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AN ANALYSIS OF THE CAUSAL RELATIONSHIP BETWEEN STOCK PRICES AND EXCHANGE RATE IN NIGERIA: A TIME SERIES INVESTIGATION

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Abstract: **Stock market and foreign exchange market play an integral role in contributing to the financial development and economic growth in any developing economy. There exists no general consensus on the nature of relationship and direction of causality between stock prices and exchange rate. It is against this backdrop that this study attempts to examine how changes in exchange rate and stock prices are related to each other in Nigeria using monthly data over the period 1993 – 2015. The empirical work is based on unit root test, Johansen cointegration and Granger causality test to examine long run and short run causality. The result suggests that the series are stationery at their first difference and there is a short-run positive relationship between stock prices and exchange rate. There also exists one-way causality between stock prices and exchange rate with causality running from exchange rate to stock prices. The result calls for long-term policy package that should focus on stabilization of the foreign exchange market as an appreciating exchange rate may boost the stock market. Also, since activities of stock market serves as a gauge with the stock prices, we suggest that stock prices should be closely monitored so as to prevent volatility in the prices which could drastically affect the performance of the stock exchange market. More so, institutional and operational reforms in the country's capital market are inevitable so as to increase the subsector efficiency. This will further curtail the high volatility in both markets.**

Keywords: **Exchange rate, stock prices and Granger causality.**

I. INTRODUCTION

Numerous efforts have been undertaken to investigate the relationship between exchange rate and stock prices [for international evidence see Ma and Kao (1990), Kim (2002), Stavarek (2004), Kurihara (2006), Morley (2009), Richards and Simpson (2009), Alagidede *et al.* (2010), Dimitrova (2005), and Ono (2009), Hamrita and Trifi (2011), Muhammad and Rasheed (2002), Ramasamy and Yeung (2011), Rahman and Uddin (2009), Ray (2012). For evidence from Nigeria

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see Aliyu (2009), Akpan *et al.* (2012), Olugbenga (2012), Osamwonyi *et al.* (2012), Abiodun and Elisha (2012) and Oyinlola *et al.* (2012)]. However, these studies have provided mixed conclusions on the nexus between exchange rate and stock prices.

Volatility of exchange rate has increased significantly since the emergence of the flexible exchange rate system in the early 1970s. More so, recent growth in trade and financial liberalization and the belief that corporate earnings are significantly affected by fluctuations in the currency value have attracted a great deal of interest from both economists and policy makers. The global financial crises and its linkage to foreign exchange and stock markets necessitate the need to explore the nature of the relationship between exchange rate and stock prices. Moreover, the role of stock market in enhancing the efficiency of domestic financial systems has long been established. According to Ray (2012) a healthy stock market has a positive result on aggregate demand, offer investors opportunities to diversify their portfolios and to effectively allocate their investment resources. On exchange rate, Dornbusch and Fisher (1980) explained that changes in exchange rates affect international competitiveness and trade balance, thereby influencing real economic variables such as real income and output. Thus, a given domestic currency depreciation makes local firms more competitive internationally, leading to an increase in their export.

Two sets of theoretical models, namely flow oriented models and stock oriented models have been widely used to explore the relationship between foreign exchange markets and stock markets. Flow oriented models assume that a country's current account and trade balance performance are two important factors of exchange rate determination; hence, stock prices and exchange are positively related. On the other hand, stock oriented models emphasize the capital account as the major determinant of exchange rate. There are two subsets in this category, namely portfolio balance models and monetary models. The portfolio balance model posit that increase in stock prices drives up the interest rate of domestic currency, with the consequent effect of a fall in the exchange rate. Monetary models posit that there is no linkage between exchange rates and stock prices except that both variables are influenced by some common factors.

The absence of consensus from both theoretical and empirical literature necessitate another investigation of this issue using high frequency data from Nigeria (monthly time series data) and a more robust technique of analysis. Accordingly, answers to the following questions is sought: i) what is the nature of the relationship between stock prices and exchange rate in Nigeria? ii) what is the direction of causality between stock prices and exchange rate in Nigeria?

To achieve our objective, the paper is structured into five sections: the next section provides a review of the literature on exchange rate – stock market interaction. Section three presents data and methodology. While the fourth section presents the results of the analysis, the fifth section concludes the paper.

II. LITERATURE REVIEW

This section present the theoretical framework and a review of empirical studies on the relationship between foreign exchange and stock market.

