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RESEARCH ARTICLE

# ANALYSIS OF THE RELATIONSHIP BETWEEN EXCHANGE RATE AND STOCK PRICES: EVIDENCE FROM NIGERIA

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ABSTRACT

This study examines the causal relationship between exchange rate and stock prices in Nigeria using quarterly data for the period of 1990-$Q_1$ to 2009-$Q_4$. The ADF and PP tests suggest that the series are random walk processes in their level form. Pair-wise Granger Causality was tested within multivariate co-integration and vector error correction model (VECM) framework. Three different stock exchange indicators were used as proxy for stock prices to test the direction of causality between the variables. Thus we have three VAR models. The empirical findings suggest evidence of long run equilibrium relationship between exchange rate and stock prices. It further shows that there is strong unidirectional causality running from stock prices to exchange rate irrespective of the stock market indicator used. The result supports the Stock Oriented Model (SOM). The estimated co-integrated vector showed that exchange rate exerts negative impact on Nigerian stock prices. Evidence from vector error correction term revealed that the speed of adjustment is high when SMC was used as proxy for stock prices, followed by ASI and VST. The Impulse Response Function (IRF) shows that shocks in foreign exchange market and macroeconomic environment tend to worsen the Nigerian stock market. The ASI accounted for 84.7% while EXR explained about 12.3% of forecast error variance in the stock market. This suggests that information in the stock market seems to be the driving force behind stock market variance.



## INTRODUCTION

The relationship between foreign exchange rate and stock prices has attracted much attention of researchers and academics since the beginning of 1990s. The last quarter of last century has witnessed significant changes in the international financial system such as emergence of new capital markets, gradual abolishment of capital inflows barriers and foreign exchange restrictions, or adoption of more flexible exchange rate arrangements in emerging and developing countries. All mentioned features have broadened the variety of investment opportunities but, on the other hand, they have also increased volatility of exchange rates and added a substantial portion of risk to the overall investment decision and portfolio diversification process. Studying of interaction between foreign exchange and stock markets has become thereby more complex and has received more research interest than before. Despite the existence of literature on the link between exchange rate and stock prices, there is no consensus on the direction of causality (Tabak, (2006); Granger et al, (2000)). There exist two main diverging viewpoints namely: the Flow Oriented Model (FOM) by Dounbusch and Fisher (1980) which posits that changes in exchange rates causes change in stock prices with a negative correlation and the Stock Oriented Model (SOM) by Branson and Frankel (1983) which opines that changes in stock prices affect exchange rates with a positive correlation. Also, there exist mixed viewpoints in literature (see Aggarwal, 1981; Soenan and Hennigar, 1988). Since there is no general consensus on any definite pattern of causal relationship between stock prices and exchanges rates, further investigation on the causal relationship between exchange rate and stock prices in Nigeria becomes imperative.

The recent global financial crisis, which was precipitated by the United States Mortgage crises, liberalization of global financial regulations and boom and burst in the housing market and its effect on other weaker countries like Nigeria necessitates the need for an empirical study of this nature. Evidence in Nigeria shows that between 2008 and 2009 the stock market collapsed by 70% point (Sanusi, 2004). This coincides with the period of global financial crisis which began in middle 2007 in United States and spread into Nigeria in 2008. Nigerian Stock Exchange Market All-Share Index (NSE-ASI) witnessed huge swings in recent years. The 1990s and early 2000 were an extraordinary decades for stock market index. The NSE-ASI increased more than 900 percent point from 513.8 in 1990 to 5261.4 in 1999. By late 2000, NSE-ASI had reached all high of 57,990.2 as it frog-leaped from 8,110.0 in 2000 to 57,990.2 in 2007. Unfortunately, the good time did

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not last as ASI nosedived sharply from 57,990.2 in 2007 to 31,450.78 in 2008 (CBN, 2008). The market indicators further recorded downward movements in 2009. Turnover on the exchange closed the year 2009 at N685.72 billion or 2.9% of GDP down by 71.2% from the N2.4 trillion representing 10.4% of GDP recorded in 2008. Average daily activity dropped from 775.65 million shares worth N9.95 billion in 2008 to 414.73 million shares valued at N2.8 billion in 2009. The Nigerian Stock Exchange All-Share Index (NSE-ASI) dropped by 33.8% or 10623.61 points to close at 20827.17 in 2009. The NSE-ASI had in 2008 dropped by 45% or 26539.44 points to close at 31450.7 (Okereke-Onyiuke, 2009). The performance of the index reflects a significant reduction in stock prices during this period.

