Stock Prices and Exchange Rate Interactions in Nigeria: An Intra-Global Financial Crisis Maiden Investigation

Aliyu, Shehu Usman Rano

Bayero University Kano, Nigeria

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Shehu Usman Rano Aliyu[1]

Abstract

This paper examined the long run and short run interactions between stock prices and exchange rate in Nigeria based on a sample from 1st February, 2001 to 31st December, 2008. Three models were derived from the sample, albeit pre-crisis, crisis and basic models. The paper set out by testing the time series properties of the series using the ADF and PP tests. In addition, the Engle and Granger two-step and Johansen and Juselius cointegration procedures were applied. Empirical results showed that all the series are I(1) and evidence of cointegration was established using the Johansen and Juselius methodology. Furthermore, causality tests revealed strong evidence of long run bidirectional relationship between stock prices and exchange rate in the models. Policy wise, the findings implied that monetary authorities in Nigeria are not constrained to take into account stock market development in achieving their exchange rate policy objective given the symbiotic nature of relationship between the two. The paper recommends measures that would promote greater stability and efficiency of the Nigeria's foreign exchange market.

Keywords: Stock prices, exchange rate, Granger causality, cointegration and vector error correction.

The emergence of new global capital markets, flexible exchange rate system and globalization of financial markets has sparked the need for investigation into the relationship between stock prices and exchange rate in recent years. The global energy and financial crises and the cobweb of relationships with foreign exchange and stock markets, especially for oil exporting nations like Nigeria further accentuate the need for an enquiry into the nature of the interaction between the two variables. According to Stavarek (2004) and Azman-Saini *et al* (2006) mutual relations between foreign exchange markets and stock markets have attracted much attention of researchers and academics since the beginning of 1990s.

A growing number of developing countries have recognized the useful role that stock markets can play in enhancing the efficiency of domestic financial systems. According to Ilmolelian (2005) stock markets usefully complement and compete with the banking sector, thereby reducing the cost of capital for borrowers. The markets also permit diversification of company ownership, more efficient risk sharing, and a healthier financial structure of corporations by improving their debt/equity ratios. The opportunities which stock markets offer investors for

[1] The author is an Associate Professor of Economics at Bayero University Kano. He is at the time of writing this paper a visiting scholar working with the Research Department of the Central Bank of Nigeria, Abuja on a Sabbatical leave. Email: susaliyu@yahoo.co.uk, Mobile: +2348037875246

diversifying their portfolios also help lower the risk premium component in the cost of capital. Secondary equity markets also help in matching the long term horizon of borrowers with the short-term liquidity preference of investors. Furthermore, through the stock price mechanism, a more effective allocation of investment might also result, as poor management of listed companies may have large effects on the price at which the market values a firm. In addition, listing on stock markets implies disclosure of information to investors; this will encourage firms to improve their accounting standards and make management more transparent.

The link between stock prices and exchange rate has been established in the literature. Although according to Bahmani-Oskooee and Sohrabian (1992) and Granger *et al* (2000) there are sufficient theoretical reasons for causality to run in both directions. Muhammad and AbdulRasheed (2002) and Stavarek (2004) argued that there is theoretical consensus neither on the existence of relationship between stock prices and exchange rates nor on the direction of the relationship. For instance, portfolio balance models of exchange rate determination postulate a negative relationship between stock prices and exchange rates and that the causation runs from stock prices to exchange rates. In these models individuals hold domestic and foreign assets, including currencies, in their portfolio and hence exchange rates play the role of balancing the demand for and supply of assets. An increase in domestic stock prices lead individuals to demand more domestic assets. To buy more domestic assets local investors would dispose foreign assets, which are relatively less attractive now, causing local currency appreciation. Equally, an increase in wealth due to a rise in domestic asset prices will also lead investors to increase their demand for money, which in turn raises domestic interest rates. This again leads to appreciation of domestic currency by attracting foreign capital. Another channel for the same negative relationship is increase in foreign demand for domestic assets due to stock price increase. This would also cause a domestic currency appreciation.

In contrast to the above, a positive relationship between stock prices and exchange rates with direction of causation running from exchange rates to stock prices is also expected. According to Dornbusch and Fisher (1980) 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 exports. A rise in the foreign exchange inflow – income, in turn raises their stock prices. A condition of no causation arises when firms especially in developing countries import as much - in value terms, capital inputs as they export, no causation is expected due to expected rise in the cost of production.

The absence of a general rule on the nature and direction of causation between stock prices and exchange rate from both the theoretical and empirical literature applicable to all countries makes it desirable to carry out further investigation into the issue. Already, a huge body of empirical literature exists on developed countries and in the Asian countries - motivated by the 1990s Asian economic crisis. The current global financial crisis, which was precipitated by the United States Mortgage crisis and huge corporate closures and its attendant consequences effects on other nations, particularly the weaker ones like Nigeria makes the study all the more adds to the need for an empirical study of this nature.