THEORETICAL FRAMEWORK:

The theoretical underpinning on the nexus between foreign exchange and stock market is not unanimous. Ray (2012) explained four ways in which the exchange rate can affect the stock market. Firstly, a depreciating currency can cause a decline in stock prices because of expectation of inflation;

$$RER = \frac{E \times P^*}{P} \qquad (2.1)$$

where RER is the Real Exchange Rate. Higher nominal exchange rate in the short run is consistent with a decrease in the price ratio P^*/P towards a long run equilibrium level the real exchange rate equals unity. A lower P^*/P ratio implies relatively higher domestic prices. Therefore, a depreciation of the nominal exchange rate creates expectations of inflation for the future. Secondly, foreign investors will be unwilling to hold assets including stocks in currency that depreciates because that would erode the return on their investment. Thirdly, the effect of exchange rate depreciation will be different for each company depending on whether it imports or exports more, whether it owns foreign units, and whether it hedges against exchange rate fluctuation. Heavy importers will suffer from higher costs due to weaker domestic currency and will have lower earnings, thus lower share prices. Lastly, a depreciated currency will enlarge the export industry and depress the import industry. The impact on domestic output will be positive. Increasing output is seen as an indicator of a booming economy by investors and tends to boost share prices.

REVIEW OF EMPIRICAL LITERATURE:

Most early studies on exchange rate – stock prices interaction were conducted on developed economies. Some of them are reviewed below beginning Ma and Kao (1990) which examined stock price reactions to exchange rate changes of six major industrialized countries namely United Kingdom, Canada, France, West Germany, Italy and Japan using monthly stock indices and monthly merchandise exports and imports of the U.S with respect of each of the countries from January 1973 to December 1983. The variables are adjusted by the weight of the international trade with the U.S and analysed using regression technique. Their result shows exchange rate level to be positively related to the stock index relative at one per cent level of significance. This suggests that if the investment is denominated in a strong currency, foreign investors expect to receive an ultimately higher rate of return after the payoff is converted into their own currency. Consequently, a high currency value generates a favourable transaction exposure and creates excess demand for domestic stocks. The result implies that stock indices are more affected by the exchange rate level than by the exchange rate change.

Stavarek (2004) examines the mutual interactions between stock prices and exchange rates in the US and eight EU countries namely Austria, France, Germany, Poland, Czech Republic, Hungary, Slovakia and UK. The study aims to show difference in result using nominal exchange rate (NEER) and real exchange rate (REER) and uses monthly data for both types of exchange rates. Results for co-integration test suggest that the null hypothesis of no cointegration can be rejected in none of the countries. Analysed financial markets in all countries do not share the same stochastic trend and consequently no stable long-run linkages between stock prices and exchange rates exist. Whereas Austria, Germany and the UK demonstrate stronger relationship between stock prices indices and the REER, France and USA show evidence of higher trace statistics using the NEER. Similarly, while there are no noticeable differences in the long-run linkages in Austria, France and the USA, results in Germany and the UK vary significantly involving NEER and REER into analysis. Conclusively, there is no long-run relation in the first period 1970 to 1992. The period from 1993 to 2003 shows much stronger long-run causalities in the developed countries. Cointegration between stock prices and exchange rates appear in four of the nine economies, however, the direction of causality differs.

Kurihara (2006) studied the relationship between exchange rate and stock prices during the quantitative easing policy in Japan. Quantitative easing has to do with increasing the outstanding balances of current accounts. Japan experienced recession and deflation for more than ten years. The bank of Japan enforced quantitative monetary easing to influence stock prices for economic recovery. Using daily data during the quantitative easing policy of March 19, 2001 to September 30, 2005 for the variables: Japanese stock price, U.S stock prices, exchange rate (Yen/dollar), the Japanese call (interest) rate and the FF rate and subjecting the variables to ADF test, OLS test and co-integration test; they found that the rate of change in the exchange rate is positive and significant, and interest rate did not influence stock prices. The domestic interest rate has been quite low and has not a great influence on stock prices. The one-day difference of the FF rate has a negative influence on stock prices and the U.S stock prices strongly affect Japanese stock prices. The Granger causality test result suggests that the U.S interest rate also significantly influences Japanese stock prices. The cointegration test result shows that the Japanese and the U.S stock prices can be interpreted as having a long-run equilibrium relationship between the variables.