The naira exchange rate witnessed a continuous slide in the foreign exchange markets. In the official market, the exchange rate depreciated from N8.04 per US dollar in 1990 to N81.02 per dollar in 1995 and further to N129.22, N133.50 in 2003 and 2004 respectively and thereafter appreciated slightly from N133.50 in 2004 to N132.15 in 2005 and to all high of N118.57 in 2008. It further depreciated from N118.57 in 2008 to N148.91 in 2009. It is also interesting to observe from the above that between the period 1990 to 2004, the stock market indicator (ASI) moved in opposite direction with exchange rate. That is ASI increased as exchange rate depreciated. This period seemed to support the FOM. But between 2004 and 2008, they moved in the same direction tending to support the SOM. They continued between 2008 and 2009 to move in the same direction but this time on a downward movement towards favouring the SOM. This however, shows no strong definite pattern and also does not show the lead variable. With the above trend one may ask; what is the relationship between these varibles? And which variable is the lead variable? Although a growing body of works which reflects the relationship between the variables exists in developed countries and in Asian countries – motivated by the Asian financial crisis of 1990s, only few attempts have been made in developing countries like Nigeria. Existence studies like Aliyu (2009) employed Granger Causality test. Similarly, he used NSE- ASI as a proxy for stock prices as this may not represent the stock price in Nigeria.

This study departs fundamentally from existing studies like Aliyu (2009); Maku and Atanda (2009); and Yaya and Shittu (2010) all for Nigeria in four main respects. First, two relevant variables (inflation rate and interest rate) have been included to illuminate the co-integration and causality inferences. According to Laua et al (2002) cited in Chukwu (2009), "it is well known that the causality and co-integration inferences are strongly influenced by omission of relevant causing variables''. Secondly, direction of causality between exchange rates and stock prices shall be tested in a multivariate framework using the VECM. Thirdly, we shall use alternative stock market indexes namely All Share Index (ASI), Stock Market Capitalization (SMC) and Value of Shares Traded (VST) to proxy for stock prices. Fourthly, Impulse Response Function (IRF) and Forecast Error Variance Decomposition (FEVD) shall be used to trace the effect of shock to the innovations of current and future values and testing the transmission of periodic shocks respectively. Against this backdrop, it becomes relevant to investigate if there exists any relationship between exchange rate and stock prices in Nigerian economy using quatarly data in testing for causality in a multivariate framework. The remaining parts of this paper are as follows: sections 2 reviews related literature, sections 3 discusses data features and methodology, section 4 analyzes the empirical results and discussions and section 5 is the summary and policy recommendations.

## Literature Review

There is theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. Considering flow oriented models (FOM) and stock oriented models (SOM) as two basic approaches to the exchange rate determination, a cardinal disagreement can be found. Flow Oriented Models assume that the exchange rate is determined largely by a country's current account or trade balance performance. These models posit that changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output (Dornbusch and Fisher, 1980). Stock prices, usually defined as a present value of future cash flows of firms, should adjust to the economic perspectives. Thus, flow oriented models represent a negative relationship between stock prices and exchanges rates with direction of causation running from exchange rates to stock prices. Causation can be explained as follows: domestic currency depreciation makes the local firms more competitive, making their exports cheaper in international market. Higher exports lead to higher incomes and increase in firms' stock prices. On the other hand, stock oriented models put much stress on the role of capital account in the exchange rates determination. A rise in domestic stock prices leads to the appreciation of domestic currency through direct and indirect channel. A rise in stock prices encourages investors to buy more domestic assets selling simultaneously foreign assets to obtain domestic currency indispensable for buying new domestic stocks. Described shifts in demand and supply of currencies cause domestic currency appreciation. The indirect channel grounds in the following causality chain. An increase in domestic assets prices results in growth of wealth, which leads investors to increase their demand for money, which in turn raises domestic interest rates. Higher interest rates attract foreign capital inflow and initiate an increase in foreign demand for domestic currency and its subsequent appreciation (Branson, 1983; Frankel, 1983). Thus, this postulate a positive relationship with causality running from stock prices to exchange rate.

## Definition of Model Variables and methodology

The All share Index (ASI), Stock Market Capitalization (SMC) And Values of Shares Traded (VST) as the indicators of the Nigeria Stock Exchange Market performance were used as proxy for Stock Prices (SMP). While, the nominal exchange rate of the Nigerian naira vis-à-vis the US dollar was proxied for exchange rate (EXR). Choice of nominal exchange rate as a proxy is predicated on the fact that inflation rate is serving as a control variable in the model. Real interest rate (RIR) and inflation rate (INF) were included to avoid problem of omitted variable bias in the VAR model. An increase in interest rate will increase the opportunity cost of holding money and investors will substitute holding interest bearing securities for share hence falling stock prices (Adam and Tweneboah 2008;

Craigwell et al, 2009). High rate of inflation increases the cost of living and a shift of resources from investments to consumption. This leads to a fall in demand for market instruments and subsequently leads to a reduction in the volume of stock traded.

