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Exchange Rate Volatility and Stock Market Behaviour: The Nigerian Experience

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Abstract

This study examines the long-run and short-run effects of exchange rate on stock market development in Nigeria over 1985:1 – 2009:4 using the Johansen cointegration tests. A bi-variate model was specified and empirical results show a significant positive stock market performance to exchange rate in the short-run and a significant negative stock market performance to exchange rate in the long-run. The Granger causality test shows a strong evidence that the causation runs from exchange rate to stock market performance; implying that variations in the Nigerian stock market is explained by exchange rate volatility.

Keywords: Johansen Cointegration Tests; Granger Causality Test; Exchange Rate Volatility; Stock Market performance.

1. Introduction

The stock market plays a major role in financial intermediation in both developed and developing countries by channeling idle funds from surplus to deficit units in the economy. As the economy of a nation develops, more resources are needed to meet the rapid expansion. The stock market serves as a channel through which savings are mobilized and efficiently allocated to achieve economic growth (Alile, 1984). Large and long term capital resources are pooled through issuing of shares and stocks by industries in dire need of finance for expansion purposes. Thus, the overall development of the economy is a function of how well the stock market performs. Empirical evidences from developed economies as well as the emerging markets have proved that the development of the stock market is sacrosanct to economic growth (Asaolu and Ogunmuyiwa, 2010).

The macroeconomic view is one of the five schools of thought having bearing on the stock price behaviour. It is a method of using factor analysis technique to determine the factors affecting asset returns. The arbitrage pricing theory (Ross, 1976) has been the primary motives for earlier studies. Among macroeconomic factors included in the models is the exchange rate. The approach is based on the economic logic which suggests that everything does depend on everything else. The impact of exchange rate on stock market differs from country to country (Abdelaziz *et. al.*, 2008).

According to Maku and Atanda, (2009), theoretically, exchange rate as a macroeconomic variable is expected to affect the performance of stock market. But over the years, the observed pattern of the influence of this variable (in signs and magnitude) on stock market varies from one study to another in different countries. Most findings in the literatures suggest that there is a significant linkage between exchange rate and stock return.

The purpose of the study therefore is in two phases. First to investigate the empirical relationship persisting in Nigeria between exchange rate and stock market performance in the Nigerian Stock Exchange (NSE) using quarterly data that span from 1985 to 2009. Specifically, in this phase we test for market informational efficiency in NSE, by testing the existence of a long run causal relationship between exchange rate and stock market performance using Granger causality test. Secondly, to complement the existing literature on the stock market–exchange rate nexus

2. Literature Review

Theory explains that a change in the exchange rates would affect a firm's foreign operation and overall profits. This would, in turn, affect its stock prices. The nature of the change in stock prices would depend

on the multinational characteristics of the firm. Dimitrova (2005) asserted that establishing the relationship between stock prices and exchange rates is important for a few reasons. First, many researchers share the view that it may affect decisions about monetary and fiscal policy. As quoted by Damitrova, Gavin (1989) in his study demonstrates that a booming stock market has a positive effect on aggregate demand. According to him, if aggregate demand is large enough, expansionary monetary or contractionary fiscal policies that target the interest rate and the real exchange rate will be neutralized. Sometimes policy-makers advocate less expensive currency in order to boost the export sector. They should be aware whether such a policy might depress the stock market. Second, the link between the two markets may be used to predict the path of the exchange rate. This will benefit multinational corporations in managing their exposure to foreign contracts and exchange rate risk stabilizing their earnings. Third, currency is more often being included as an asset in investment funds' portfolios. Knowledge about the link between currency rates and other assets in a portfolio is vital for the performance of the fund. The mean-variance approach to portfolio analysis suggests that the expected return is implied by the variance of the portfolio. Therefore, an accurate estimate of the variability of a given portfolio is needed. This requires an estimate of the correlation between stock prices and exchange rates. Is the magnitude of this correlation different when the stock prices are the trigger variable or when the exchange rates are the trigger variable? Last, the understanding of the stock price-exchange rate relationship may prove helpful to foresee a crisis. Aggarwal (1981) found a significant positive correlation between the US dollar and US stock prices while Soenen and Hennigan (1988) reported a significant negative relationship.