Using monthly data from January 1985 to April 2005 with a further 12months for out of sample forecasting and applying the Autoregressive Distributed Lag (ARDL) approach to cointegration for long-run analysis and Error Correction Model (ECM) for short-run analysis of out-of-sample forecasting, Morley (2009) determined the nature of any direct relationship between the exchange rate and stock prices for the Canadian, Japanese, Swiss and UK currencies against the U.S dollar. His findings suggest that there is evidence of a long-run relation between exchange rates and stock prices with the exception of the Canadian/US exchange rate. In the short-run, they produce a well specified error correction model in which the exchange rate and stock price differential are positively related.

In Australia, Richards and Simpson (2009) investigate the relationship between stock prices and exchange rates and then expanded the analysis to investigate the changes in these key economic variables and the relationship between these changes through the process of the Granger-Sim Causality test. The study period covers January 2, 2003 to June 30, 2006.

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The level series OLS regression result indicate a short-run positive relationship between the Australian dollar exchange rate and stock prices during the period. First difference examination shows same result as above. Co-integration test result shows evidence of both short term and long term relationship. The study finds that a significant unidirectional causal relationship exists between the variables; with stock price changes found to Granger cause the Australian dollar exchange rate. This agrees with the portfolio balance approach. The degree of causality for exchange rate to stock exchange though visible, but it's very insignificant.

Hamrita and Trifi (2011) examines the multi-scale relationship between the interest rate, exchange rate, and stock price by applying the maximum overlap discrete wavelet transform (MODWT) to the interest rate, exchange rate and stock price in US over the period from January 1990 to December 2008 and using the definitions of wavelet variance, wavelet correlation and cross-correlation to analyze the association as well as the lead/lag relationship between these series at the different time scales. The result of the wavelet cross-correlation analysis shows that the relationship between interest rate and exchange rate is not significantly different from zero at all leads and at all scales. The relationship between interest rate and stock index is significantly different from zero only at the coarsest scales. Only at low frequencies was a significant relationship between exchange rate and stock index at this period established. Conclusively, their results show that a possible bi-directional causality running between exchange rate and stock index exists only at longer horizons.

Studies on emerging economies include Ray (2012) which investigated a bivariate exploration into stock prices and exchange rates dynamics in some selected Asian economies. The study, based on unit root test, Johansen co-integration test, and Granger causality test examines how changes in exchange rates and stock prices are related to each other both in the long-run as well as short-run for India, Japan, Hong Kong, Singapore and Korea using monthly closing prices of both variables over the period 2002 to 2010. The result suggests that in countries like Hong Kong, Japan and Singapore, long-run relationship exists between exchange rate and stock prices but short-run causality disappears. Whereas in case of India and Korea, short-run unidirectional Granger causality is found to exist but long-run co-integrating relationship disappears.

Rjoub (2012) who empirically investigates the dynamic relationship between the Turkish stock price and the exchange rates, and also considers the US stock prices as a world market. The study used data consisting of monthly nominal exchange rate, national currency per US end of period and the stock prices for both Turkey and US for the period August 2001 to August 2008. Granger causality test in VEC form which allows for the examination of dynamic causal integration amongst the stock prices and exchange rates was adopted. The results from long-run co-integration indicate that the exchange rate has a negative impact and the US stock market has a positive impact on the Turkish stock market in the analysis. The causality dimensions determined that there are two way relationships between exchange rates and Turkish stock prices.

Baharom *et al.* (2008) however, came to a different conclusion when they used real effective exchange rate (REER) in analysing the pre-and post-crisis relationship between stock prices and exchange rates in Malaysia. The data consist of monthly real effective exchange rate (REER) and stock prices for a sample period of January 1988 to June 1997 (pre-crisis period) and July 1998 to December 2006 (post crisis period). Result of standard Granger causality test depicts that the null hypothesis of no co-integration cannot be rejected in the pre-and post-crisis periods. Therefore, there is no evidence of long-run relationship between the real effective exchange rate (REER) and the stock price index for both periods.

Bhunia (2012) employs modified Wald test (MWALD) to investigate the causal relationship between stock indices and exchange rates in India using daily series data for the period 2nd April, 2001 to 31st March, 2011. ADF, PP and KPSS tests are employed to determine integrated status of the series. The test result shows that the stock market indices have integrated of order one for all unit root tests. On the other hand, there are different results about the integrated level of exchange rate. Although ADF and PP tests indicated that exchange rate is integrated of order zero, KPSS test shows that this result is not valid, exchange rate is integrated of order one. The result of the causality test indicates that there is bi-directional relationship between exchange rate and all stock market indices.