The Vector Autoregressive (VAR) model was employed. The model in its general form is:

$$y_{1T} = \alpha_i + \beta_i \sum_{J=1}^{K} y_{t-1} + \partial_i \sum_{J=1}^{K} X_{1T-1} \; V_J \ldots \qquad (1)$$

where

$y_{1T}$ = 4 x 1 vector of endogenous variables (ie. $y_{1t}$ = $SMP_t$, $INF_t$, $EXR_t$, and $RIR_t$)

$\alpha_i$ = 4 x 1 vector of constant terms

$\beta_i$ = 4x4 coefficient matrix of the autoregressive t erms

$\partial_i$ = 4x4 coefficients matrix of the explanatory variables (vector of coefficients)

$V_i$ = vector of innovations.

Equation (1) can be re-written thus:

$$SMP_T = \alpha_0 + \alpha_1^1 \sum_{J=1}^{K} SMP_{T-1} + \alpha_2^1 \sum_{J=1}^{K} EXR_{T-1} + \alpha_3^1 \sum_{J=1}^{K} INF_{T-1} + \alpha_4^1 \sum_{J=1}^{K} RIR_{T-1} + \varepsilon_{1T} \ldots \qquad (2)$$

$$EXR_T = \beta_0 + \alpha_1^1 \sum_{J=1}^{K} EXR_{T-1} + \alpha_2^1 \sum_{J=1}^{K} SMP_{T-1} + \alpha_3^1 \sum_{J=1}^{K} INF_{T-1} + \alpha_4^1 \sum_{J=1}^{K} RIR_{T-1} + \varepsilon_{2T} \ldots \qquad (3)$$

$$INF_T = \gamma_0 + \alpha_1^1 \sum_{J=1}^{K} INF_{T-1} + \alpha_2^1 \sum_{J=1}^{K} SMP_{T-1} + \alpha_3^1 \sum_{J=1}^{K} EXR_{T-1} + \alpha_4^1 \sum_{J=1}^{K} RIR_{T-1} + \varepsilon_{3T} \ldots \qquad (4)$$

$$RIR_T = \phi_0 + \alpha_1^1 \sum_{J=1}^{K} RIR_{T-1} + \propto_2^1 \sum_{J=1}^{K} EXR_{T-1} + \propto_3^1 \sum_{J=1}^{K} SMP_{T-1} + \propto_4^1 \sum_{J=1}^{K} INF_{T-1} + \varepsilon_{4T} \ldots \qquad (5)$$

where j is the lag length, K is the maximum distributed lag length $\alpha_0$, $\beta_0$, $\gamma_0$, $\phi_0$, are the constant terms $\varepsilon_T$ is independent and identically distributed error term.
In matrix form, the above can be compactly specified as in equation (6)

$$\begin{bmatrix} SMP_T \\ EXR_T \\ INF_T \\ RIR_T \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \beta_0 \\ \gamma_0 \\ \phi_0 \end{bmatrix} + \sum_{J=1}^{K} \begin{bmatrix} SMP_{T-1} & EXR_{T-1} & INF_{T-1} & RIR_{T-1} \\ EXR_{T-1} & SMP_{T-1} & INF_{T-1} & RIR_{T-1} \\ INF_{T-1} & SMP_{T-1} & EXR_{T-1} & RIR_{T-1} \\ RIR_{T-1} & EXR_{T-1} & SMP_{T-1} & INF_{T-1} \end{bmatrix} \begin{bmatrix} \alpha_1 \\ \alpha_2 \\ \alpha_3 \\ \alpha_4 \end{bmatrix} + \begin{bmatrix} \varepsilon_{1T} \\ \varepsilon_{2T} \\ \varepsilon_{3T} \\ \varepsilon_{4T} \end{bmatrix} \ldots \qquad (6)$$

Transforming the VAR equations into VECM specifications correspond to:

$$\Delta SMP_T = \alpha_0 + \alpha_1^1 \sum_{j=1}^{k} \Delta SMP_{T-1} + \alpha_2^1 \sum_{j=1}^{k} \Delta EXR_{T-1} + \alpha_3^1 \sum_{j=1}^{k} \Delta INF_{T-1} + \alpha_4^1 \sum_{j=1}^{k} \Delta RIR_{T-1} + \delta_5 ECM_{T-1} + \varepsilon_{1T} \ldots \qquad (7)$$

$$\Delta EXR_T = \beta_0 + \alpha_1^1 \sum_{j=1}^{k} \Delta SMP_{T-1} + \alpha_2^1 \sum_{j=1}^{k} \Delta EXR_{T-1} + \alpha_3^1 \sum_{j=1}^{k} \Delta INF_{T-1} + \alpha_4^1 \sum_{j=1}^{k} RIR_{T-1} + \Pi ECM_{T-1} + \varepsilon_{2T} \ldots \qquad (8)$$

