expected to encourage savings by providing individuals with additional financial instruments that may better meet their risk preferences and liquidity needs. He further explained that developed stock markets can positively influence savings among individuals and provide avenues for firms' financing. The stock market allows growing companies to raise capital at lower costs. A typical stock market is characterized by trading equity securities such as shares, representing ownership in a particular corporation (Cheng, Gul, 2011). A well-developed stock exchange increases savings by ensuring the availability of several financial securities to savers (Ake, 2010). By doing this, savers' portfolios are diversified, risks are effectively reduced, and capital is efficiently allocated to the most productive units of the economy. According to (Asekunowo, 2016), it is also attributed to the fact that the highest goal of a current economic system is to maintain stability in the prices of goods and services that would not be destructive to the economic system. Based on the *inflation illusion hypothesis* by (Modigliani Cohn, 1979) argues that participants in the stock market are unable to calculate the long-term future growth rates of cash flows correctly. At high inflation rates, the nominal interest rate is generally quite high, which causes an upward bias on the discount rate investors actually use for discounting. When expected returns are discounted using these higher rates, there are lower stock price levels. The theory was developed in an attempt to explain the depressed stock market prices. Contrary to the classical hypothesis that nominal stock returns may serve as a hedge against inflation, resulting in an "Inflation-stock returns enigma",

significant negative impact of inflation rates on stock market prices has been postulated (Nelson, 1976; Fama, Schwert, 1977) claiming that every increase of inflation rates, companies real capital cost increases and hence impacts negatively on the stock market (Eldomiaty *et al.*, 2020). According to (Fama, 1981), the negative relationship between stock market prices and inflation rates is a result of the negative relationship between inflation rates and macroeconomic real movements referred to as the stagflation phenomenon, and this is when stock market prices and real movements are significantly related positively. Consistent with *rational expectations theory*, stock prices, and inflation rates depend upon future real movement expectations. Also, (Davis and Kutan, 2003) reported similar results of the significant negative effect of real variables on inflation rates and, in turn, the negative effect of inflation rates on stock market prices.

Based on (Omankhanlen *et al.*, 2016; Celebi, Hönig, 2019; Pal, Garg, 2019; and Asamoah *et al.*, 2020) examination of how the stock markets often react to macroeconomic environments such as political and socioeconomic climates (that is, foreign exchange rate, interest rate, gross domestic product [GDP], and so on) owing to the interactions between the excess unit and the prolific sectors of the economy. It is no doubt that a stable macroeconomic environment is a catalyst for stock market growth and economic growth (Hussain, Sohail, 2009). It was concluded that stock markets have an essential role to play in the economy. According to their study, the stock markets serve as a source for mobilizing domestic resources for productive investments. They further explained that to perform this role, the stock market must have a significant relationship with the economy. All economies function based on the money supply in their system, which surely has a significant impact on the economy, which in turn influences the stock prices and other macroeconomic variables like exchange rates and inflation rates. Real *movement theorists* believe that a positive change in the money supply offers information on higher money demand and anticipation about greater economic movements and future output, resulting in a rise in stock market prices (Sahu, Pandey, 2020). It is widely believed that the immediate effect of monetary policy shocks is observed in stock prices through changes in the cost of capital and wealth effects. However, there exist two prominent and highly accepted theories in this regard: the capital asset pricing model (CAPM) and the *arbitrage pricing theory (APT)* (Ross, 1976). Both theories are actually based on the efficient market hypothesis (EMH) postulated by (Fama, 1970).

Specifically, ATP postulates that sock market prices are susceptible to few non-correlated common variables and by a particular independent factor. Hence, APT introduces the theoretical framework for modeling stock market prices through a linear function of various macroeconomic variables (Sahu, Pandey, 2020), and this linkage can lead to the forecasting of stock market prices by suggesting variable risk to be of crucial significance in asset pricing (Gilles, Leroy, 1991). The APT is in agreement with (Dornbush, Fischer, 1980) *flow-oriented theory* that postulated that it is exchange that affects stock market prices because variables that reduce the cash flow of a firm by keeping everything constant, will lead to a fall in stock market prices of any firm and this is the same in the opposite. Therefore, events that negatively react to exchange rates have the latent energy drive of upsetting the stock market prices. According to *traditional economic theory*, a depreciation or appreciation of any economic currency may cause a firm to record profits or losses, which eventually affects the firm's share prices. The theory postulates that currency depreciation results in higher exports and an upward movement of firms' profits, which will definitely attract investors, resulting in the firms' market share prices increasing.

2.2 Literature Review

Many researchers have studied the linkage between stock market prices and macroeconomic variables. However, many more research on it is still inevitable due to daily, weekly, monthly, quarterly, and yearly stock price volatility. The resultant direction of the linkage between exchange rates, inflation rates, broad money supply movements, and stock market prices depends on econometric and economic factors, and the results are largely mixed. (Mitra, 2017) study of South African stock market linkage with exchange rate using dynamic cointegration technique obtained a significant positive long-run relationship between the real effective exchange rates and the total value of stock transactions. However, the result indicated a lack of integration between stock transactions in the U.S. and South Africa. A significant positive relation between the exchange rate and the stock market in the short run and a significantly negative relation in the long run was reported for Nigeria in the study (Olugbenga, 2012).

(Tsen, 2017) examined Malaysia, the Philippines, Singapore, Korea, Japan, the United Kingdom (UK), and Germany's real exchange rate returns and real stock price returns relationship. The constant conditional correlation (CCC) or dynamic conditional correlation (DCC)-multivariate generalized autoregressive conditional heteroskedasticity (MGARCH) model was applied, and the results obtained showed a significant negative impact of real exchange rates on real stock prices for Malaysia, Singapore, Korea, and the UK although no significant relationship was found for the Philippines, Japan, and Germany. The research concluded that the exchange rate markets are important in influencing stock market prices.

(Zang, 2021) studied the movement of stock market price and inflation relation under different monetary policy regimes and conditions using an expanded dataset from 71 economies. Results obtained suggested that the stock return-inflation relation was partially driven by monetary policy. Based on the result, Zang opined that if a

country's monetary power conducts a further countercyclical monetary policy, the stock return-inflation relation becomes more negative. In addition, the results contrast with monetary policy frameworks. Also, in exchange rate-hinged countries, stock prices do not respond to monetary policy cyclicalities, while in inflation-targeting countries, there is a stronger stock price reaction to inflation.

(Katz *et al.*, 2017) examined why local stock markets adjust slowly to changes in local inflation. The research showed that when the local inflation rate increases, local investors consequently earn lower real returns on local stocks. This suggests that the local stock market investors use tacky long-run nominal discount rates that go lower when the inflation rate increases because they are slow to update the inflation expectations in discount rates. Their results showed that small amounts of tackiness in inflation expectations are sufficient enough to match the real stock return predictability prompted by inflation in the economy.