Dayyat (2008) adopted Granger causality test to examine the relationship between Amman stock exchange index and exchange rate using monthly data for the period 1989 to 2004. The data series were subjected to vector autoregressive model (VEC) lag length selection, unit root test and Granger causality test. The result indicated that there is no any relationship between the exchange rate and the stock index as the Jordanian Dinar is pegged to the US dollar and the factors that affect the exchange rate might be different from the factors that affect the stock index.

In Kenya, Kisaka and Mwasaru (2012) applied error correction model to examine the causal relationship between foreign exchange rates and stock prices in Kenya. They used monthly observations of the closing price index and Ksh/USD foreign exchange rates in the two markets for the period November 1993 to May 1999. The empirical results show that foreign exchange rates and stock prices are non-stationary both in first differences and level forms and they are integrated of order one. Cointegration tests show that the two variables are co-integrated. The error correction model shows a unidirectional causality from exchange rates to stock prices in Kenya.

Mlambo *et al.* (2013) applied Generalised Autoregressive Conditional Heteroskedasticity (GARCH) to investigate the effects of exchange rate volatility on the stock market in South Africa on a monthly series data for the period 2000 to 2010. ARCH test and unit root test were performed to examine the data characteristics before employing GARCH. The ADF and PP test result shows that all variables were not stationary in level but became stationary after first differencing. The analysis of the study reported a very weak relationship between exchange rate volatility and the stock market. The stock market was seen to be affected by other macroeconomic variables namely; interest rate, total mining production, money supply and the US interest rates.

Adam and Tweneboah (2008) examined the role of macroeconomic variable in the stock market movement in Ghana. Using quarterly data from 1991:01 to 2007:04 of stock prices sourced from Databank research and of exchange rate, inflation, interest rate, oil prices and FDI sourced from IMF IFR series and applying cointegration test to look for linear combination of I(d) time series that are stationary and cointegrating equation to interpret the long-run equilibrium relationship between variables as captured in Granger (1987). They also employed the Johansen maximum likelihood procedure which is based on Vector Error Correction Model. To estimate VECM, they conducted ADF test and AIC for lag selection. Finally, the cointegration rank is conducted with the Maximum Eigen-value and trace test. The result of ADF unit root test shows stationary at first difference for all the variables. The cointegration test result shows that there is no significant relationship between stock prices and exchange rate. However, the overall conclusion is that Ghana stock market formed significant relationships with macroeconomic variables identified.

Evidences from Nigeria are very sketchy. Most of which are recent with diverse conclusions. We began with the study by Aliyu (2009) which applied co-integration and Granger causality test to investigate the nexus between stock prices and exchange rates in Nigeria. The study employs daily figures of nominal exchange rates and the All Share Index for the period February 1, 2001 to December 31, 2008. The series were transformed into natural logarithm such that coefficients would be interpreted as elasticities in the models. The sample period is broken into two sub-samples namely pre-crisis period from February 2001 to December 2006 and crisis period from January 2007 to December 2008. While the Engle and Granger two-step reveals no long-run relationship between stock market prices and levels of exchange in Nigeria, the Johansen approach reveals presence of long-run equilibrium relationship. To verify the nature of causality between the variables, VECM test result shows that stock prices and exchange rates are bound together in a form of bidirectional relationship in the long-run. The regression results of the vector co-integrating equation showed that although all were consistent theoretically, only the crisis model is statistically significant. This is attributable to the huge inflow of crude oil money into the economy between 2007 and 2008 which resulted into high monetization of the economy.

Oyinlola et al. (2012) used Johansen and Gregory-Hansen cointegration analysis, causality tests and Exponential General Auto Regressive Conditional Heteroskedasticity modelling on daily data from January 2, 2002 to august 11, 2011 to investigate the dynamics of stock prices and exchange rates in Nigeria. Their result shows that there is no long-run relationship between stock prices and exchange rates in Nigeria. The EGARCH result shows that there is a unidirectional relationship running from stock prices to exchange rates.

Umoru and Asekome (2013) employs Johansen cointegration and Granger-Sim methodology on daily series data for the period 2000 to 2012 to investigate stock prices and exchange rate variability in Nigeria. The Augmented Dickey Fuller and Phillip Perron test result indicate that the level series of stock prices and exchange rates are non-stationary processes at the 1% level, but stationary after first differencing. Johansen cointegration results indicates one cointegrating relationship between the stock prices and exchange rate indicating that both variables are into a long-run relationship. The study finds a significant bi-directional causal relationship between the exchange rate movement and the reaction of the stock prices. Although, there is evidence of uni-directional causality running from the exchange rate to stock price index, the instantaneous incidence of reverse causality for most part of the analysis is a pointer to mix empirical evidence.