$$\Delta INF_T = \gamma_0 + \alpha_1^1 \sum_{j=1}^{k} \Delta INF_{T-1} + \alpha_2^1 \sum_{j=1}^{k} \Delta SMP_{T-1} + \alpha_3^1 \sum_{j=1}^{k} \Delta EXR_{T-1} + \alpha_4^1 \sum_{j=1}^{k} \Delta RIR_{T-1} + \lambda ECM_{T-1} + \varepsilon_{3T} \ldots \qquad (9)$$

$$\Delta RIR_T = \phi_0 + \alpha_1^1 \sum_{j=1}^{k} \Delta RIR_{T-1} + \alpha_2^1 \sum_{j=1}^{k} \Delta INF_{T-1} + \alpha_3^1 \sum_{j=1}^{k} \Delta SMP_{T-1} + \alpha_4^1 \sum_{j=1}^{k} \Delta EXR_{T-1} + \psi ECM_{T-1} + \varepsilon_{4T} \ldots \qquad (10)$$

where $\alpha^s$ are parameters to be estimated, $\Delta$ is the difference operator, $\varepsilon_T$, k are as defined above. The parameter estimates of $\delta$, $\Pi$, $\lambda$ and $\psi$ should be negative (<0). Equation 7, 8, 9 and 10 can be summarized thus;

$$y_{1T} = \alpha_i + \beta_i \sum_{J=1}^{K} y\gamma_{t-1} + \partial_i \sum_{J=1}^{K} X_{1T-1} \; \phi.ECM_{T-1} + \varepsilon_Y \ldots \qquad (11)$$

The choice of a VAR model to be transformed into a vector error correction mechanism (VECM) is made because it is one of the models that is not vulnerable to simultaneity bias. It offers an easy solution in explaining, predicting and forecasting the values of a set of economic variables at any point in time. It has the ability to test for weak exogeneity and parameter restrictions. It also assumes there is no priory direction of causality among variables. A good attribute of the VAR model is that it obviates a decision as to what contemporaneous variables are exogenous with only lagged variables on the right-hand, and all variables are endogenous.

Because the order of integration of a time series is of great importance for time series analysis, we used the Augmented – Dickey Fuller (ADF) and Phillip- Perron unit root tests to examine the time series properties of model variables. The Johanson (1988) co-integration procedure was employed to determine the number of co-integrating vectors. This approach was chosen because it does not suffer normalization problem and it is robust to departure from normality (Gujarati, 2003). This would enable us to know whether a long-run relationship exists between exchange rate and stock prices. Pairwise causality test in the VECM framework was used to test for the direction of causality between the variables. Also the optimum lag length of the VECM was determined using the multivariate versions of information criteria of Akaike's Information Criteria (AIC) and Schwarz's Bayesian Information Criteria (SBIC).The Impulse Response Function (IRF) which allow us to study the dynamic behavior of each variables of the system by determining whether an exogenous shock causes short run or long run changes in the variables chosen and other variables in the VECM was used. Finally, the Forecast Error Variance Decomposition (FEVD) which gives information about the relative importance of each shock to the variable in the VAR model was estimated.

# RESULTS AND DISCUSSION

## Unit Roots Test Result

In this study, the Augmented Dickey Fuller (ADF) and Phillip Perron (PP) unit roots tests were employed to test for the time series properties of model variables. The null hypothesis is that the variable under investigation has a unit root against the alternative that it does not. The choice of lag length was based on Akaike and Schwartz-Bayesian information criteria. Thus, the optimum lag length for ADF and PP were 2 and 3 respectively. The decision rule is to reject the null hypothesis if the ADF and PP statistic value exceeds the critical value at a chosen level of significance (in absolute term). These results are presented in table I below.

**Table 1: Unit Roots Test Result**

| Variable | ADF statistics | | | PP statistics | | |
|---|---|---|---|---|---|---|
| | Level | 1st different | Critical values | Level | 1st different | Critical |
| EXR | -1.25 | -6.42 | 1% -3.52 | -1.11 | -10.2.5 | 1% -3.52 |
| | | | 5% -2.89 | | | 5% -2.89 |
| | | | 10% -2.59 | | | 10% -2.59 |
| ASI | -1.33 | -6.36 | 1% -3.52 | -1.77 | -14.15 | 1% -3.52 |
| | | | 5% -2.89 | | | 5% -2.89 |
| | | | 10% -2.59 | | | 10% -2.59 |
| SMC | -1.77 | -6.51 | 1% -3.52 | -1.53 | -13.54 | 1% -3.52 |
| | | | 5% -2.89 | | | 5% -2.89 |
| | | | 10% -2.58 | | | 10% -2.58 |
| VST | -1.40 | -6.69 | 1% -3.5176 | -1.88 | -13.59 | 1% -3.51 |
| | | | 5% -2.899 | | | 5% -2.89 |
| | | | 10% -2.59 | | | 10% -2.58 |
| INT | -0.01 | -5.87 | 1% -3.51 | -3.49 | -16.69 | 1% -3.51 |
| | | | 5% -2.89 | | | 5% -2.89 |
| | | | 10% -2.59 | | | 10% -2.59 |
| INF | -1.28 | -6.57 | 1% -3.52 | -1.99 | -14.15 | 1% -3.52 |
| | | | 5% -2.89 | | | 5% -2.89 |
| | | | 10% -2.59 | | | 10% -2.59 |