The Nigeria's capital market according to Oluba (2008) has been hailed as one with the highest returns in the world and one which offers opportunities for portfolio diversification outlets by both the capital world and the Nigerian Stock Exchange (NSE). The market witnessed an unprecedented growth in both the volume and scale of its activities, which was stimulated by the recently concluded banking sector consolidation. A process which saw the neat collapse/merger of eighty nine feebling banks into twenty five strong banks each with a capital base of over five hundred billion naira- N500 billion or roughly $4.3billion. The spillover effect of the global crisis sets in as investors in the market begin reaping huge inflationary income from excessive banks credits nurtured by recapitalization of the banks and massive inflows of portfolio investments. In addition some foreign investment banks set up offices in the country. Two factors were traced by analyst as responsible for burst in the market. First was the decision by the Central Bank of Nigeria (CBN) to stop massive credit expansions via bank lending for equities and the consequent halt on margin facilities. The second factor was the equally massive withdrawals of funds from the market by foreign institutional investors and investment banks in response to the global financial crisis.

Empirical evidences have shown that the NSE has lost about 50.8 percent of its value since the beginning of the year. Market capitalization fell from N15.3 trillion in the first quarter of 2008 to N7.53 trillion in the first week of November, 2008 and further down to N6.25 trillion in the second week of December, 2008. Value of stocks trade in the market declined drastically from N387.3 billion in February, 2008 to N161.0 billion in September, 2008 and to only N38.1 billion by end of November, 2008. Meanwhile, the All Share Index (ASI) fell from N66, 371.20 in the first quarter of 2008 to N27, 958.25 in the second week of December, 2008. Number of deals in the market also saw a rapid decline. The morale in the market was also badly – significantly, affected when measured in terms of number of deals recorded in the market. From a total number of 447,660 deals in the first quarter of 2008 to only a total of 111,872 deals as at the end of October, 2008, thus a fall by 75.01 percent.

Consequently, the Nigeria's external sector was hit by the ongoing crisis. For an economy, which is umbilically tied to wind fall in the world oil market, the plummeting of crude oil prices resulted in significant decline in foreign exchange earnings and evidently, lower accretion to external reserves. The average price of crude oil fell by 36.2 percent to US $69.23 per barrel. External reserves which in September, 2008 stood at US $62,082.86 million declined to US $58,426.40 or a fall by 6.3 percent in October, 2008. The naira exchange rate, which hitherto remained stable, was deliberately devalued by the CBN from N116.20 in November, 2008 to N131.5 in December, 2008 or a decline in value by 12. 95%.

With the above trend and the unfolding events across the world, there is the need to investigate the interactions between stock prices and exchange rate in Nigeria. The main objective of this paper is to assess whether there have been any relationships between stock prices and exchange rate in Nigeria on the basis of a daily stock prices and exchange rate data from February, 2001 to December, 2008. The essence is to detect whether the recent global financial crisis has any significant effect on the nature and direction of causality between the two variables. The rest of the paper is decomposed into the following sections. The next, which is section two, presents a review of the relevant literature. Section three explains methodology employed. Section four contains the empirical results and discussions and the last section contains conclusions and recommendations.

II. Review of Relevant Literature

Stock market plays important role in the economic development of any nation. Beside serving as an instrument for mobilization of domestic capital for the corporate sector, the mere presence of the market boosts the international investment climate of a country. Theoretically, capital market not only knots the domestic macroeconomic indicators within an economy, but also with the outside economy as well. Trade, capital and other financial flows are all tied to it. A particular link that currently is attracting so much attention is the one between stock prices and the levels of exchange rate of a country. According to the Classical economists, currency appreciation may affect product international competitiveness and trade balance position.[2] This section reviews empirical studies carried out on the nexus between stock prices and exchange in developed, Asian and some African countries.

The first era of empirical studies on the relationship between stock prices and exchange rate, according to Stavarek (2004) started after the Britton-wood agreement. These include studies by Franck and Young (1972), Aggarwal (1981) Giovannini and Jorion (1987), Solnik (1987) and Soenen and Hennigan (1988). Much as they were taken as pioneer studies, yet they came up with different conclusions. For instance, Solnik (1987) found no significant effect of exchange rate (among other variables) on stock prices in a group of nine industrialized countries. Soenen and Hennigan (1988) reported strong negative interaction using monthly data of the US dollar effective exchange rate and US stock market index during 1980–86. In addition, Jorion (1990) found moderate relations between stock returns of US multinational companies and the effective US dollar exchange rate for the period 1971–87.