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Employing Johansen cointegration and Granger causality to a monthly series data for the period April 2001 to December 2011, and dividing the period into pre-crisis period: April 2001 to February 2008; and crisis period: March 2008 to December 2011, Zubair (2013) investigated the causal relationship between stock market index and exchange rate in Nigeria. The study adopted trivariate model which comprises three variables namely: natural logarithm of exchange rate, natural logarithm of stock prices and money supply (M2). While the unit root test result shows that the series are stationary at first difference for all the sub-period, the Johansen cointegration test result shows no cointegration exist between the variables for all the period. Granger causality test result indicates absence of causality between stock prices and exchange rates. However, there is a unidirectional causality running from money supply (M2) to stock prices.

III. DATA AND METHODOLOGY

This paper uses secondary time series data. The variables of interest are the All Share Index of the Nigerian Stock Exchange as a proxy for stock prices represented by All Share Index on the Nigerian Stock Exchange and exchange rates represented by monthly average official exchange rate of the Naira to US dollar. The frequency of data is monthly spanning the period 1993:1 to 2015:12 consisting of 276 observations per variable. The choice of 1993 as base year for data collection emanated from the fact that the Nigerian Capital Market was deregulated same year, consequently prices of new issues are determined by issuing houses and stockbrokers, while on the secondary market, prices are made by stockbrokers only. However, the choice of December 2015 was based on availability data. The data was sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin.

This study considers a bivariate framework widely employed in the literature (see Ibrahim 2000; Rahman and Uddin 2009; Aliyu 2009; and Ray 2012). Most of the studies in this area employ the standard time series procedure in exploring the relationship between exchange rate and stock prices. This study is not an exception. First, we check the data for stationarity using Dickey-Fuller Generalized Least Squares (DF-GLS) test. If the series are found to be stationary, we test for co-integration among the variables. But existing literatures shows that spot prices for the two variables are not likely to be stationary at level value but are usually stationary at first difference. Hence, if DF-GLS test finds the data to be stationary, we will proceed to testing for co-integration. To test for cointegration, Johansen (1988) approach was employed. If the series are cointegrated, then an error correction term is required and hence VECM was applied to find the causality between the two variables as it can capture both long-term and short-term relationships. If however, there is no evidence of cointegration, Granger causality test shall be employed to establish the causal relationship between the variables.

Empirical work based on time series data assumes that the underlying time series is stationary. But many studies have shown that majority of time series variables are non-stationary or integrated of order 1 (Engle and Granger, 1987). To this end, Dickey-Fuller Generalized Least Square (DF-GLS) test was adopted. The DF-GLS is a more powerful test than the Dickey-Fuller test. In Augmented Dickey-Fuller (ADF) test regression either a constant or a constant and a linear time trend is included to take account of the deterministic component of the data. Elliot, Rothenberg and Stock (1996) proposed a modification to the ADF regression in which data are de-trended before the unit root test is conducted. This de-trending is done by taking the explanatory variables out of the data. The following equation is then estimated to test for a unit root in the variable:

$$\Delta Y_t^d = \alpha Y_{t-1}^d + \beta_t \Delta Y_{t-1}^d + \ldots + \beta_p \Delta Y_{t-p}^d + \varepsilon_t \qquad (3.1)$$

Where:

Δ	=	Difference operator
β & α	=	Coefficients to be estimated
$Y_t^{\,d}$	=	Generalized Least Squares de-trended value of the variables, and
ε_t	=	Independently and identically distributed error term

As in the case of the ADF test, a test for a unit root of the variable *Y* involves examination of whether the coefficient of the AR (1) term, in this case α, is zero against the alternative of a $\neq 0$ (Cooray and Wickremasinghe 2005).