The results of table 1 show that all the variables are non-stationary in level form since their ADF and PP values are less than the critical values at 1%, 5% and 10%, the null hypothesis of no unit root was accepted for all the variables

**Table 2: Co-integrating Test Result between ASI and EXR**

| Eigen value | Likelihood Ratio | 5% critical value | 1% critical value | Hypothesized No of CE(s) |
|---|---|---|---|---|
| 0.415158 | 57.6063 | 47.21 | 54.46 | None** |
| 0.151561 | 16.83517 | 29.68 | 35,65 | At most 1 |
| 0.054479 | 4.344017 | 15.41 | 20.04 | At most 2 |
| 0.001138 | 0.0086574 | 3.76 | 6.65 | At most 3 |

***(**) denotes rejection of the hypothesis at 5% (1%) significance level. L.R. test indicates 1 co-integrating equation(s) at 5% level of significance**

**Table 3: Co-integrating Test Result between SMC and EXR**

| Eigen value | Likelihood ratio | 5% critical value | 1% critical value | Hypothesized No of (E(s) |
|---|---|---|---|---|
| 0.402940 | 56.09390 | 47.21 | 54.46 | None** |
| 0.152230 | 16.89780 | 29.68 | 35,65 | At most 1 |
| 0.054462 | 4.346730 | 15.41 | 20.04 | At most 2 |
| 0.001192 | 0.090663 | 3.76 | 6.65 | At most 3 |

*(**) denotes rejects of the hypothesis at 5% (1%) significance level. L.R test indicates 1 co-integrating equation(s) at 5% significance level.

**Table 4: Co-integrating Test Result between VST and EXR**

| Eigen value | Likely hood ratio | 5% critical value | 1% critical value | Hypothesized No of (E(s) |
|---|---|---|---|---|
| 0.424665 | 59.17089 | 47.21 | 54.46 | None** |
| 0.157792 | 17.15786 | 29.68 | 35,65 | At most 1 |
| 0.061658 | 4.106489 | 15.41 | 20.04 | At most 2 |
| 0.000992 | 0.075416 | 3.76 | 6.65 | At most 3 |

*(**) denotes rejection of the hypothesis at 5% (1%) significance level L.R indicates 1 co-integrating equation(s) at 5% significance level.

**Table 5a: Variables included in the VECM: ASI and EXR, INF, INT**

| Variable | α's | ECM |
|---|---|---|
| ASI | 1.0000 | -0.435615 |
| | | (-1.82611) |
| EXR | -149.3955 | -0.001285 |
| | (8.60132) | (-2.21130) |
| INT | 3649.175 | -0.000388 |
| | (10.0404) | (-4.69758) |
| INF | -11.40409 | 0.000360 |
| | (-1.78096) | (1.17351) |
| C | -68364.64 | |

**Table 5b: Variables included in the VECM: SMC and EXR, INF, INT**

| Variable | β's | ECM |
|---|---|---|
| SMC | 1.0000 | -0.62339 (-2.97159) |
| EXR | -11.54050 (-3.47597) | 0.009743 (-3.55917) |
| INT | 631.1404 (10.1835) | -0.002 (-5.40126) |
| INF | -11.113762 (-0.33522) | 0.000476 (0.33026) |
| C | -12617.92 | |

**Table 5c Variables included in the VECM: VST and EXR, INF, INF**

| Variable | β's | ECM |
|---|---|---|
| VST | 1.0000 | -0.155194 (-0.51513) |
| EXR | -313.4535 (-0.89418 | -6.99E-05 (-3.31315) |
| INT | 73395.71 (10.8844) | -1.58E05 (-5.00591) |
| INF | 1213.164 (0.97422) | 5.42E-06 (0.36539) |
| C | -1619254 | |

Note: The t-statistics are in Parentheses

**Table 6: Pairwise Granger Causality Test Results**

| Null hypothesis | F-statistical | P-value | Conclusion |
|---|---|---|---|
| EXR does not granger cause ASI | 1.63626 | 0.3575 | Do not reject Ho |
| ASI does not granger cause EXR | 3.75960 | 0.00142 | Reject Ho |
| EXR does not granger cause SMC | 1.65167 | 0.13155 | Do not reject Ho |
| SMC does not granger cause EXR | 2.32729 | 0.03142 | Reject Ho |
| EXR does not granger cause VST | 1.34348 | 0.24217 | Do not reject Ho |
| VST does not granger cause EXR | 9.00160 | 8.5E-08 | Reject Ho |

but was rejected in 1st difference. Thus, we conclude that the variables under investigation are integrated of order one (I(1)).