Ajayi and Mougoue (1996) investigate the short-and long- run relationship between stock prices and exchange rates in eight advanced economies. Of interest to them are the results on short-run effects in the U.S. and U.K. markets. They find that an increase in stock prices causes the currency to depreciate for both the U.S. and the U.K. Ajayi and Mougoue explain this as follows: a rising stock market is an indicator of an expanding economy, which goes together with higher inflation expectations. Foreign investors perceive higher inflation negatively. Their demand for the currency drops and it depreciates.

As revealed by Bhattacharya and Mukherjee (2001), Bahmani-Oskooee and Sohrabian (1992) were among the first to use cointegration and Granger causality to explain the direction of movement between exchange rates and stock prices. Since then various other papers analyzing these aspects and using this technique have appeared covering both industrial and developing countries (for example, Granger *et al.* (2000); Ajayi *et al.* (1998); Ibrahim (2000). The direction of causality, similar to earlier correlation studies, appears mixed. For Hong Kong, Mok (1993) found that the relationship between stock returns and exchange rates are bidirectional in nature. For the United States, Bahmani-Oskooee and Sohrabian (1992) point out that there is a two-way relationship between the U.S. stock market and the exchange rates. Ma and Kao (1990) in his study attributed the differences in results to the nature of the countries i.e. whether countries are export or import dominant.

In their study on Istanbul Stock Exchange (ISE), Acikalin *et al.* (2008) using cointegration test and vector error correction model submit that exchange rate provides a direct long run equilibrium relationship with stock market index. Findings from the study reveal two ways of causalities between the two variables; implying that prediction of ISE is possible using the past information on the moves of exchange rate. The study of Ali *et al.* (2010) on Pakistan Stock Exchange reveals that exchange rate has no cointegration with stock exchange price index. The authors went further to establish that there is no granger causality between exchange rate and stock market performance.

On the Nigerian scene, in their study on Nigerian Stock Exchange, Asaolu and Ogunmakinwa (2011) investigated nine (9) macoeconomic variables. Exchange rate was found to have a positive significant impact on stock market prices. The authors went further to affirm that exchange rate granger causes average share price when considered in pairs.

In a related work by Atanda and Maku (2009), the Nigerian Stock Exchange all share index is found to be consistently determined by exchange rate. The work reveals that exchange rate has a long run significant negative effect on stock market performance. This finding is consistent with the findings of Olowe (2007) which also revealed that exchange rate has a negative influence on stock market performance.

3. Data Sample

This paper investigates the dynamic relationship between stock market performance and exchange rate in Nigerian economy. The choice of the variables is familiar with the works of Abdelaziz *et. al.* (2008) and Jones and Kaul, (1996). All Share Index (ALS) was used as proxy for stock market performance while the official foreign exchange of naira to US dollar was used as the exchange rate. The time period employed is therefore from 1985:1 to 2009:4; implying the use of quarterly data, representing a total of 100 observations. Data were sourced from the Central Bank of Nigeria Statistical Bulletin.

4. Econometric Methodology

The two variables of stock exchange as ALS_t , and exchange rate $ECHR_t$ were defined at time t . The natural Log values of the data were also determined to express them in common denominator. Thereafter, the following econometric procedure was systematically pursued. First, the non-stationarity and the order of integration for both $LALS_t$ and $LECHR_t$ were tested by employing the Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) unit root tests which use a null hypothesis of stationarity. The tests are performed for 0 to 100 lags i.e. 25 years. For all the unit root tests, if non-stationarity is not rejected, the variable is differenced once and the unit root tests are performed again. This is repeated until stationarity is achieved. The number of differences taken before the series become stationary is then the order of integration. i.e. $I(d)$. If the two time series are found to be integrated of the same order, we then proceed to test for the existence of cointegration vectors among them by performing the Johansen Cointegration test as specified below:

$$\Delta v_t = \phi v_{t-1} + \sum_{i=1}^k \lambda_i \Delta v_{t-i} + \mu_t \dots\dots\dots (1)$$