(Zang, 2021) stated that markets' reaction to inflation and monetary policy cyclicalities is due to central banks' ability to control inflation within their target bands. Hence, markets become sensitive to inflation dynamics when inflation exceeds the stated target bands. Also, when monetary policy is constrained by the Zero Lower Bound (ZLB), a structural break is introduced, and real stock prices no longer react to inflation rates and monetary policy cyclicalities. When the central bank, based on its monetary policy, injects money into the economy, it benefits other sectors of the economy but, most importantly, the financial markets, thereby pushing asset prices up. Stock prices tend to move higher when the money supply in an economy is high. Plenty of money circulating in the economy makes more money available to invest in stocks and makes alternative investment instruments, such as bonds, less attractive (Hunkar, 2014).

(Olulu-Briggs, Ogbulu (2015) examined the impact of broad money supply (M2) on asset prices in Nigeria. They applied the Johansen Cointegration test, which gave evidence of one cointegrating equation implying the existence of a long-run equilibrium relationship between stock market prices and broad money supply. Also, the vector error correction model (VECM) was used to analyze short-run adjustment dynamics, and the result obtained showed a -0.08% speed adjustment before deviations from equilibrium, but about 8% of disequilibrium was corrected monthly. The result they obtained from applying the Granger causality test showed unidirectional causality from M2 to stock market prices, which implies that the supply of money significantly impacts asset prices. Furthermore, the impulse response and variance decomposition test results showed both negative and positive shocks, which are consistent with their findings from the VECM and Granger causality results.

(Eldomiaty *et al.*, 2020) used quarterly data to examine the effect of both interest and inflation rates on stock market prices of non-financial firms listed in DJIA30 and NASDAQ100 from 1999 to 2016. They applied the stock duration model in measuring the sensitivity in inflation and interest rates variations on stock market prices. Also, panel Johansen cointegration test, linearity, normality tests, cointegration regression analysis, Granger causality test, and vector error correction model were applied in their study. The panel Johansen cointegration analysis results showed that cointegration exists between the stock market prices, the changes in stock market prices due to inflation rates, and the changes in stock market prices due to real interest rates. The results of the cointegration regression analysis showed that inflation rates are negatively associated with stock market prices, and the real interest rates and stock market prices are positively associated. Also, changes in real interest rates and inflation rates Granger caused significant changes in stock market prices, significant speed of adjustment to long-run equilibrium between observed stock market prices and real interest rates, and significant speed of adjustment to long-run equilibrium between changes in stock market prices due to real interest rates and changes in inflation rates.

In the study of Takawira, (2022), they examined exchange rates, interest rates, and inflation rates' effect on stock market prices in South Africa from 1980 to 2020 using the method of Autoregressive Distributed Lag (ARDL) modeling approach. Their results showed that there is a long-term relationship between the variables. Also, it revealed a negative relationship between the stock market prices and exchange rates, interest rates, and inflation rate movements. However, their results showed that the exchange rate effect was positive on the stock market prices in the short run.

Generally, the literature has asserted mixed directions of the effect of exchange rate, inflation rate, and money supply on stock market prices. Also, most of the methods used in the literature centered on vector error correction modeling, the Granger causality test, and cointegration regression analysis. However, in this research, the autoregressive distributed lag modeling approach is applied, as also used by Javangwe, Takawira, (2022) due to its ability to perform better in the small sample time frame and the data need not be stationary as long as the variables under study are integrated at order zero or integrated at order one, that is, $I(0)$ or $I(1)$ (David *et al.*, 2023).

3 Materials and Methods

This study employs a secondary source of data. The quarterly time series data is collected from the National Bureau of Statistics (NBS), the Central Bank of Nigeria (CBN), and other journals and articles covering 1999–2021. The autoregressive distributed lag (ARDL) model proposed by (Pesaran, Shin, 1999) and (Pesaran *et al.*, 2001) is adopted over (Johansen, 1991) and (Engle, Granger, 1987) co-integration tests. The ARDL has been

employed in many time series regression studies, like those in (David *et al.*, 2023), (Farouk *et al.*, 2021a), and (Farouk *et al.*, 2021b). The macroeconomic variables for this study are inflation rate (IFR), broad money supply (BMS), and exchange rate (EXR). The consumer price index (CPI) was used as a proxy for IFR, and M2 was also used as a proxy for BMS.

3.1 Model Specification

In its general form, the model specification is a formulation of NSP as a function of variability (relationship) with IFR, BMS, and EXR. The representation of the model specification is presented below as follows:

$$NSP = \phi(IFR, BMS, EXR) ; \phi_1, \phi_2, \phi_3 < 0 \quad (1)$$

A priori expectation of IFR, BMS, and EXR for this study is negative or less than zero. This is because, in the long run, these variable's effects on NSP are paramount. If they go above the required threshold of tolerance, their impact will definitely be of concern. In the short run, the effect could be positive and greater than zero, but it's not a reliable point to classify IFR, BMS, and EXR impacts as adverse. Theoretically, a low and stable IFR, BMS, and EXR are expected to support NSP and vice versa.

3.2 Autoregressive Distributed Lag (ARDL) Models

In this research, the single and combined ARDL models for achieving our research aim and objectives are presented in the next subsection.

3.2.1 Model I: ARDL Model for NSP and Inflation Rate

Based on the model specification as formulated in equation (1), the first research model is a formulation of the ARDL model, which captures the NSP and inflation rate. Therefore, our first research model is given as follows:

$$\Delta R(NSP)_t = \beta_0 + \beta_1 R(NSP)_{t-1} + \beta_2 R(IFR)_{t-1} + \sum_{i=1}^j \theta_{1i} \Delta R(NSP)_{t-i} + \sum_{i=1}^j \theta_{2i} \Delta R(IFR)_{t-i} + \varepsilon_t \quad (2)$$

where Δ is the 1st difference operator, $R(NSP)$ is the return value of Nigeria stock price, β_0 is the intercept, β_1 , and β_2 are constant elasticity coefficients with respect to returns values of NSP and IFR, and ε are the error term. The apriori expectations for the model parameters are $\beta_0 > 0$, $\beta_1 > 0$ and $\beta_2 < 0$.

3.2.2 Model II: ARDL Model for NSP and Broad Money Supply

Based on the model specification as formulated in equation (1), the second research model is a formulation of the ARDL model, which captures NSP and broad money supply variables under study. Therefore, our second research model is as follows:

$$\Delta R(NSP)_t = \beta_0 + \beta_1 R(NSP)_{t-1} + \beta_2 R(BMS)_{t-1} + \sum_{i=1}^j \theta_{1i} \Delta R(NSP)_{t-i} + \sum_{i=1}^j \theta_{2i} \Delta R(BMS)_{t-i} + \varepsilon_t \quad (3)$$

All parameter descriptions are the same except for β_2 , which is a constant elasticity coefficient for returns value of BMS.

3.2.3 Model III: ARDL Model for NSP and Exchange Rate

Based on the model specification as formulated in equation (1), the third research model is a formulation of the ARDL model, which captures NSP and exchange rate variables under study. Therefore, our third research model is as follows:

$$\Delta R(NSP)_t = \beta_0 + \beta_1 R(NSP)_{t-1} + \beta_2 R(EXR)_{t-1} + \sum_{i=1}^j \theta_{1i} \Delta R(NSP)_{t-i} + \sum_{i=1}^j \theta_{2i} \Delta R(EXR)_{t-i} + \varepsilon_t \quad (4)$$

All parameters descriptions are the same except for β_2 which is a constant elasticity coefficient for return value of EXR.