Since the variable are integrated of the same order. We therefore, examine their co-integrating relationship using Johansen's full information maximum likelihood.

**Table 7: summary of the descriptive statistics of the variables**

| | ASI | SMC | VST | EXR | INT | INF |
|---|---|---|---|---|---|---|
| Mean | 13907.64 | 1779.234 | 235749.7 | 75.41954 | 18.99488 | 21.57431 |
| Median | 7195.975 | 444.6500 | 26392.96 | 96.22283 | 19.11375 | 13.28500 |
| Maximum | 57990.20 | 10301.00 | 1679144. | 148.9100 | 29.80000 | 76.76000 |
| Minimum | 513.8000 | 12.10000 | 225.4000 | 8.037800 | 3.242500 | 0.220000 |
| Std. Dev. | 13816.00 | 2616.175 | 411768.6 | 51.26438 | 4.046126 | 19.62319 |
| Skewness | 0.844460 | 0.192292 | 2.050041 | 0.886304 | 0.485640 | 1.492398 |
| Kurtosis | 2.879445 | 2.005000 | 6.190115 | 2.381684 | 3.423381 | 3.905418 |
| Jarque-Bera | 3.583729 | 1.422412 | 89.95834 | 3.524452 | 1.122636 | 32.42931 |
| Probability | 0.166649 | 0.491052 | 0.000000 | 0.171008 | 0.570437 | 0.000000 |
| Observations | 80 | 80 | 80 | 80 | 80 | 80 |

## Co-integration Test Result

A necessary but insufficient condition for co-integrating test is that each of the variables be integrated of the same order (Granger, 1986). We examined the long-run relationship between exchange rate (EXR) and stock prices (SMP) using three different stock exchange indicators namely: All Share Index (ASI), Stock Market Capitalization (SMC) and Value of Shares Traded (VST). To overcome simultaneity bias in bi-variate VAR model, we include real interest rate (RIR) and inflation rate (INF) as control variables. The Johansen co-integration test utilizes two statistics test namely: the trace test and the maximal Eigenvalue test. The first row in each of the table test the hypotheses of no co-integrating relation, the second row test the hypothesis of one co-integrating relation and so on, against the alternative of full rank of co-integration. The results are presented in table 2 to 5. In table 2 to 5, the likelihood and maximal Eigenvalue statistics indicate the presence of one co-integrating equation at 5% significance level which implies that exchange rate (EXR) and the stock price indicators (ASI, SMC and VST) used as proxies for stock prices (SMP) are co-integrated. These show rejection of null hypothesis of no co-integration and acceptance of the alternative of co-integration. Thus, the results suggest existence of a stable long run relationship between exchange rate (EXR) and stock market prices (SMP).

## Vector Error Correction Model (VECM) Result

Since there is co-integration, the vector error correction model is estimated. The results are presented in table 5 below. From tables 5a, 5b and 5c respectively, we can formally state the normalized long-run co-integrating equation between exchange rate and stock prices.

ASI =-68364.64 – 149.3955 EXR + 3649.175INT-11.4049INF---------- (1)
SMC = -12617.92 – 11.54050 EXR + 631.1404INT-4.113762---------- (2)
VST =-161254 – 313.4535 EXR + 73395.71INT + 1313. 164INF ------- (3)

From equation (1) as in table 5(a), the VECM result shows that there is a significant negative long-run relationship between stock prices proxied by ASI and exchange rate suggesting that an appreciation in exchange rate impacts negatively on stock prices. A naira appreciation in exchange rate will lead to 149.40 naira fall in stock prices. This is in line with "a priori" expectation validating the Mundell-Flemming rule which says that depreciation in exchange rate increases export, and hence, output and income of firms and their stock prices. Interest rate had a significant positive impact on stock prices. This suggests that a rise in interest rate will attract foreign capital inflow as foreign investors will take advantage of it to diversify their portfolio, and hence, rise in stock prices. This is consistent with theory postulates. Inflation rate (INF) had negative and insignificant impact on stock prices. This conforms to economic theory. During inflationary period, there is a shift from investment to consumption which leads to a fall in demand for market instrument and stock traded which in turn leads to a fall in stock prices. Similarly results obtained in 5(b) and 5(c) show when SMC and VST were used as stock exchange measures respectively. Exchange rate exerted significant but negative impact on each of the variables used. This is consistent with "a priori" expectation.