If the series used are integrated of the same order, it is useful to test for cointegrating relationship between the integrated variables. For this purpose, we employ the Johansen (1995) procedure to test for the possibility of a cointegrating

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relationship. The Johansen method applies maximum likelihood procedure to determine the presence of co-integrating vectors in non-stationary time series as a vector autoregressive (VAR):

$$\Delta Y_t = C + \sum \Gamma \Delta Y_{t-1} + \Pi Y_{t-1} + \dot{\eta}_t \qquad (3.2)$$

Where Y_t is a vector of non-stationary variables and C is the constant term. The information on the coefficient matrix between the levels of the ∏ is decomposed as $\prod = \alpha\beta$ where the relevant elements the α matrix are adjustment coefficient and the β matrix contains co-integrating vectors. Johansen and Juselius (1990) specify two likelihood ratio test statistics to test for the number of co-integrating vectors, the first likelihood ratio statistics for the null hypothesis of exactly r cointegrating vectors against the alternative r+1 vectors is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vectors against the alternative is the trace statistic.

In the absence of any cointegrating relationship between the variables, the standard Granger causality test base on Granger (1987) method will be applied. According to the concept of Granger's causality test, a time series x_t Granger-causes another time series y_t if series y_t can be predicted with better accuracy by using past values of x_t rather than by not doing so, other information is being identical. If it can be shown, usually through a series of F-tests and considering AIC on lagged values x_t (and with lagged values of y_t also known), that those x_t values provide statistically significant information about future values of y_t time series then x_t is said to Granger-cause y_t. The Granger method involves the estimation of the following equations:

$$\Delta S_t = \beta_0 + \sum \beta_{1i} \Delta S_{t-i} + \sum \beta_{2i} \Delta X_{t-i} + \varepsilon_{1t} \qquad (3.3)$$

$$\Delta X_t = \varphi_0 + \sum \varphi_{1i} \Delta X_{t-i} + \sum \varphi_{2i} \Delta S_{t-i} + \varepsilon_{2t} \qquad (3.4)$$

Where S_t and X_t represent the stock prices and exchange rates respectively. ε_{1t} and ε_{2t} are uncorrelated stationary random process, and t denotes the time period. Failing to reject H_0: $\beta_1 = \beta_2 = 0$ implies that exchange rates do not Granger cause stock prices. On the other hand, failing to reject H_0: $\varphi_1 = \varphi_2 = 0$ implies that stock prices do not Granger cause exchange rates.

If cointegration exists between stock prices and exchange rates, the VECM is required in test Granger causality as shown below:

$$\Delta S_t = \alpha_0 + \sum \beta_{1i} \Delta S_{t-i} + \sum \beta_{2i} \Delta X_{t-i} + \alpha_0 \gamma_{t-i} + \varepsilon_{1t} \qquad (3.5)$$

$$\Delta X_t = \lambda_0 + \sum \varphi_{1i} \Delta X_{t-i} + \sum \varphi_{2i} \Delta S_{t-i} + \lambda_1 \gamma_{t-i} + \varepsilon_{2t} \qquad (3.6)$$

Where γ_{t-i} is the error correction term obtained from the co-integrating equation (3.4), so that changes in the variables S_t and X_t are partly driven by the past values of γ_t. The first difference operator is marked by Δ. The error correction coefficients, α_1 and λ_1, are expected to capture the adjustments of S_t and X_t towards long-run equilibrium, whereas the coefficients of S_{t-1} and X_{t-1} are expected to capture the short-run dynamics of the model. ε_{1t} and ε_{2t} are stationary random processes included to capture the information not contained in the lagged terms.

IV. RESULTS

This section covers descriptive analysis of the data inferential results. Graphs and summary statistics figures are employed to conduct preliminary analysis of the data while cointegration and Granger causality tests results makeup the inferential results.

Table 4.1 Summary statistics

Measurement	Stock Prices	Exchange Rate
Observation	276	276
Mean	18802.74	96.89183
Standard Deviation	28886.63	51.63248
Skewness	10.30306	-0.5890485
Kurtosis	137.6903	1.676282

Table 4.1 presents a summary statistics for the selected variables namely stock prices and exchange rate. We have examined 276 monthly observations of both variables to estimate the following statistics: mean, standard deviation which measures the dispersion or spread of the series. The stock prices were highly volatile compared to exchange rate. The skewness measures the distribution of the series. A positive skewness value is recorded for stock prices an indication that the series has a long right tail, while a negative skewness value is recorded for exchange rate indicative of a long left tail. Kurtosis estimates indicates that stock prices are relatively peaked compared to normal while that of exchange rate has platykurtic distribution.

To begin the inferential analysis, all series were transformed into natural logarithm form and tested for unit roots at both level and first difference values. DF-GLS test was used with and without trend as recommended by Elliot, Rothenberg and Stock (1996). The optimal number of lags was chosen according to Schwartz Information Criterion (SIC) and result of the tests tabulated below.