3.2.4 Model IV: ARDL Model for all Variables

Based on the model specification as formulated in equation (1), the fourth research model is a formulation of the ARDL model, which captures all variables under study. Therefore, our fourth research model is as follows:

$$\begin{aligned} \Delta R(NSP)_t = & \beta_0 + \beta_1 R(NSP)_{t-1} + \beta_2 R(IFR)_{t-1} + \beta_3 R(BMS)_{t-1} + \beta_4 R(EXR)_{t-1} + \sum_{i=1}^j \theta_{1i} \Delta R(NSP)_{t-i} \\ & + \sum_{i=1}^j \theta_{2i} \Delta R(IFR)_{t-i} + \sum_{i=1}^j \theta_{3i} \Delta R(BMS)_{t-i} + \sum_{i=1}^j \theta_{4i} \Delta R(EXR)_{t-i} + \varepsilon_t \end{aligned} \quad (5)$$

All parameter descriptions are the same as presented in the previous three models except β_2 , β_3 , and β_4 , which are the constant elasticity coefficients for returns of IFR, BMS, and EXR, respectively. The apriori expectations for the model parameters are $\beta_2 < 0$, $\beta_3 < 0$, and $\beta_4 < 0$.

3.3 Error Correction Model (ECM)

In this work, the ECM within the bivariate relationship system is used to examine the impact direction between NSP and IFR, BMS, and EXR, respectively. Also, the ECM has the interesting property of capturing the velocity of the adjustment of growth and the independent variables considered for this research. The ECM is chosen over other alternative techniques because of its favorable response to both large and small samples. For this research, four ECMs are presented.

3.3.1 Model I: NSP against Inflation Rate

If NSP and inflation rate are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta NSP_t = a_0 + \sum_{i=1}^n a_{1i} \Delta NSP_{t-i} + \sum_{i=1}^n a_{2i} \Delta IFR_{t-i} + a_3 EC_{t-1} + \mu_t \quad (6)$$

where, EC_{t-1} is a one period slacked error adjustment term (EAT) captured from the integration regression, NSP_t is the gross domestic product at time t and IFR_t is inflation rate at time t .

3.3.2 Model II: NSP

If NSP and BMS are co-integrated, the bivariate co-integration in ECM can be represented in the following form,

$$\Delta NSP_t = a_0 + \sum_{i=1}^n a_{1i} \Delta NSP_{t-i} + \sum_{i=1}^n a_{2i} \Delta BMS_{t-i} + a_3 EC_{t-1} + \mu_t \quad (7)$$

where is a one period slacked EAT captured from the integration regression, is the Nigeria stock price at time t , and is broad money supply at time t .

3.3.3 Model III: NSP against Exchange Rate

If NSP and EXR are co-integrated, the bivariate co-integration in ECM can be represented in the following form.

$$\Delta NSP_t = a_0 + \sum_{i=1}^n a_{1i} \Delta NSP_{t-i} + \sum_{i=1}^n a_{2i} \Delta EXR_{t-i} + a_3 EC_{t-1} + \mu_t \quad (8)$$

where, EC_{t-1} is a one period slacked EAT captured from the integration regression, NSP_t is the Nigeria stock price at time t and EXR_t is exchange rate at time t .

3.3.4 Model IV: NSP against IFR, BMS, and EXR

If NSP IFR, BMS, and EXR are co-integrated, the multiple co-integration in ECM can be represented in the following form.

$$\Delta NSP_t = a_0 + \sum_{i=1}^n a_{1i} \Delta NSP_{t-i} + \sum_{i=1}^n a_{2i} \Delta IFR_{t-i} + \sum_{i=1}^n a_{3i} \Delta BMS_{t-i} + \sum_{i=1}^n a_{4i} \Delta EXR_{t-i} + a_5 EC_{t-1} + \mu_t \quad (9)$$

where, EC_{t-1} is a one period slacked EAT captured from the integration regression, NSP_t is the Nigeria stock price at time t , IFR_t is inflation rate at time t , BMS_t is broad money supply at time t and EXR_t is the exchange rate.

4 Results

An initial analysis of NSP, IFR, BMS, and EXR was computed. Table 1 displays the descriptive statistics of the variables. The NSP has mean, median, maximum, and minimum values of 26871.67, 25725.07, 60952.95, and 4933.800 for the time period examined. NSP has a standard deviation and Jarque-Bera statistic values of 123188.43 and 1.2273, respectively, with a P-value of 0.5413. The IFR has a mean, median, maximum, and minimum of 139.3043, 107.9350, 417.1100, and 26.8260, respectively, for the time period examined. The CPI also has a standard deviation and Jarque-Bera statistic values of 103.1051 and 15.4406, respectively, with a P-value of 0.0004. M2 has a mean, median, maximum, and minimum of 13068.66, 11186.24, 43817.57, and 609.0300, respectively, for the time period examined, and a standard deviation and Jarque-Bera statistic value of 11249.29 and 9.3632, respectively, with a P-value of 0.0093. Also, EXR has a mean, median, maximum, and minimum of 185.2868, 150.5200, 418.8300, and 88.6667, respectively, for the time period examined, and has a standard deviation and Jarque-Bera statistic value of 89.2675 and 21.4024, respectively, with a P-value of 0.0000. NSP, IFR, M2, and EXR show positive skewness, while NSP, IFR, and EXR are highly leptokurtic since the kurtosis is greater than three (3). The result of the Jarque-Bera statistic showed that NSP is normally distributed since its p-

value is greater than 0.05, while IFR, M2, and EXR are not normally distributed as the p-values are smaller than 0.01.

Table 1. Empirical Analysis of NSP, CPI, M2 and EXR

	NSP	CPI	M2	EXR
Mean	26871.67	139.3043	13068.66	185.2868
Median	25725.07	107.9350	11186.24	150.5200
Maximum	60952.95	417.1100	43817.57	418.8300
Minimum	4933.800	26.82596	609.0300	88.66667
Std. Dev.	12318.43	103.1051	11249.29	89.26753
Skewness	0.281992	1.003092	0.774019	1.181333
Kurtosis	3.045778	3.056656	2.785189	3.032214
Jarque-Bera	1.227332	15.44062	9.363158	21.40237
Probability	0.541363	0.000444	0.009264	0.000023
Sum	2472193.	12815.99	1202317.	17046.39
Sum Sq. Dev.	1.38E+10	967390.9	1.15E+10	725151.0
Observations	92	92	92	92

Table 2 shows the unit root tests of the variables. The table shows the ADF test results and the Phillips-Perron test results. The null hypothesis is that the series has a unit root. The ADF unit root results presented in Table 2 revealed that at 5% significant level, all the variables are stationary at levels (i.e., integrated-of-order-zero series, i.e., I(0) series). This is evident from their respective P-values being less than 0.05. The outcome of the unit root test necessitates the need for the ARDL bounds test approach to cointegration developed by [17] to verify if a long-run equilibrating relationship exists among the variables.