If we find the existence of one cointegrating relation between the two variables of $LALS$ and $LECHR$, we can then proceed to derive the error correction mechanism (ECM) of forms:

$$\Delta LALS_t = \mu_1 + \sum_{j=1}^{k-1} \Gamma_{11(j)} \Delta LALS_{t-j} + \sum_{j=1}^{k-1} \Gamma_{12(j)} LECHR_{t-j} + \Pi_{11} LALS_{t-k} + \Pi_{12} LECHR_{t-k} \dots\dots\dots (2)$$

$$\Delta LECHR_t = \mu_2 + \sum_{j=1}^{k-1} \Gamma_{21(j)} \Delta LALS_{t-j} + \sum_{j=1}^{k-1} \Gamma_{22(j)} \Delta LECHR_{t-j} + \Pi_{21} LALS_{t-k} + \Pi_{22} LECHR_{t-k} \dots (3)$$

Where the matrix Γ represents the short run dynamics of the relationship between $LALS$ and $LECHR$ and matrix Π captures the long run information in the data.

5. The Granger Causality Test

Thus, the model uses Granger causality test to ascertain the direction of causality between all share index (ALS) and exchange rate (ECHR) in Nigeria between 1985 and 2009 which covers the structural adjustment, post adjustment and reform periods. The test procedure as described by Granger (1969) is illustrated as:

$$LALS_t = \sum_{j=1}^k A_j LECHR_{t-j} + \sum_{j=1}^k B_j LALS_{t-j} + U_{1t} \dots\dots\dots (4)$$

$$LECHR_t = \sum_{j=1}^k C_j LECHR_{t-j} + \sum_{j=1}^k D_j LALS_{t-j} + U_{2t} \dots\dots\dots (5)$$

6. Empirical Findings and Results

Figures 1 and 2 show the time series plots of the all share index (ALS) and exchange rate (ECHR). A visual inspection of the graphs suggests a lack of existence of time trending properties in both series. Hence, the need to perform the unit roots tests.