Subsequently, most empirical studies in the 1990's applied cointegration techniques. For instance, Yu (1997) employed daily stock price indices and spot exchange rates obtained from the financial markets of Hong Kong, Tokyo, and Singapore over the period from January 3, 1983

[2] Decline in product demand affect balance of payment position, output and profit of firms and adversely affects stock prices. The portfolio-balance model, however, argued that, being part of wealth, equity may affect the exchange rates through demand for money. Higher stock prices, for example, may lead to a higher demand for money, which in turn, causes interest rates to rise. Eventually, higher interest rate leads to foreign capital inflows and an appreciation of domestic currency or the level of exchange rate.

to June 15, 1994 to examine the possible interaction between these financial variables. Findings based on the Granger causality test show that the changes in stock prices are caused by changes in exchange rates in Tokyo and Hong Kong markets. However, no such causation was found for the Singapore market. On the reverse causality from stock prices to exchange rates, his results showed such causation for only Tokyo market. Therefore, for Tokyo market there is a bi-directional causal relationship between stock returns and changes in exchange rates. In addition findings from vector autoregressive (VAR) model showed a strong long run stable relationship between stock prices and exchange rates on levels for all three markets.

Abdalla and Murinde (1997) applied cointegration approach to examine the long-run relation between stock price index and the real effective exchange rate for Pakistan, Korea, India and Philippines. Their study relied on monthly data from January 1985 to July 1994. Findings revealed no long-run relationship for Pakistan and Korea but a long-run relationship for India and Philippines. Furthermore, vector error correction model was applied in the case of India and Philippines and the results showed a unidirectional causality from exchange rate to stock prices for India, but, for Philippines the reverse causation from stock prices to exchange rates was found. The same authors also established a unidirectional causality from exchange rates to stock prices for both Pakistan and Korea using standard Granger causality tests.

In a study by Kaminsky *et al* (1998), stock prices are found to be the fourth best predictor of currency crises. Granger, Huang and Yang (2000) examined the issue of causality using Granger causality tests and impulse response function for nine Asian countries. They used daily data for the period January 3, 1986 to November 14, 1997 and the countries included in their study are: Hong Kong, Indonesia, Japan, South Korea, Malaysia, Philippines, Singapore, Thailand and Taiwan. Results for Japan and Thailand showed that exchange rate leads stock prices with positive correlation while stock prices leads exchange rates with negative correlation in Taiwan. Findings also revealed no relationship for Singapore while a bi-directional causality was found in the remaining countries. Using the same sample of nine countries, Amare and Mohsin (2000) applied cointegration technique on a monthly. Their results revealed long run relationship between stock prices and exchange rates only for Singapore and Philippines. They attributed lack of cointegration between the said variables in the other countries to the bias created by the "omission of some important variables".

In the US, Nonlinear Least Square method was applied by Ong and Izan (1999) to examine the association between stock prices and exchange rates. They found that U.S. share price returns fully reflect information conveyed by movements in both the Japanese yen and the French francs after four weeks. Their results, however, suggested a very weak relationship between the U.S equity market and exchange rates. They concluded that depreciation in a country's currency would cause its share market returns to rise, while an appreciation would have the opposite effect. Also, Kim (2003) investigates the existence of long-run equilibrium relationships among the aggregate stock price, industrial production, real exchange rate, interest rate and inflation rate in the United States, applying Johansen's cointegration methodology. For the 1974 and 1998 period he finds that the S&P 500 index is positively related to the industrial production but negatively related to the rest of the variables. When the error correction analysis was used, it reveals that the stock prices, industrial production and inflation adjust to correct disequilibrium among the five variables. At the same time, the research indicates that stock prices are driven to a significant extent by innovations in the interest rate.

In Malaysia, Ibrahim (2000) examines the interactions between the foreign exchange market and the stock market in Malaysia and his results indicated that despite the lack of a long run relationship between the exchange rate measures and stock prices in bivariate cointegration models, there is evidence of long run relations in multivariate models that included M_2 money supply and foreign reserves. Recently, Azman-Saini *et al* (2006) examined causal relations between stock prices and exchange rates in Malaysia using a new Granger non-causality test proposed by Toda and Yamamoto (1995). Findings revealed a feedback interaction between exchange rates and stock prices for the pre-crisis period. The results also showed that exchange rates lead stock prices for the crisis period. In a financially liberalized environment according to the authors, exchange rates stability is important for stock market well-being.

Granger *et al.* (2000) found that causality runs from domestic stock prices to exchange rates in a group of Asian countries. Their findings offered theoretical support for bidirectional relationship between the stock market and foreign exchange market, but only over the short run. They argued that a change in exchange rates would change the market value of all firms that trade

internationally. Wu (2001) provides evidence of the negative relationship between equities and exchange rates in South East Asia. While in Thailand and the Philippines Nagayasu (2001) analyzes intra- and inter-market causality in a form of bivariate VAR model and concludes that stock prices seem to have caused upward pressure on exchange rates, Azman-Saini *et al* (2003) found that there is a feedback interaction in Thailand for the pre-crisis period and that exchange rates lead stock prices during the crisis period.