Table 2. Unit Root Test of NSP, CPI, M2 and EXR

Variables	Augmented Dickey-Fuller test		Phillips-Perron test		Order of Integration
	Test statistic	P. value	Test statistic	P. value	
NSP	-4.3194	0.01	-59.9500	0.01	I(0)
CPI	-5.1876	0.01	-51.1770	0.01	I(0)
M2	-4.2695	0.01	-90.5510	0.01	I(0)
EXR	-3.9724	0.01	-61.6540	0.01	I(0)

Figure 1 shows the empirical plots of the studied variable. The result of the plot displays that NSP has been gradually increasing from 1999 to 2005, skyrocketed in 2006, gradually decreased in 2009, and oscillated over the period 2010 to 2021. CPI and M2 have been increasing gradually over the years. EXR has been on a steady increase from 1999 to 2014, rose abruptly in 2016, was relatively constant from 2017 to 2020, and also increased in 2021.

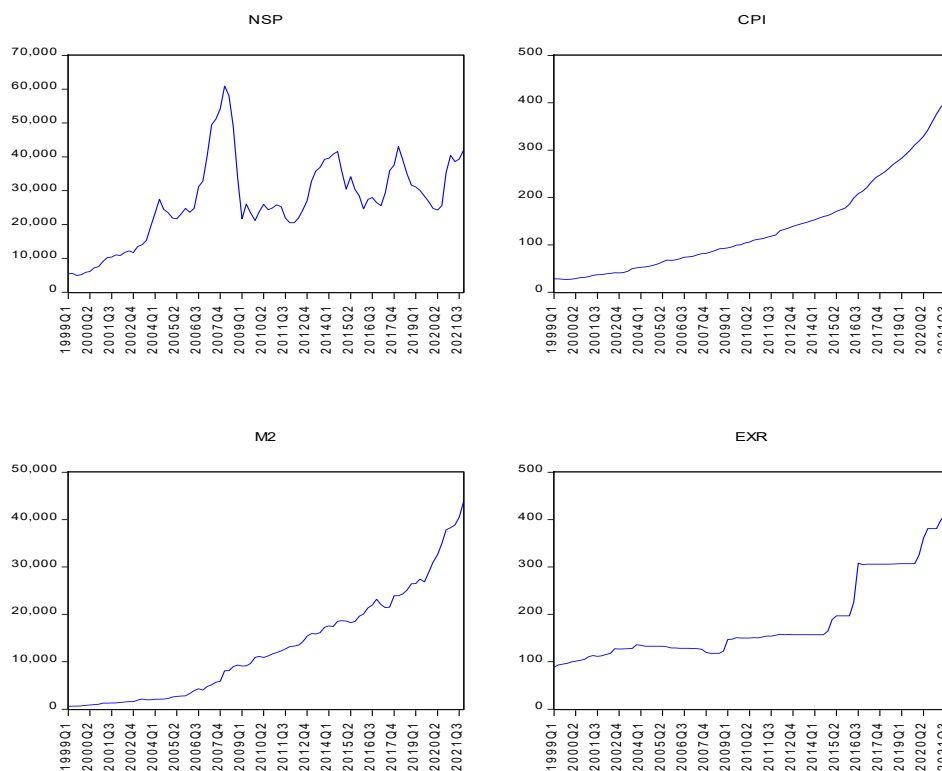


Fig. 1. Empirical Plots of NSP, CPI, BMS, and EXR

4.1 Rolling Correlation of NSP and IFR, NSP and BMS, NSP and EXR

In this part of the research, Table 3 presents the outcomes of the Rolling Correlation (RC) for NSP and IFR, NSP and BMS, and NSP and EXR. The rolling correlation is useful to test the significance of signals before moving onto further analysis of the ARDL bounds testing. To test the existence of a signal against noise, (Engle, Granger, 1987) proposed a Monte Carlo test approach based on the standard deviations of rolling correlations.

Table 3. RC Width for NSP and IFR, NSP and BMS, NSP and EXR

RC Width		Confidence Interval	
(NSP & IFR)	RCS	5% CI	95% CI
3	0.7087246	0.6378459	0.7413420
5	0.4739424	0.4017067	0.5521466
7	0.3696463	0.3093964	0.4674172
10	0.3152425	0.2250157	0.3977692
RC Width		Confidence Interval	
(NSP & BMS)	RCS	5% CI	95% CI
3	0.7001203	0.6508814	0.7472026
5	0.5215362	0.4161232	0.5540521
7	0.4364197	0.3125764	0.4726231
10	0.3688567	0.2366239	0.4015327
RC Width		Confidence Interval	
(NSP & EXR)	RCS	5% CI	95% CI
3	0.7424250	0.6399857	0.7450405
5	0.5579425	0.4159329	0.5487992
7	0.4698856	0.3143658	0.4594276
10	0.3872173	0.2311479	0.3959275

In this test, the standard deviations of empirical rolling correlations are compared to those of two correlated white noise series replicated many times with the same magnitude of correlation as the empirical series. The rolling correlation standard deviations (RCSs) in Table 3 are inside the limits for the widths 3, 5, 7, and 10 for NSP and IFR, NSP and BMS. Thus, the signal between the NSP and IFR, the NSP, and the BMS are insignificant for wider window lengths; hence, the rolling correlations between series are superfluous. But for NSP and EXR, the RCSs are outside the limits for the widths 5 and 7. However, the RCSs for widths 3 and 10 are inside the limits. Thus, the signal between the NSP and the EXR is significant for wider window lengths. In Figure 2, the dashed red lines show the 95% confidence interval limits for the mean of the average rolling correlations over the time points, shown by the horizontal solid line.

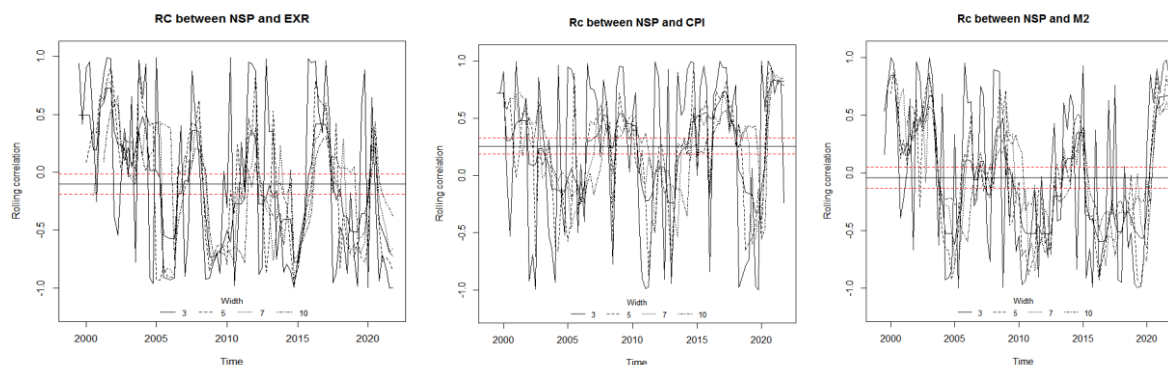


Fig. 2. Rolling Correlation between NSP and CPI, M2, and EXR

The bold, solid line shows the average rolling correlation over the widths. A line is plotted to show the rolling correlations for each width. In accordance with the test results, rolling correlations for widths of 3 differ more than those for widths of 5, 7, and 10. Low rolling correlations are recorded between 5 and 7 years of NSP, and the inflation observations between 2010 and 2015 and after 2020 are insignificantly different. Also, low rolling correlations are recorded between 3, 5, 7, and 10 years of NSP and the BMS observations between 2010 and 2015, after both 2015 and 2020, which are insignificantly different from the rolling correlations between two independent white noise series. High rolling correlations are recorded between 3, 5, and 7 years for NSP, and the EXR observations between 2000 and 2005, after 2015, significantly differ from the rolling correlations between two independent white noise series.