The vector error correction term for ASI is -0.44. This speed of adjustment suggests that about 44% of the previous period's disequilibrium in stock exchange market is corrected every quarter. The implication is that it will take more than two quarters for any disequilibrium to be corrected. The vector error correction term for exchange rate (EXR) is -0.001. This implies that about 0.1% of the previous period's imbalance is corrected every quarter. The vector error correction term for interest rate is -0.0003 implying that about 0.03% of the past period's deviation in the model will converge in the current period. The error correction term for inflation rate is 0.0003. This is wrongly signed implying that inflation rate is neutral in the short run. For SMC, the vector error correction is 0.62 implying that about 62% of the disequilibrium in stock exchange markets is corrected quarterly while those of exchange rate, interest rate and inflation rate are -0.0097, -0.002 and 0.000y respectively. Similarly, error correction term for inflation rate shows that it is neutral in the short run as it is wrongly signed. For VST, the speeds of adjustment are respectively -0.55194, -6.99E-0E -1.58E-05 and 5.42E-06 for VST, EXR, INT and INF. These error correction terms suggest high speed of adjustment when SMC is used as proxy for stock prices, followed by ASI and VST respectively. This implies that exchange rate and stock prices adjust to their stable long run equilibrium relationship. The optimum lag length of 8 was selected based on AIC and SBC information criteria. This means that the convergence between the variables is not instantaneous.

## PAIRWISE GRANGER CAUSALITY TEST

The direction of causality between exchange rate and stock prices were tested using pair-wise Granger causality test. The results are presented in table 6. The null hypothesis of no direction of causality was tested against the alternative that there exists a direction of causality amongst the variables.

From table 6, the causality test revealed that stock prices proxied by ASI, SMC and VST granger cause exchange rate (EXR) without a feedback. This indicates a strong unidirectional causality running from stock prices (SMP) to exchange rate. The conclusion was arrived based on the fact that their F-statistics were statistically significant at 5% as indicated by their p- values. These three outcomes support the Stock Oriented Model (SOM) or the Portfolio balance approach which posits that there is robust effect from stock market prices to exchange rate since changes in stock markets affect capital movements which will affect the demand for domestic currency, and in turn affect exchange rate. These results corroborate the findings of Ajayi et al (1988), Rahman et al (2009) and Gopalan (2010). Thus, any change in stock market prices affects capital flight and this in turn affects exchange rate movements.

**Impulse Response Function**

Following objective three, Impulse Response Function (IRF) is used to trace the transmission of periodic shocks between exchange rate and stock prices for over 10 quarters. The impulse response graph (see appendix VII) represents various response of stock prices proxied by ASI to a one standard deviation (0.25 percentage point) shocks in the exchange rate. Shocks in the foreign exchange markets, macroeconomic environment like inflation rate and interest rate seem to worsen stock exchange market. The negative response of ASI to EXR implies that an unexpected appreciation of exchange rate decreases stock price. Though response of ASI to INF is positive, it is marginally equal to zero implying that shocks in inflation rate insignificantly impact on stock prices. The response of ASI to interest rate is negative suggesting that shocks in interest rates impact negatively on stock exchange.

**Forecast Error Variance Decomposition**

In view of objective four, the forecast error variance between exchange rate and stock prices was examined using Cholesky Forecast Error Variances Decomposition (FEVD) for a period of ten quarters (see appendix VI). This is computed by orthogonalizing the innovations with Cholesky decomposition. For ASI, after ten periods, the exchange rate accounted for 12.3% of the forecast error in stock exchange market, while interest rate and inflation rate accounted for 1.97% and 1.02% respectively while, ASI accounted for 84.7%. This implies that exchange rate and information in the stock exchange market seem to be the driving force behind the stock exchange market variance. For exchange rate, All Share Index accounted for about 15.67% of the forecast error variance in foreign exchange market after ten periods. Interest rate and inflation rate explained 3.68% and 11% respectively of the forecast error variance to a one standard deviation shock. This suggests that stock exchange markets and inflation rate seem to be the driving force behind foreign exchange market variance.

**Descriptive Statistics**

The characteristics of the distribution of the variables are presented in table 7. Jarque-Bera is a statistical test that determines whether the series is normally distributed. This statistic measures the difference of the skewness and the kurtosis of the series with those from the normal distribution. The null hypothesis is that the series is normally distributed against the alternative that it is not. Evidently, the Jarque-Bera statistic rejects the null hypothesis of normal distribution for the value of shares traded (VST) and inflation rate (INF) since their probability value is less than 0.05. However, the null hypothesis of normal distribution is accepted for stock market capitalization (SMC), all share index (ASI), exchange rate (EXR) and interest rate (INT) implying that all the variables except VST and INF are normally distributed.