Figure 1. GRAPH OF LALS

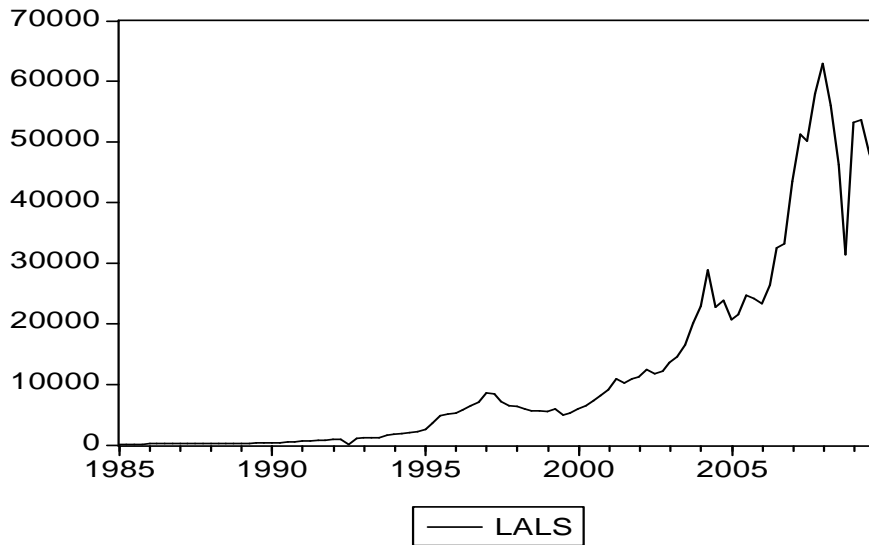


Figure 2. GRAPH OF ECHR

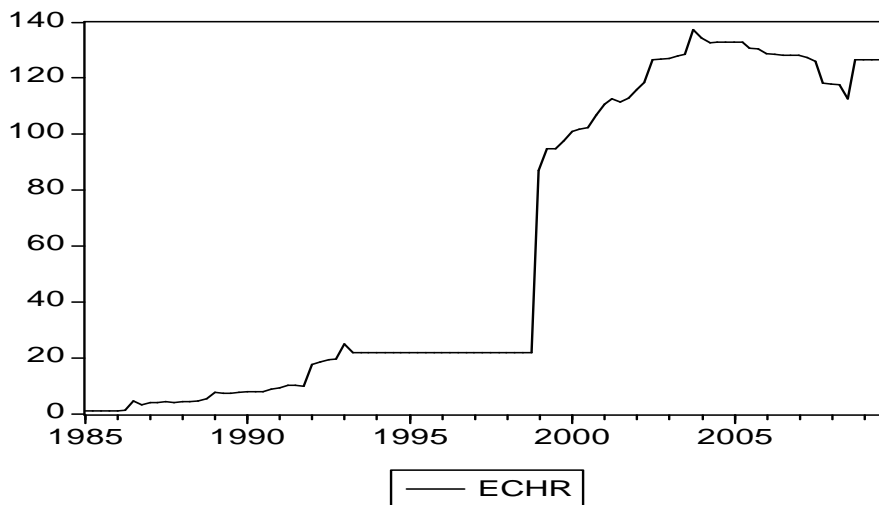


Table 1: Unit Root Test

		variables in levels		variables in 1 st diff	
		ALS	ECHR	ALS	ECHR
ADF	H0:Unit Root ADF(c)	1.456886	1.172962	-11.51530*	-10.79414*
PP	H0:Unit Root PP (c)	1.027810	1.172962	-22.83619*	-10.76638*

Notes: All variables in logarithms; Period: 1985 – 2009; Significance levels: * = 5%

In general, the unit root tests for non-stationarity (i.e. ADF and PP) in table 1 above fail to reject the null hypothesis of non-stationarity at both 1% and 5% levels for both ALS and ECHR in level terms.

However, the null hypotheses were rejected at 1% and 5% significance levels for both variables in first differenced terms. The unit root tests therefore show strong evidence that Nigerian all share index (ALS) and exchange rate (ECHR) are non-stationary and are integrated of order one i.e. I(1)

Johansen Cointegration Tests

Table 2: Trace Statistics Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.127940	19.49513	15.41	20.04
At most 1 *	0.062073	6.216087	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
 Trace test indicates 2 cointegrating equation(s) at the 5% level
 Trace test indicates no cointegration at the 1% level

Having confirmed the stationarity of the variables (LALS, LECHR) at the I(1), the existence of a long-run equilibrium relationship between the variables in the model was determined. This was achieved by using the trace statistics test and the maximum eigen test of the Johansen Cointegration test. From the above, it could be deduced that the trace statistics is greater than the 5 percent critical value at the Non-hypothesized (None *) which established a long run cointegration relationship in the model. Furthermore, the Maximum eigen test also confirms the existence of a long-run cointegration relationship in the model. The table below shows the result of the Maximum eigen test. The 5% critical value is less than the maximum eigen statistic showing that there exists one cointegrating equation.

Table 3: Maximum Eigen Test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	5 Percent Critical Value	1 Percent Critical Value
None	0.127940	13.27904	14.07	18.63
At most 1	0.062073	6.216087	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level
 Max-eigenvalue test indicates 1 cointegration at both 5% level

Results in the table 4 below further confirm the existence of a long-run equilibrium relationship in the model. Furthermore, it shows an existence of one cointegration equation which pointed out that the long-run relationship between ALS and ECHR is negative (see results in the following table). $t^* = -8.125$ which implies that exchange rate exerts a significant negative impact on stock market performance in Nigeria.