4.2 Research Model I

In this section, the outcomes of the Bounds Test (BT), the ARDL model estimates, ECM, and the recursive cumulative sum (RCUSUM), RCUSUM square (RCUSUMS), and recursive moving sum (RMOSUM) test charts for NSP and IFR estimated parameter stability are presented.

4.2.1 Bounds Test for NSP and IFR

The bound test result is to examine the existence of co-integration between NSP and IFR. The result of the bound test for the relationship between NSP and IFR, as displayed in Table 4, shows that the calculated F-statistic is 9.2612. This value surpasses the upper bound value of 5.73 at the 5% significance level (SL). This implies that NSP and IFR are co-integrated. Thus, it can be stated that there exists a long-term relationship between NSP and IFR since the F-statistic computed = 9.2612 is greater than the 5% F-statistic = 5.73.

Table 4. Bounds Test for NSP and IFR Relationship

F-Bounds Test		H ₀ : No levels relationship		
Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	9.2612	10%	4.04	4.78
K	1	5%	4.94	5.73
		1%	6.84	7.84

4.2.2 ARDL Model for NSP and IFR

The ARDL Model selection for NSP and IFR is ARDL (1, 5) since it has the smallest Bayesian information criterion (BIC) value. The result in Table 5a shows no significant impact of IFR on NSP. There is also no significant long-run effect of the current IFR and all the lags of IFR on NSP, but the first lag of NSP has a significant impact on NSP, signifying that the present NSP would quite disturb NSP in the next quarter of the year. The short-run ECM, having the predictable coefficient of the lag value of the residual (ECMt-1), is -0.68806, is negative and significant at a 5% significant level. This implies that the model converges to equilibrium which also confirms the existence of a stable long-run relationship and co-integration between the NSP and IFR. The coefficient also determines the speed of adjustment towards equilibrium, which means that the NSP will, after a shock in IFR, return to equilibrium in the long run with a speed of approximately 68.81% per quarter.

Table 5a. Estimated Long Run (ARDL) Model for NSP and Inflation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.05252	0.04564	-1.151	0.253
NSP(-1)	-0.68806	0.10409	-6.610	0.0000*
CPI(-1)	2.28716	1.44087	1.587	0.116
DRCPI	1.13411	0.69515	1.631	0.107
DRCPI(-1)	-0.30589	1.08570	-0.282	0.779
DRCPI(-2)	-0.25070	0.88920	-0.282	0.779
DRCPI(-3)	0.51079	0.73919	0.691	0.492
DRCPI(-4)	0.53373	0.63959	0.834	0.407
R-squared	0.3785			
F-statistic	6.874	Durbin-Watson stat		2.003881
Prob(F-statistic)	0.0000			

Table 5b. Short Run Error Correction Model for NSP and Inflation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.05252	0.01436	-3.656	0.0004
CointEq(-1)*	-0.68806	0.10342	-6.653	0.0000*
DRCPI	1.13411	0.59931	1.892	0.0621
DRCPI(-1)	-0.30589	0.66567	-0.460	0.6471
DRCPI(-2)	-0.25070	0.65538	-0.383	0.7031
DRCPI(-3)	0.51079	0.63715	0.802	0.4251
DRCPI(-4)	0.53373	0.58758	0.908	0.3664
R-squared	0.3785			
Durbin-Watson stat	2.003881			

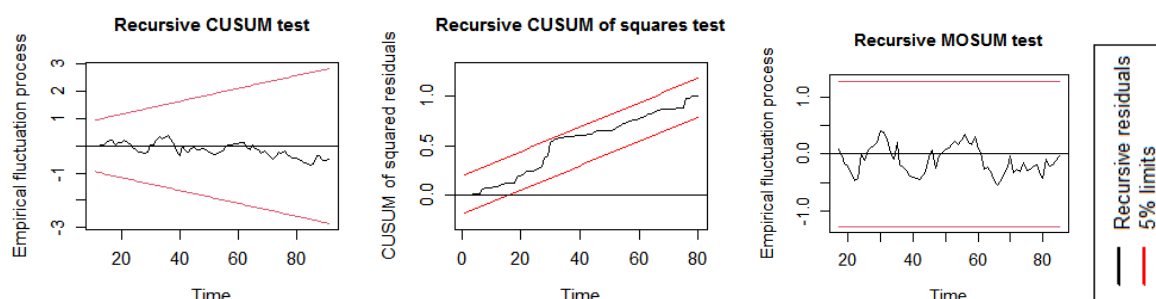


Fig. 3. RCUSUM, RCUSUMOS, and RMOSUM for NSP and IFR

The RCUSUM test reveals that the parameters of the NSP and IFR in the ARDL model are stable. It can be seen that the RCUSUM, RCUSUMOS, and RMOSUM lines did not go outside the area among the two acute lines at the 5% SL. These tests for the stability of estimated parameters designate that the parameters are stable during the quarterly sample retro (1999–2021). Also, the Durbin-Watson value in Table 5b indicates that the selected model has no serial autocorrelation.

4.3 Research Model II

This section presents the outcomes of the BT, the ARDL model estimates, the ECM, and the recursive cumulative sum (RCUSUM), RCUSUM square (RCUSUMS), and recursive moving sum (RMOSUM) test charts for NSP and BMS estimated parameter stability.

4.3.1 Bound Test for NSP and BMS

The result of the bound test for the relationship between NSP and BMS presented in Table 6 indicates that the calculated F-statistic is 9.1284. This value is greater than the upper bound acute value of 5.73 at 5% SL. This entails that NSP and BMS are co-integrated. Thus, it can be stated that there exists a long-term relationship between NSP and BMS since the F-statistic computed = 9.1284 is greater than the 5% F-statistic = 5.73.

Table 6. Bounds Test for NSP and BMS Relationship

F-Bounds Test		H ₀ : No levels relationship		
Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	9.1284	10%	4.04	4.78
K	1	5%	4.94	5.73
		1%	6.84	7.84

4.3.2 ARDL Model for NSP and BMS

The ARDL model selection for NSP and BMS is ARDL (1, 5) since it has the smallest BIC value. The outcome in Table 7a displays that there is a significant impact of the current BMS on the NSP, while the first lag of the NSP has a significant impact on the NSP, indicating that the present NSP will quiet disturb the NSP in the next quarter of the year. Also, the Durbin-Watson value in table 4.8a indicates that the selected model has no serial autocorrelation since the value can be approximated to two (2).