Table 4.2: Unit root test results at level value

Panel A: with trend				
Variables	**DF – GLS tau Test Stat.**	**Critical Values**		
		1%	**5%**	**10%**
lnStock Prices	-1.547 (1)	-3.480	-2.920	-2.631
lnExchange Rate	-1.597 (14)	-3.480	-2.812	-2.533

Panel B: with no trend				
Variables	**DF – GLS tau Test Stat.**	**Critical Values**		
		1%	**5%**	**10%**
lnStock Prices	0.736 (4)	-2.581	-2.009	-1.695
lnExchange Rate	0.312 (1)	-2.581	-2.022	-1.706

Significant at 10% (*), 5% (**), 1% (***)

Table 4.3: Unit root test results at first difference values

Panel A: with trend				
Variables	**DF – GLS tau Test Stat.**	**Critical Values**		
		1%	**5%**	**10%**
ΔlnStock Prices	-15.863 (1) ***	-3.480	-2.920	-2.632
ΔlnExchange Rate	-9.466 (1) ***	-3.480	-2.920	-2.632

Panel B: with no trend				
Variables	**DF – GLS tau Test Stat.**	**Critical Values**		
		1%	**5%**	**10%**
ΔlnStock Prices	-15.894 (1) ***	-2.581	-2.022	-1.706
ΔlnExchange Rate	-6.666 (1) ***	-2.581	-2.022	-1.706

Significant at 10% (*), 5% (**), 1% (***)

From Table 4.2, the null hypothesis of a unit root at level values with trend can be accepted at all levels of significance. Same applies to with no trend. However, at first difference values, it can be rejected for all series (Table 4.3). Hence, both stock prices and exchange rate are not stationary at level values but are stationary when the first difference is taken.

Table 4.4: Maximum likelihood tests and lag exclusions tests

Lag	LL	LR	FPE	AIC	HQIC	SBIC
0	250.065		0.000415	-2.11119	-2.09932	-2.08175
1	274.537	48.944	0.000349	-2.28542	-2.24981*	-2.19709*
2	280.638	12.202*	0.000343*	-2.3033*	-2.24395	-2.15609
3	281.873	2.4704	0.000351	-2.27977	-2.19668	-2.07367
4	282.261	0.77524	0.000362	-2.24903	-2.1422	-1.98404

***Indicates lag order selection by the criterion**

Table 4.4 shows the maximum lag selection criterion. Lag 1 was selected by two criteria being Hanna-Quinn Information Criterion (HQIC) and Schwarz Information Criterion (SBIC). Lag 2 was selected by three criteria being Sequential Modified Likelihood Ratio (LR) each test at the 5% level, Final Prediction Error (FPE) and Akaike Information Criterion (AIC). Therefore, a maximum of 2 lags was selected to estimate VAR.

Table 4.5 Vector Autoregressive estimation result (Dependent variable: Δlnstockprices)

Independent variable	Coef.	Std. Err.	z	P>|z|
Δlnexchangerate	0.0554885	0.1608193	0.35	0.730
Constant	0.012988	0.01462	0.89	0.374

$R^2 = 0.4614$

Table 4.5 indicates the nature of relationship that exists between stock prices and exchange rate with stock prices as the dependent variable and exchange rate as the independent variable. The coefficient 0.0554885 shows that there is a positive relationship between stock prices and exchange rate, R^2 as 0.4614 indicating that 46.14% of changes in stock prices are determined by exchange rate.

Table 4.6: Vector Autoregressive estimation result (Dependent variable: Δlnexchangerate)

Independent variable	Coef.	Std. Err.	z	P>|z|
Δlnstockprices	0.0034754	0.0261133	0.13	0.894
Constant	0.007875	0.0058766	1.34	0.180

$R^2 = 0.1142$

Table 4.6 also shows a positive relationship between exchange rate and stock prices when the former is used as dependent variable and the later as independent variable as indicated by the coefficient 0.0034754. However, the coefficient of determination R^2 as 0.1142 indicate that only 11.42% of change in exchange rate is determined by stock prices.