Furthermore, a study in South East Asia by Broome and Morley (2003) using a basic currency crisis model assessed the effectiveness of stock prices as a leading indicator of currency crisis between 1997 and 1998. Using monthly data, the results revealed that the domestic stock price is a significant leading indicator with the Hong as the most significant indicator. Results of causality tests further showed evidence of bi-causality between the stock markets and foreign exchange markets. Dong *et al* (2005) examined six emerging Asian countries between 1989 and 2003 and found no cointegration between their exchange rates and stock prices. They, however, detected a bi-directional causality in Indonesia, Korea, Malaysia and Thailand. Except for Thailand, the stock returns showed a significant negative relation with the contemporaneous change in the exchange rates, which implies that currency depreciations generally accompany falls in stock prices.

Murinde and Poshakwale (2004) examined price interactions between the foreign exchange market and the stock market in a number of three European emerging financial markets – Hungary, Poland and Czech Republic –before and after the adoption of the euro. Using daily observations on both stock prices and exchange rates, they found that the pre-euro period stock prices in these countries uni-directionally Granger cause exchange rates only in Hungary, while bi-directional causality relations exist in Poland and Czech Republic. After the euro adoption, exchange rates uni-directionally Granger cause stock prices in all three countries.

In the Middle East and North Africa region, Gunduz and Abdulnasser (2004) investigated the causality between the exchange rates and stock prices before and after the Asian financial crisis. Empirical evidences revealed uni-directional Granger causality from exchange rates to stock prices for Israel and Morocco before and after the crisis, and for Jordan after the crisis.

Additionally, no relationship was identified between the two variables for Egypt. In Africa, Jefferis, Okeahalam and Matome (2001) reported that the real stock market index of the Johannesburg Stock Exchange (JSE) has a positive long term relationship with real GDP and real exchange rate and a negative relationship with real long term interest rate over the period 1985 to 1995.

Phylaktis and Ravazollo (2005) examined the long run and short run dynamics between stock prices and exchange rates and the channels through which exogenous shocks impact on these markets in Pacific Basin countries using cointegration methodology and multivariate Granger causality tests. Their results suggested that these markets are positively related and that the US market acts as a leading factor for these links. Moreover, the links between the stock prices and exchange rates were found to be determined by foreign exchange restrictions.

Alexandra and Livia (2007) applied bivariate cointegration and Granger causality tests on daily and monthly exchange rates and stock prices data collected over the 1999 to 2007 period. Their study uses three types of exchange rates; the nominal effective exchange rates of the Romanian *leu*, the bilateral nominal exchange rates of the *leu* against the US dollar and the euro, and the real effective exchange rates of the *leu*. While the application of the Engle and Granger methodology indicates no cointegration between the exchange rates and the stock prices, the Johansen-Juselius procedure, however, suggests the presence of cointegration between stock market indices used and the exchange rates - nominal bilateral, nominal effective or real effective rates. The authors concluded that the lack of cointegration indicated by the Engle and Granger procedure may be due to the lower power of the test, as recognized in the literature. Granger causality tests, on the other hand revealed unilateral causality relations from the stock prices to exchange rates for the entire period and the second sub-period, and one bilateral causality relation between the stock prices and the bilateral exchange rate against the US dollar and the euro for the first sub-period.

It is evident from the above review that there is no consensus from both the theoretical and empirical literature on the direction of causality between stock prices and exchange rates. This was found to be so in both the developed, Asian and emerging economies. Equally, studies in Africa and Gulf States also revealed this lack of consensus. According to Alexandra and Livia

and (2007) the countries involved and regions are diverse and the results are also mixed, no definite conclusion could be drawn from them. From the review, however, there were more evidences suggesting the direction of causality running from stock price to exchange rate; Jarion (1990), Granger *et al* (2000), Amare and Mohsin (2000), Wu (2001), Nagayasu (2001) Jefferis, Okeahalam and Matome (2001) Broome and Morley (2003), Phylaktis and Ravazollo (2005), Murinde and Poshakwale (2005), Alexandra and Livia and (2007). While Solnik (1987), Soenen and Hannigan (1988), Yu (1997), Abdullah and Murinde (1997), Granger, Huang and Yang (1998), Ong and Izan (1999), Gundaz and Abdulnasser (2004) and Dong *et al* (2005), Azman-Saini *et al* (2003) and (2006) all reported exchange leading stock price, in most cases with a negative sign. Although this categorization is not very distinct as some studies reported mixed results because their sample comprised of a number of countries, yet it showed that the direction of causation falls within the neat theoretical divide of either of the two taking the lead in the direction of causation. Equally, important from the review also is the existence of cointegration established by some studies among the variables. The next section presents the methodology of the paper where the empirical model is presented.