Table 7a. Estimated Long Run (ARDL) Model for NSP and BMS

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.00475	0.023693	-0.200	0.8416
RNSP(-1)	-0.62284	0.102579	-6.072	0.0000*
RM2(-1)	0.46559	0.407026	1.144	0.2561
DRM2	0.39536	0.196442	2.013	0.048*
DRM2(-1)	-0.16705	0.367079	-0.455	0.650
DRM2(-2)	-0.18063	0.321354	-0.562	0.576
DRM2(-3)	-0.06089	0.268436	-0.227	0.821
DRM2(-4)	-0.33169	0.19450	-1.705	0.092
R-squared	0.3803			
F-statistic	6.926	Durbin-Watson Stat.		1.880582
Prob(F-statistic)	0.0000			

Table 7b. Short Run Error Correction Model for NSP and BMS

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.00475	0.01220	-0.389	0.6981
CointEq(-1)*	-0.62284	0.10174	-6.122	0.0000*
DRM2	0.39537	0.18282	2.163	0.0336*
DRM2(-1)	-0.16705	0.24000	-0.696	0.4884
DRM2(-2)	-0.18063	0.24916	-0.725	0.4706
DRM2(-3)	-0.06089	0.23684	-0.257	0.7978
DRM2(-4)	-0.33169	0.18172	-1.825	0.0717
R-squared	0.3803			
Durbin-Watson	1.880582			

The ECM in Table 7b displays that the projected coefficient of the lag value of the residual (ECM_{t-1}) is -0.62284, which is negative and significant at 5% SL. This indicates that approximately 62.28% deviations from the long run balance in the preceding quarter adjust to by the current quarter. The short-run coefficients display that the short run, the coefficient of the current BMS is positive and has a significant impact on NSP at 5% SL (sig. = 0.0336). This implies that a unit increase in the current BMS would lead to a corresponding increase in NSP by 39.537%.

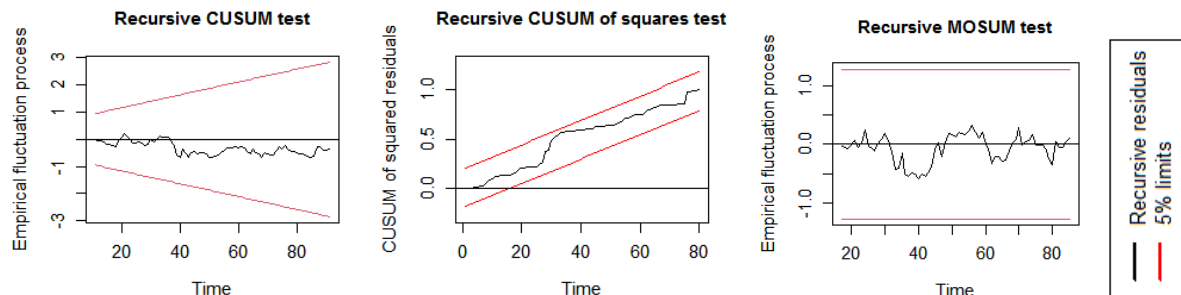


Fig. 4. RCUSUM, RCUSUMOS, and RMOSUM for NSP and BMS

The RCUSUM test indicates that the parameters of the NSP and BMS in the ARDL model are stable since the RCUSUM, RCUSUMOS, and RMOSUM lines did not go outside the area among the two acute lines at 5% SL. These RCUSUM, RCUSUMOS, and RMOSUM stability tests indicate that the parameters were stable during the quarterly sample retro (1999–2021).

4.4 Research Model III

This part of the research presents the outcomes of the BT, the ARDL model, and the ECM for NSP and EXR. Also, the estimated parameter stability test charts are presented.

4.4.1 Bound Test for NSP and EXR

Table 8 shows the bound test for the exchange rate equation. The calculated F-statistic is 8.7124. This value is greater than the upper bound acute value of 5.73 at the 5% significance level. This implies that NSP and EXR are co-integrated. Thus, it can be stated that there exists a long-term relationship between NSP and EXR since the F-statistic computed = 8.7124 is greater than the 5% F-statistic = 5.73.

Table 8. Bounds Test for NSP and Exchange Rate Relationship

F-Bounds Test		H ₀ : No levels relationship		
Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	8.7124	10%	4.04	4.78
K	1	5%	4.94	5.73
		1%	6.84	7.84

4.4.2 ARDL Model for NSP and EXR

The ARDL model selection for NSP and EXR is ARDL (1, 5) having the least BIC values was selected as the best. However, the CUSUM test of parameter stability for this model in Figure 7 shows that the model parameters are stable, as clearly seen from the RCUSUM, RCUSUMOS, and RMOSUM lines, which did not go outside the area among the two lines limit at 5% confidence limits. Also, the Durbin-Watson value in Table 9a indicates that the selected model has no serial autocorrelation. The parameter of EXR did not show any evidence of significance, but the first lag of NSP had a significant impact on NSP, signifying that the present NSP would quite disturb NSP in the next quarter of the year.

Table 9a. Estimated Long Run (ARDL) Model for NSP and Exchange rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.01093	0.01576	0.694	0.4899
RNSP(-1)	-0.67092	0.10600	-6.329	0.0000*
REXR(-1)	0.49468	0.51169	0.967	0.3366
DREXR	-0.38587	0.25347	-1.522	0.1319
DREXR(-1)	-0.52359	0.42236	-1.240	0.2188
DREXR(-2)	-0.56962	0.36671	-1.553	0.1243
DREXR(-3)	-0.58727	0.30392	-1.932	0.0569
DREXR(-4)	-0.21945	0.25540	-0.859	0.3928
R-squared	0.3779			
F-statistic	6.857	Durbin-Watson stat		1.975131
Prob(F-statistic)	0.0000			

Table 9b. Short Run Error Correction Model for NSP and EXR

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	0.01093	0.01234	0.886	0.3784
CointEq(-1)*	-0.67092	0.10348	-6.484	0.0000*
DREXR	-0.38587	0.22980	-1.679	0.0970
DREXR(-1)	-0.52359	0.27359	-1.914	0.0592
DREXR(-2)	-0.56962	0.27350	-2.083	0.0405*
DREXR(-3)	-0.58727	0.25636	-2.291	0.0246*
DREXR(-4)	-0.21945	0.23971	-0.915	0.3627
R-squared	0.3779			
Durbin-Watson stat	1.880582			

The ECM indicates that the projected coefficient of the lag value of the residual (ECMt-1) is -0.67092, which is negative and significant at 5% SL. This indicates that approximately 67.09% of the divergence from the long-run balance in the preceding quarter adjust to by the present quarter. The short-run coefficients for the second and third lags of EXR reveal that EXR has a significant negative impact on NSP. This indicates a unit increase in the two-period lag of EXR would lead to a corresponding fall in NSP by 56.962%, while a unit increase in the period lag of EXR would tip to a corresponding fall in NSP by 58.727%.