Table 4.7 Granger causality Wald test result

Equation	Excluded	Chi2	df	Prob > chi2
Δlnstockprices	lnexchangerateD1	7.0418	1	0.030
Δlnexchangerate	lnstockpricesD1	0.0177	1	0.894

Table 4.7 shows the Granger Causality test result. The probability value is significant at 5%, indicating that Δlnexchangerate Granger-causes Δlnstockprices. But Δlnstockprices does not Granger-cause Δlnexchangerate. Thus, we can reject the null hypothesis that there is no causality between stock prices and exchange rate as there is a one-way causality running from exchange rate to stock prices.

Table 4.8: Diagnostic Tests [Test for residual autocorrelation (Lagrange-Multiplier test)]

Lag	Chi2	df	Prob > chi2
1	59.7173	4	0.00000
2	1.1576	4	0.88502

Table 4.8 presents Lagrange Multiplier test for residual autocorrelation. Because the probability value is significant at 1% level, we cannot reject the null hypothesis of no autocorrelation in the residuals; this test does not indicate any model misspecification.

Table 4.9: Test for normality of distribution (Jarque-Bera test)

Equation	Chi2	df	Prob > chi2
Δlnstockprices	0.049	2	0.97583
Δlnexchangerate	1.193	2	0.55075
All	1.242	4	0.46924

Table 4.8 shows result of test for normally distributed disturbances. The probability level for both stock prices and exchange rate 0.97583 and 0.55075 respectively are not significant indicating that the series is normally distributed.

4.10: Further tests of normality

Equation	skewness	Chi2	df	Prob > chi2
lnstockpricesD1	-0.03378	0.005	1	0.94182
lnexchangerateD1	-0.15315	0.109	1	0.74077
All		0.114	2	0.53718
Equation	**Kurtosis**	**Chi2**	**df**	**Prob > chi2**
lnstockpricesD1	3.7281	0.618	1	0.43164
lnexchangerateD1	2.6189	0.169	1	0.68062
All		5.592	2	0.34797

Table 4.10 present both the skewness and kurtosis tests for normality. The probability values for both stock prices and exchange rate 0.94182 and 0.74077 respectively are not significant indicating that the series are normally distributed. For the kurtosis statistic test, the probability values for stock prices are 0.43164, while that of exchange rate is 0.68062 indicating that both are not significant. Hence the series are normally distributed.

Table 4.11: Test for Stability Condition of VAR

Eigenvalue	Modulus
.08074713 + .07786731i	.112176
.08074713 - .07786731i	.112176
-.08074713 + .07786731i	.112176
-.08074713 - .07786731i	.112176

All the eigenvalues lie inside the unit circle. VAR satisfies stability condition

Table 4.11 shows the test for stability condition of vector autocorrelation. The modulus of each eigenvalue is strictly less than one (0.112176). The estimates satisfy the eigenvalue stability condition; hence, the model is stable. Conclusively, there is a short-run positive relationship between stock prices and exchange rate. There also exists one-way causality between stock prices and exchange rate with causality running from exchange rate stock prices. These results support the flow oriented theoretical foundation by Dornbusch and Fisher (1980) who proposed a positive relationship with causation running from exchange rate to stock prices and empirical findings of Ma and Kao (1990), Kurihara (2006), Ray (2012), Kisaka and Mwasaru (2012), Abiodun and Elisha (2012), and Olugbenga (2012).

V. CONCLUSION AND RECOMMENDATIONS

This paper investigated the relationship between stock prices and exchange rate in Nigeria using time series analysis. The All Share index (ASI) of the Nigeria Stock Exchange was used as a proxy for stock prices and the Naira/Dollar rate of the foreign Exchange Market was used as proxy for exchange rate. Two hundred and seventy-six (276) monthly observations for each of the variables spanning 20 years were used for the investigation.

Result of Vector Autoregression analysis show that there exists a positive relationship between stock prices and exchange rate. However, the coefficient of determination is more significant when exchange rate is used as explanatory variable on stock price and less significant when stock price is used on exchange rate. Therefore, any significant change in exchange rate will have significant effect on stock prices.

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The Granger causality test was carried out with two optimal lag length, the result show that the null hypothesis of no causality between stock prices and exchange rate can be rejected as there exist evidence of unidirectional causality running from exchange rate to stock prices i.e. exchange rate Granger-cause stock prices.

Drawing from the findings, we recommend for a long-term policy to stabilize the foreign exchange market to boost the stock market. This will have multiplier effect on the economy, domestic currency and investment decision. In addition, since activities of stock market serves as gauge, we suggest that stock prices should be closely monitored to prevent volatility in the prices which could negatively affect the performance of the stock exchange market.

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