III. Research Methodology

This paper generates data over the period of 1st February, 2001 – 31st December, 2008 on a daily - using five working days in a week, basis. The nominal the exchange rate of the Nigerian naira vis-à-vis the US dollar and the Nigeria's Stock Exchange (NSE) market performance. The former, that is, the nominal exchange rate of the naira was obtained from results of the daily bidding for the currency published by the Central Bank of Nigeria (CBN) and the latter was obtained from the databank of the CBN. The All Share Index (ASI) was used as an indicator of the market performance covering the same period. The plot of the series is present in figure one. The use of lower frequency data such as weekly or daily was preferred in order to tract the pattern of movements in the two series and their significant interactions. The series were transformed into natural log such that coefficients would be interpreted as elasticities in the models. In order to better understand the pattern of interactions among the variables, the sample period is broken into two sub-samples. Pre-crisis period covers February, 2001 to December,

2006 and crisis period[3] continues from January, 2007 to December, 2008. At large, the author retained the basic sample as the general form of the model.

Figure 1: Stock Prices and Exchange Rate series.

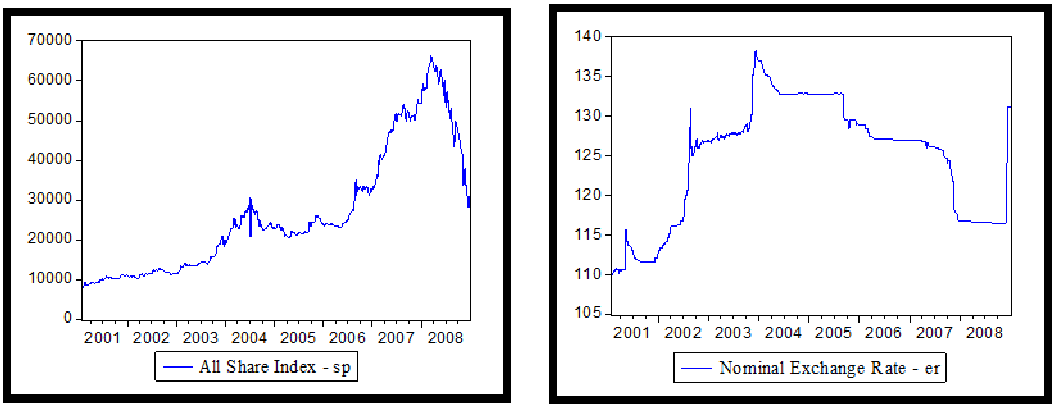

Figure 1 above shows the pattern of movements in the All Share Index in the NSE. The graph depicts moderate and healthy acceleration in the index until 2004. The most violent turning point in the index started towards the end of 2008, the most noticeable one occurring in the mid of August, 2008. This coincides with the developments taking place in the global financial markets, which started in the US since 1st August, 2007 and became more pronounced in July 2008. The graph of the nominal exchange on the other hand is less cyclical, which characterizes the regime of intervention[4] in the determination of the exchange by the Central Bank of Nigeria.

Since the research objective is to detect significant interactions between the stock prices and the exchange rate on a bivariate basis, the paper carried out its analysis by using two types of analysis: cointegration and a Granger causality tests. For the cointegration, the Engle and Granger (1987) two step procedure and the Johansen and Juselius (1990) bivariate cointegration tests were applied.

[3] The crisis period here is the combined effect of the post banking sector consolidation which saw massive inflow of banks shares into the NSE – both secondary and primary issues, and the Global financial crisis, which generated massive outflow of funds by foreign firms.

[4] Since the deregulation of the economy in July, 1986, a number of exchange rate management options were adopted. The ones that feature between 2001 and 2008 were the Retail Dutch Auction System and the Wholesale Dutch Auction System. The systems involve selling foreign exchange to authorized Banks/dealers at a rate arrived at during the auction sessions.

The Engle and Granger (1987) test procedure involves an OLS estimation of a pre-specified cointegrating regression between the indices, followed by a unit root test performed on the regression residual previously identified, the Johansen-Juselius procedure on the other hand is based on the maximum likelihood estimation in a VAR model, and calculates two statistics – the trace statistic and the maximum Eigenvalue – in order to test for the presence of *r* cointegrating vectors. While the null hypothesis of no cointegration is rejected in the Engle and Granger test if the regression residuals are found to be stationary at levels, the trace statistic in the Johansen procedure tests the null hypothesis that there are at most r cointegrating vectors against the hypothesis of r or more cointegrating vectors. The maximum Eigenvalue statistic also tests for r cointegrating vectors against the hypothesis of r+1 cointegrating vectors. The Johansen and Juselius procedure considers all variables included in the cointegration test as being endogenous and therefore it avoids the issue of cointegrating vector normalization on one of the variables or of imposing a unique cointegrating vector, as implied in the Engle and Granger test. Beside its ability to determine the number of cointegrating vectors, the Johansen-Juselius procedure is generally considered to have more power than the Engle and Granger test.