Figure 5 presents the RCUSUM test, RCUSUMOS test, and RMOSUM test plots for the stability of the parameter estimates of the NSP relationship with EXR. All the test plots indicate that the parameters of the NSP and EXR in the ARDL model are stable since the RCUSUM, RCUSUMOS, and RMOSUM lines did not go outside the area among the two acute lines at 5% SL. These RCUSUM, RCUSUMOS, and RMOSUM stability tests indicate that the parameters were stable during the quarterly sample retro (1999–2021).

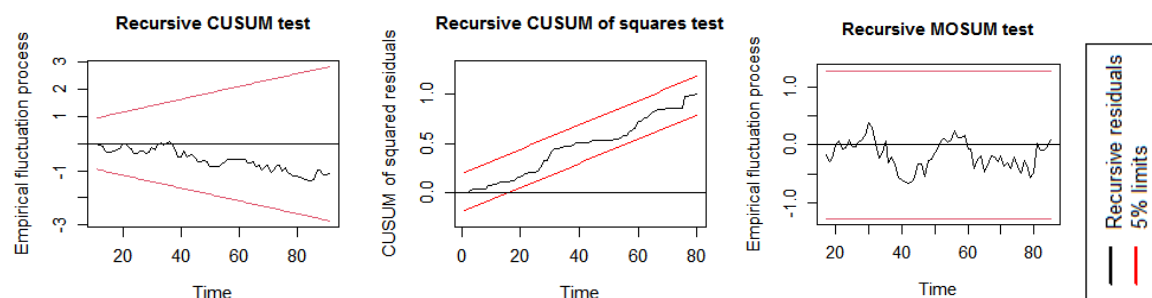


Fig. 5. RCUSUM, RCUSUMOS, and RMOSUM for NSP and EXR

4.5 Research Model IV

This part of the research presents the outcomes of the Bounds Test, the ARDL model, and the ECM for NSP, IFR, BMS, and EXR. The estimated parameter stability tests and recursive charts are presented.

4.5.1 Bound Test for NSP, IFR, BMS, and EXR

The outcome of the bound test for the relationship between NSP, IFR, BMS, and EXR, as shown in Table 10, indicates that the calculated F-statistic is 7.6801. This value tops the upper bounds acute value of 4.35 at the 5% SL. This implies that NSP, IFR, BMS, and EXR are co-integrated. Thus, we conclude that a long-term relationship exists between NSP, IFR, BMS, and EXR.

Table 10. Bounds Test for NSP, IFR, BMS and Exchange rate

F-Bounds Test		H ₀ : No levels relationship		
Test Statistic	Value	Sig.	I(0)	I(1)
F-statistic	7.6801	10%	2.72	3.77
K	3	5%	3.23	4.35
		1%	4.29	5.61

4.5.2 ARDL Model for NSP, IFR, BMS, and EXR

The ARDL Model selection of all the variables, that is, IFR, BMS, and EXR on NSP, is ARDL (1, 0, 0, 0), since it has the smallest BIC value. The result in Table 11a indicates that there is a significant effect on both the first lag of NSP and the first lag of IFR on NSP and also that the current BMS has a significant effect on NSP. Therefore, the selected model indicates that the present NSP would upset the NSP in the subsequent first quarter of the year, and the present IFR and M2 would upset the NSP in the next first quarter. The Durbin-Watson value shows that the selected model has no serial autocorrelation.

Table 11a. Estimated Long Run (ARDL) model for NSP, IFR, BMS and EXR

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.04187	0.03412	-1.227	0.2234
RNSP(-1)	-0.73004	0.13971	-5.225	0.0000*
REXR(-1)	-0.18643	0.39160	-0.476	0.6354
RCPI(-1)	1.86399	0.91054	2.047	0.0440*
RM2(-1)	0.21568	0.34144	0.632	0.5294
DREXR	-0.45570	0.25890	-1.760	0.0823
DREXR(-1)	0.05690	0.25433	0.224	0.8235
DRCPI	0.97910	0.66316	1.476	0.1439
DRCPI(-1)	0.00889	0.67333	0.013	0.9895
DRM2	0.38962	0.19382	2.010	0.0479*
DRM2(-1)	0.15168	0.18915	0.802	0.4250
DRNSP(-1)	0.04308	0.11600	0.371	0.7114
R-squared	0.4127			
F-statistic	4.982	Durbin-Watson stat		1.975131
Prob(F-statistic)	0.0000			

Table 11b. Short Run Error Correction Model for NSP, IFR, BMS and EXR

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
C	-0.04187	0.01391	-3.010	0.0035
CointEq(-1)*	-0.73004	0.12925	-5.684	0.0000*
DREXR	-0.45570	0.20153	-2.261	0.0264*
DREXR(-1)	0.05690	0.20160	0.282	0.7785
DRCPI	0.97910	0.51895	1.887	0.0628
DRCPI(-1)	0.00889	0.56942	0.016	0.9876
DRM2	0.38962	0.15717	2.479	0.0153*
DRM2(-1)	0.15168	0.15224	0.996	0.3221
DRNSP(-1)	0.04308	0.10707	0.402	0.6885
R-squared	0.4127			
Durbin-Watson stat	1.880582			

The bounds test in Table 10 reveals the presence of co-integration and a long-term bond between NSP versus IFR, BMS, and EXR. The short-run coefficients display that in the short run, the coefficient of the current EXR is negative and has a significant effect on the NSP at a 5% significant level, while the coefficient of the current BMS is positive and significantly impacts the NSP at a 5% SL. This indicates that a unit increase in the current EXR would lead to a corresponding failure in NSP of 45.570%, but a unit increase in the current BMS would lead to a corresponding increase in NSP of 38.962%. The coefficient of the current IFR and the first lag of IFR are positive and do not have a significant effect on NSP at 5% SL (sig. = 0.0628, sig. = 0.9876, respectively). This implies that a variation in the current IFR will lead to an insignificant 97.910% corresponding change in NSP, and a variation in the first lag of the IFR will lead to an insignificant 0.889% corresponding change in NSP. The ECM indicates that the projected coefficient of the lag value of the residual (ECMt-1) is -0.73004, which is negative and significant at a 5% significant level.