Table 4: Normalized Cointegrating Coefficients

1 Cointegrating Equation(s):		Log likelihood	-95.76575	
Normalized cointegrating coefficients (std.err. in parentheses)				
LALS	LECHR			
1.000000	-1.362229			
	(0.16765)			

From this, the short-run relationship of the parameters using the Error Correction Model (ECM) was ascertained. The Error correction model shows that the individual coefficients of the explanatory variable (ECHR) are in conformity with theory. This is shown in the table below:

Table 5: Result of the Error Correction Mechanism (ECM)

Included observations: 97 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LALS(-1),2)	-0.555103	0.066842	-8.304767	0.0000
D(LECHR,2)	1.022607	0.425789	2.401674	0.0183
D(LECHR(-1),2)	0.875460	0.418269	2.093056	0.0391
ECM(-1)	-0.723121	0.113154	-6.390588	0.0000
R-squared	0.619338	Mean dependent var		-0.000830
Adjusted R-squared	0.607059	S.D. dependent var		1.725542
S.E. of regression	1.081657	Akaike info criterion		3.035227
Sum squared resid	108.8082	Schwarz criterion		3.141401
Log likelihood	-143.2085	Durbin-Watson stat		2.173022

The table above shows that ECHR including its lagged variable are positively related to ALS in deviation from the long-run perspective. The R^2 shows that exchange rate accounted for about 61.9% of the variations in the behaviour of Nigerian stock market. Furthermore, the durbin-watson statistics of 2.17 shows that there exist no autocorrelation or serial correlation in the data for the model.

Table 6: Granger Causality Test

Pairwise Granger Causality Tests
 Sample: 1985:1 2009:4
 Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
LECHR does not Granger Cause LALS	98	5.02329	0.00848
LALS does not Granger Cause LECHR		0.34050	0.71230

Lastly, the Granger causality test rejects the null hypothesis that says 'LECHR does not Granger Cause LALS'. This implies the acceptance of the alternative hypothesis. However, the test fails to reject the second null hypothesis saying 'LALS does not Granger Cause LECHR'. The test therefore clearly shows a unidirectional relationship running from exchange rate to stock market performance in Nigeria. i.e. there is a strong evidence that the causation runs from exchange rate stock market returns; implying that variations in the Nigerian stock market is explained by exchange rate volatility. My finding here is consistent with the works of Granger, Huang and Yang (2000).

7. Summary and Concluding Remarks

This paper applies the Johansen cointegration technique and error correction mechanism to investigate whether exchange rate exerts any influence or impact on the performance of Nigeria stock market. The main results of the paper show that exchange rate as a factor exerts significant impact on Nigerian stock market both in the short run and in the long run. In the short run, exchange rate has a positive significant impact on stock market performance in Nigeria. However, the results also show that the relationship is significantly negative in the long run. This is consistent with theory especially for import dominated economies like Nigeria. Ma and Kao (1990) attributed the differences in results to the nature of the countries. My findings give empirical support for the work of Olowe (2007). The negative influence of

exchange rate on Nigerian stock market performance could be as a result of heavy devaluation of the currency since the introduction of the structural adjustment programme in 1986. As a result of this, the stock market could not adjust to the high devaluation. The findings here are consistent with the works of Ajayi and Mougoue (1996), and Soenen and Hennigan (1988). Although, Nigeria is an oil exporting country, the import bill on oil and other products is substantially greater than what is exported in the recent times. Government has to resuscitate the various export sectors such as agriculture, energy and manufacturing sectors of the economy so that the nation import bills will be kept at minimum.

The statistical significance of exchange rate both in the short-run and the long-run suggests that volatility of exchange rate can be used to predict the performance of stock market in Nigeria. Hence, investors are guided in their investment decision making. Again, policy makers must also be mindful of the trend exchange rate as regards the formulation of policies having impact on the Nigerian stock market. As corollary to this, the predictability of stock market performance with exchange rate volatility is a serious violation of efficient market hypothesis.

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