Meanwhile, the paper first examines the time series properties of the said variables using the Augmented Dickey Fuller (ADF) and Phillips and Perron tests to establish the order of integration of the series before embarking on the cointegration tests. Meaning, it is only when the series are found to be of the same order of integration then we can proceed to apply the cointegration tests. Economically speaking, cointegration of two or more variables implies a long term or equilibrium relationship between them, given by their stationary linear combination (called the cointegrating equation). The ADF tests involved the estimation of the following regression

$$\Delta x_t = \alpha + \beta_t + \delta x_{t-1} + \sum_{i=1}^{k} \Delta x_{t-1} + \varepsilon_t \qquad 3.1$$

where *x* in the above equation 3.1 is the variable under consideration. Normally, the variables at level are nonstationary according to Engle and Granger, while the first differences are stationary at the 1% statistical significance level. Equation 3.2 gives the Johansen (1991) and (1995) maximum likelihood procedure. The procedure is based on a vector error correction model (VECM) and is represented in following form:

$$\Delta X_t = \mu + \sum_{t=1}^{p} \Gamma_i \Delta X_{t-i} + \Pi X_{t-p} + \xi_t \qquad 3.2$$

where Δ is the first difference lag operator, X_t is a (kx1) random vector of time series variables with order of integration equal to one, $I(1)$, μ is a (kx1) vector of constants, Γ_i are (k x k) matrices of parameters, ξ_t is a sequence of zero-mean p- dimensional white noise vectors, and Π is a (k x k) matrix of parameters, the rank of which contains information about long-run relationships among the variables. If the Π - matrix has reduced rank, implying that $\Pi = \alpha\beta'$, the variables are cointegrated, with β as the cointegrating vector. If the variables were stationary in levels, Π would have full rank. The cointegration rank in this study is conducted with the maximum eigenvalue and trace test. The asymptotic critical values are given in Johansen (1990) and MacKinnon-Haug-Michelis (1999).

For the purpose of this paper and from theoretical, intuitive, and review of empirical studies, we specify the cointegration relationship between stock prices *sp* and exchange rate *er* as follows:

$$ln\ sp_t = \alpha_0 + \beta_0\ er_t + Z_{0t} \qquad 3.3$$

$$lner_t = \alpha_1 + \beta_1 sp_t + Z_{1t} \qquad 3.4$$

where *lnsp* is the natural log of All Share Index (ASI) and *lner* is the natural log of nominal exchange rate and both were obtained from the CBN Research department. $\alpha_{'s}$ and $\beta_{'s}$ are the constants and elasticities of the independent variables; exchange rate and stock prices and are expected to be negative and positive respectively. $Z_{'s}$ are the white noise residual terms. Finally, the modified Granger causality representation is given in equation 3.5 and 3.6 below:

$$\Delta sp_t + \alpha_0 + \beta_0\ Z_{1t-1} + \Sigma\gamma_{0i}\Delta\ sp_{t-i} + \Sigma\delta_{0i}\Delta er_{t-i} + \varepsilon_{0t} \qquad 3.5$$

$$\Delta er_t + \alpha_1 + \beta_1\ Z_{2t-1} + \Sigma\gamma_{1i}\Delta er_{t-i} + \Sigma\delta_{1i}\Delta sp_{t-1} + \varepsilon_{1t} \qquad 3.6$$

where Δ is the first differenced operator (i.e., $\Delta sp_t = sp_t - sp_{t-i}$), ε_t is error term with zero mean and constant variance and Z_1 and Z_2 are the lagged residuals[5] obtained from the regressions of equations 3.3 and 3.4 respectively. In Equation 3.5, for instance, *er* Granger causes *sp* if either β_0 is statistically significant (the long-run causality) or the δ_{0i}'s are jointly significant (short-run causality). Alternatively, rejecting H_0: $\beta_0 = 0$ and H_o: $\beta_1 = 0$ implies Granger causation among the variables in the long run. However, if β_0 and $\beta_1 = 0$, that is, there is no long run equilibrium relationship between *sp* and *er*, then the above causality test reduces to the standard Granger causality test[6]. Granger (1983) pointed out that the error correction based approach allows for the finding that *X* Granger causes *Y*, even if the coefficients on lagged changes in *X* are not jointly significant by including lagged residuals from the cointegrating regression. Miller and Russek (1990) added that the error-correction model introduces an additional channel through which Granger causality emerges. The next section presents results of the ADF, Johansen cointegration and the Granger causality tests.