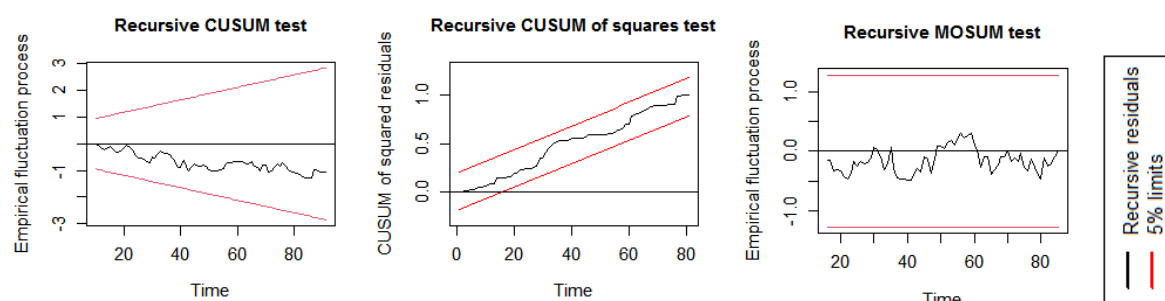


Fig. 8. RCUSUM, RCUSUMOS, and RMOSUM for All Variables

Figure 8 presents the RCUSUM tests charts, and the RCUSUM tests indicate that the parameters of NSP, IFR, BMS, and EXR in the ARDL model were stable since the RCUSUM, RCUSUMOS, and RMOSUM lines do not fall outside the two critical lines at 5% SL. The stability test conducted using the RCUSUM, RCUSUMOS, and RMOSUM indicates that the parameters are stable during the quarterly sampled period (1999–2021).

4.6 Discussion of Results

In this research, an ARDL model, RCUSUM, RCUSUMOS, and RMOSUM parameter stability tests were fitted and plotted, respectively, for NSP versus IFR, NSP versus BMS, NSP versus EXR, and a combined model of NSP versus IFR, BMS, and EXR. The results obtained from the analysis performed for the research data that spanned from 1999 Q1 to 2021 Q4 showed that for NSP versus IFR, an ARDL (1, 5) model was selected as the best-fitted model using the BIC as the selection method. This implies IFR has no significant effect on NSP. Also, the first lag of the NSP had a significant effect on the NSP, signifying that the current NSP would upset the NSP in the next quarter. The RCUSUM, RCUSUMOS, and RMOSUM parameter stability plots for the fitted model showed that the parameter estimates were stable during the quarterly sample retro of 1999 to 2021. Also, an ARDL (1, 5) model was selected by the BIC as the best model for NSP versus BMS, and the RCUSUM, RCUSUMOS, and RMOSUM Square parameter stability test plots exhibited that the estimates for the selected model were stable during the period of study. The selected model showed that there is a significant effect of the current BMS on the NSP, while the first lag of the NSP has a significant effect on the NSP, implying that the present NSP would quite disturb the NSP in the next quarter of the year. In inspecting the RCUSUM, RCUSUMOS, and RMOSUM parameter stability plots, they showed their stability lines are within the upper and lower line bounds at 5%.

The selected ARDL model indicates that the current EXR does not have a significant effect on NSP at the 5% SL, but NSP at the first lag has a significant effect on NSP, which signifies that the current NSP will have an effect on NSP in the next quarter. It was observed for the combined model that an ARDL (1, 0, 0, 0) model was selected

as the best model by the BIC. The plotted RCUSUM, RCUSUMOS, and RMOSUM plots showed that the model parameter estimates are stable during the period of 1999 Q1 to 2021 Q4 at 5%. Still, EXR is not significant, which implies that it has no effect on NSP, but the first lag of IFR and the current BMS are significant at 5%. Likewise, NSP lags significantly at 5% at first. The implication is that the current NSP will upset the NSP in the subsequent first quarter, and the present IFR will also upset the NSP in the next first quarter of the year.

Based on the ARDL-selected models, a bounds test was performed to help show the existence of cointegration in the four selected ARDL models. The bounds test showed that NSP and IFR are cointegrated, NSP and BMS are cointegrated, NSP and EXR are cointegrated, and NSP, IFR, BMS, and EXR are cointegrated. The result implies that a long-term bond exists among NSP versus IFR, NSP versus BMS, NSP versus EXR, and NSP versus IFR, BMS, and EXR. However, a short-run relationship was not observed for any of the models. ECM was fitted to the data to capture the speed of adjustment of equilibrium and the explanatory variables considered (that is, IFR, BMS, and EXR). It was found from the error correction model (ECMt-1) fitted for NSP versus IFR that 68.81% of the deviation from the long-run steadiness in the preceding quarter is adjusted to the present quarter. However, for NSP versus BMS, the projected coefficient of the lag value of the residual (ECMt-1) was significantly negative (-0.62284), and it implied that approximately 62.28% of the deviation from the long-run equilibrium in the preceding quarter is adjusted to by the present quarter.

The short-run coefficients also display that in the short run, the coefficient of the current BMS is positive and has a significant impact on NSP at a 5% significant level. This implies that a unit increase in the current BMS would lead to a corresponding increase in NSP by 39.537%. A long-run relationship was observed for NSP versus EXR, and the projected coefficient of the lag value of the residual (ECMt-1) was negative and significant with approximately 67.09% of the divergence from the long-run balance in the preceding quarter is adjusted to by the present quarter. Also, the short-run coefficients for the second and third lags of the exchange rate reveal that the exchange rate has a significant negative impact on NSP. This indicates a unit increase in the two-period lag of EXR would lead to a corresponding fall in NSP by 56.962%, while a unit increase in the period lag of EXR would tip to a corresponding fall in NSP by 58.727%. For the combined fitted model, that is, NSP versus IFR, BMS, and EXR, a long-run relationship existed. The short-run coefficient of the current EXR is negative and has a significant effect on NSP. In contrast, the coefficient of the current BMS is positive and significantly impacted on the NSP. This indicates that a unit increase in the current EXR would lead to a corresponding fall in NSP by 45.570%, but a unit increase in the current BMS would lead to a corresponding increase in NSP by 38.962%. The coefficient of the current IFR and the first lag of IFR is positive and does not significantly affect NSP. This implies that a variation in the current IFR will lead to an insignificant 97.910% corresponding change in NSP, and a variation in the first lag of IFR will lead to an insignificant 0.889% corresponding change in NSP. The ECM indicates that the projected coefficient of the lag value of the residual (ECMt-1) is -0.73004, which is negative and significant at a 5% significant level.

5 Conclusion

In this research, the empirical validity of the Nigerian stock price has been tested to determine whether some of the macroeconomic variables affect the stock price. The inflation rate, broad money supply, and exchange rate have been chosen as independent variables, and the NSP has been chosen as a dependent variable among the four models. The model tested under the ARDL approach was used from 1999 Q1 to 2021 Q4. In the relationship between NSP and IFR, IFR is not influential in determining NSP. Also, the relationship between NSP and EXR reveals evidence of no significant influence in determining NSP in the long run. In contrast, it reveals evidence of significant influence in determining NSP in the short run. However, the relationship between NSP and BMS reveals evidence of significant influence in determining NSP. A combination of the IFR, BMS, and EXR on NSP reveals that the IFR at lag one and the current BMS had a significant positive effect on NSP in the long run. In contrast, in the short run, the current exchange rate has a negative influence on the stock price, and the current broad money supply has a positive influence of 0.38962 on the stock price, all at the 5% SL. Thus, in making monetary policy choices, the NSP should include both the existing and previous rates of IFR, BMS, EXR, and other relevant economic factors. Since the bound test shows evidence of cointegration between NSP and the three macroeconomic variables (IFR, BMS, and EXR), the model with all these variables is selected. The ARDL long run model and the ECM for long run and short run crescendos between the Nigerian stock prices.

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