Kurtosis measures the peakedness or flatness of the distribution of the series. The statistic for Kurtosis shows that interest rate and all share index are normally distributed. However, value of shares traded and inflation rate are leptokurtic, since their distributions are peaked (approximately greater than 3) relative to the normal. Stock market capitalization and exchange rate are platykurtic, suggesting that its distribution is flat (less than 3) relative to the normal. Lastly, skewness is a measure of asymmetry of the distribution of the series around its mean. The statistic for skewness shows that only stock market capitalization has bell shaped. All share index, value of shares traded, exchange rate, interest rate and inflation rate are positively skewed implying that these distributions have long right tails.

**Summary and policy recommendations**

Given the nature of the objectives, the vector autoregressive model (VAR) transformed into a vector error correction model (VECM) was used. In order to find whether the causality inference depends on the choice of stock exchange indicator, three measures of stock exchange performance namely All Share Index (ASI), Stock Market Capitalization (SMC) and Value of Shares Traded (VST) were used. Inflation rate and interest rate as macroeconomic variables were included as control variables to avoid omitted variable bias and to determine the effect of macroeconomic environment on stock prices. Each of the three stock exchange indicators was used to proxy for stock prices and we estimated three VAR models. The summary of the result drawn from the findings are stated below:

- The variables are non stationary, therefore, random walk series. When the first differences of the series were taken, the ADF and PP test statistics became significant. Therefore, the series are I (0) processes and they are integrated of order one.
- The Johansen co-integration test result showed a one co-integrating vector between exchange rate and stock prices. This means that there exists a stable long-run equilibrium relationship between exchange rate and stock prices.
- The estimated co-integrated vector within the VECM framework reveals that exchange rate exerts a negative impact on stock prices. The magnitude of the estimated coefficients shows that exchange rate has significant but negative impact on the magnitude of stock prices.
- Interest rate had a positive impact on stock market prices suggesting that increase in interest rate will attract foreign investors into the country. In order to reduce portfolio risk investors diversify their funds among investment portfolios and hence rise in stock market prices.
- Evidence from the VECM shows that the speed of adjustment is higher when SMC was used as a proxy

for stock prices than when other variables were used. This is followed by ASI and VST respectively. On average, the speed of adjustment is 0.44 implying that it will take about seven months and five days for any disequilibrium in the stock exchange market to be corrected.

- In order to consider the parsimony principle and residual's white-noise property, lag interval of 8 was selected based on MAIC and MSBC information criteria. The lag length of 8 suggests that the adjustment of exchange rate and stock prices to their long run equilibrium relationship is not instantaneous. Specifically, it will take about 8 quarters (2 years) for any disequilibrium in the stock market is spread to the foreign exchange market.
- The results show that shocks in the foreign exchange market and macroeconomic environment like inflation rate seem to worsen the stock exchange market.
- The result from FEVD shows that for stock market, after 10 quarters, ASI accounted for 84.7% of the forecast error to itself, the EXR accounts for 12.3% of the forecast error variance while INF and INT explains only 1.97% and 1.02% respectively. This suggests that information in the stock exchange market and foreign exchange market seem to be the driving force behind stock exchange market variance.
- For foreign exchange market, ASI accounts for 15.67% of the forecast error variance while INF and INT accounts for 11% and 3.68% respectively.

Given that correlation does not imply causation in any way, the study carried out a Granger causality test within VECM framework to determine the direction of causality between exchange rate and stock prices. The result shows that there is unidirectional causality running from stock prices to exchange rate for all the three stock exchange measures.

**Policy Recommendations**

The results suggest that exchange rates impact negatively on stock prices in the long run. Thus:

1. If policy makers are interested in promoting stable and sustainable growth in stock prices, a more stable exchange rate policy should be pursued.
2. Economic reforms must target macroeconomic stability, removal of structural distortions and creation of business-friendly environment to enhance domestic production capacity. Anti- inflationary policy like non-expansionary monetary and fiscal policies as well as inflation-adjusted interest rate policy should be pursued to attract foreign investors and discourage capital flight in the country.
3. Since information dissemination in the stock market accounts for the largest forecast error variance in the market, scandalous acts that could degenerate into bad news should be avoided. To achieve this, efforts should be devoted to:
   - Strengthening of supervisory and regulatory bodies in the financial system.
   - Government and supervisory bodies should ensure meritocracy in the choice of appointees as top executives in banking industry, SEC and NSE without political sentiment. This has implications for the performance of firms in particular and the market at large. People with questionable character should not be appointed but those with good past records.
4. Since stable and sustainable stock price leads exchange rates, policy makers should be cautious in implementing or taking stock market regulation/ policies as it has a long term implication on exchange rate.
   - Also there is need to address the decay in the critical infrastructures like power, transport, water, etc as this will reduce the cost of funds, operating cost, increase firms' profits and stabilize stock prices which will in turn attract foreign investors and sustain the momentum for growth.

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