IV Results and Interpretations

As a first step in the analysis the paper transforms all time series into natural logarithm values. Thus, first differences correspond to growth rates. The paper then tested for unit roots in all stock prices, *sp* and exchange rate, *er* using ADF and PP tests. The results suggested that the series are all nonstationary at level across the three models; the pre-crisis, crisis and the basic models. From the results presented in table 2 – left hand side, the null hypothesis of presence of unit root cannot be rejected at level. However, the right hand side results in the same table 2 showed that by taking the series at their first difference, both series across all the three specifications of the model were found to be stationary at 1 percent level using both the ADF and the PP tests. Therefore, all the series in these three model are stationary or integrated for order one, that is, *I*(1). Meaning, there exist a long run relationship between stock prices and exchange rate in Nigeria between 2001 and 2008. This leads us to next, which is applying the cointegration tests.

[5] Alexandra and Livia (2007) stated that statistically, the presence of cointegration excludes non-causality between the variables under consideration. Therefore, if two variables are found to be cointegrated, then there must be causality in the Granger sense between them, either uni-directionally or bi-directionally. In such a case, the Granger test can be correctly specified by including in the equation referring to two cointegrated variables an error correction (EC) term, representing the residuals from the cointegrating regression.

[6] See: Granger, 1988 and Jones and Joulfaian, 1991; for details. Naeem and Rasheed (2002) argued that the use of the standard Granger causality test when the variables are cointegrated may leads to misleading results because of employing a wrong model specification.

Table 1: Unit Root Tests

	Level		*First Difference*	
Model	ADF Test Statistic	PP Test Statistic	ADF Test Statistic	PP Test Statistic
Pre-crisis Model				
sp	-1.08	-1.08	-51.4*	-51.6*
er	-2.05	-2.15	-11.9*	-42.3*
Crisis Model				
sp	-0.71	-0.86	-10.4*	-10.7*
er	-1.40	-1.03	-8.18*	-24.1*
Basic Model				
sp	-1.72	-1.81	-24.4*	-52.7*
er	-1.90	-1.92	-15.6*	-48.7*

* indicates significance at 1 percent level using MacKinnon critical values
Note: Lag length was chosen in line with the Schwarz information criterion which imposes a larger penalty for additional coefficients. It is given by SC = $2l/T + (k \log T)/T$. where l is the log likelihood, T is the number of observations and k is the number of coefficients.

As mentioned earlier, both the Engle and Granger the Johansen and Juselius cointegration approaches were applied. For the Engle and Granger test, when the residuals from the regression of cointegrating equations (3.3) and (3.4), were tested at level, results presented in table 2 indicated that the residual series are not stationary. The null hypothesis of unit root could not be rejected. The residuals from the three model are, therefore, I(1) and this reveal no cointegration going by the procedure.

Table 2: Engle-Granger Cointegration Test Applied to Residuals

	Level		*First Difference*	
Variable	ADF Test Statistic	ADF-C.V at 5%	ADF Test Statistic	Order of Cointegration
Pre-Crisis Model (ec_{1t})	-0.54	-3.41	-23.6	I(1)
Crisis Model(ec_{2t})	-1.22	-3.41	-48.9	I(1)
Basic Model(ec_{3t})	-2.27	-3.41	-10.7	I(1)

Note: Regression contains both intercept and trend in the models. See appendix for more results.

The bivariate Johansen procedure when applied on the other hand revealed presence of cointegration among the variables, that is, the existence of a long run equilibrium relationship between stock prices and exchange rate. The level of cointegration is, however, not very strong. In addition, the regressions assume no deterministic trend in the data. In line with the lag selection criteria, lag of 1 to 2 was used in the basic and pre-crisis models while lag of 1 to 4 in the crisis model. The results presented in table 3 show the existence of one cointegrating equations in the three models going by the maximum eigenvalue and trace statistic. However, in the second model – crisis model, the maximum eigenvalue is less than the critical value. It is, therefore, only on the basis of the trace statistic that the existence of cointegration is established.

Table 3: Cointegrating Relations between Stock Prices and Exchange Rates

Model	Maximum Eigenvalue	Trace Statistic	Max-Eigen C.V.	Trace Statistic C.V
Pre-crisis Model *(1, Feb. 2001 - 31st Dec. 2006)*	14.78*	15.92*	11.22	12.32
Crisis Model *(1st, Jan. 2007 - 31st Dec. 2008)*	14.62	20.13*	15.67	19.96
Basic Model *(1st, Feb. 2001 - 31st Dec. 2008)*	14.35*	14.37*	11.22	12.32

* Indicates rejection of null hypothesis of no cointegration at 5 percent

Regression results of the vector cointegrating equations showed that although all were consistent theoretically, only the exchange coefficient in the second model – crisis model, is statistically significant. This suggests a significant long run effect of exchange rate on the level of stock price. The corresponding *alpha* – adjustment coefficient, has correct sign and is statistically significant. Meaning, adjustment to long run equilibrium can be achieved via exchange rate adjustment.

Pre-crisis Model $sp = 18.09 - 1.72er$

Crisis Model $sp = 23.86 - 2.72^{*}er$

Basic Model $sp = 13.06 - 0.63er$

This finding is very instructive in the sense that until 2006, the Nigeria's stock exchange market has been quite lull, but the period of banking sector consolidation, which resulted in the overflow of activities in the market coupled with the attendant effect of huge foreign capital inflow completely changed pattern of things. Thus, the above correspondence could be expected.

The foregoing results from the two cointegration approaches revealed lack of consensus in the outcomes. While the Engle and Granger two-step approach reveals no long run relationship between stock market prices and levels of exchange in Nigeria, the Johansen approach, even though at a weak level, reveals presence of long run equilibrium relationship. As reported earlier, a number of studies arrived at different conclusion concerning the existence of cointegration between the two indices. These findings, for example, are similar to, on one hand, those reported by Yu (1997) and Jefferis, Okeahalam and Matome (2001) in support of cointegration. On the other hand, Abdulla and Murinde (1997) reported mixed results; the existence of cointegration in Pakistan and Korea and lack of it in India and Philippines. More recently, Alexandra and Livia (2007) found no cointegration between stock prices and exchange rate in Romania using Engle and Granger methodology, however, established one using the Johansen-Juselius procedure. They ascribed the lack of cointegration indicated by the Engle and Granger procedure may be due to the lower power of the test, as recognized in the literature.

In view of the above, the paper further examines the nature of causality between the two variables by estimating equations (3.5) and (3.6) specified in section three. It was earlier stated that if the variables are non-stationary and are cointegrated, the adequate method to examine the issue of causation is the VECM, which incorporates the residual terms. From the results, the estimated coefficients β_0 and β_1 are supposed to measure the long run causality in the models. The results show that both coefficients are statistically different from zero across the three models; pre-crisis, crisis and the basic models. The significance of the coefficients, uniformly, suggests that stock prices and exchange rates are bound together in a form of bidirectional relationship in the long run. In other words, just as exchange rate follows and adjusts to innovations in the stock prices, the stock prices also follows and adjusts to innovations in the level of exchange rate. Exchange rate appreciation (depreciation), for instance, tends to bring about a rise (decline) in stock prices in Nigeria or an increase in stock prices has positive effects on

the level of exchange rate (currency appreciation). This finding is theoretical consistent with the underpinning of the "stock oriented models".

Table 4: Vector Error Correction Model

Variable	*Pre-crisis Model*		*Crisis Model*		*Basic Model*	
$Z_{t-1}(ecm)$	0.731*	0.927*	1.569*	0.924*	0.845*	0.943*
	(28.6)	(36.3)	(35.9)	(22.3)	(38.4)	(43.7)
sp_{t-1}		0.119*		-0.136*		0.016*
		(25.7)		(-7.45)		(4.34)
sp_{t-2}	0.259*	0.001	-0.441*	0.038	0.235*	0.003
	(8.21)	(0.29)	(-5.43)	(1.16)	(8.14)	(0.58)
sp_{t-3}	0.043	-0.001	-0.281*	0.009	-0.013	0.001
	(1.35)	(-0.34)	(-3.46)	(0.30)	(-0.45)	(0.13)
sp_{t-4}	-0.035	-0.002	0.154*	-0.018	-0.069*	-0.001
	(-1.37)	(-0.64)	(3.49)	(-1.04)	(-3.12)	(-0.18)
er_{t-1}	3.498*		-4.427*		1.359*	
	(15.3)		(-28.1)		(10.1)	
er_{t-2}	0.046	0.136*	-0.051	0.177*	-0.007	0.157*
	(0.17)	(3.91)	(-0.36)	(3.08)	(-0.04)	(5.27)
er_{t-3}	-0.057	-0.004	0.224	0.237*	0.058	0.112*
	(-0.22)	(-0.35)	(1.58)	(4.15)	(0.32)	(3.76)
er_{t-4}	0.029	-0.060**	-0.009	-0.351*	0.113	-0.214*
	(0.15)	(-2.36)	(-0.09)	(-8.49)	(0.87)	(-9.92)
Constant	-9.84*	3.34*	37.40*	5.65*	1.14*	4.37*
	(-28.5)	(36.4)	(35.5)	(22.9)	(27.9)	(43.8)
R^2	0.998	0.998	0.998	0.992	0.999	0.998
Adj. R^2	0.998	0.998	0.998	0.992	0.999	0.998
F-Statistic	112186	169517	34677	8862	361015	144587
Prob. F-Stat.	0.000	0.000	0.000	0.000	0.000	0.000
D.W	1.99	2.00	2.03	1.99	1.99	2.01

* and ** indicate significance ant 1 and 5 percent respectively

Because of the number of lagged variables involved in the VECM estimation, series of coefficients and residual tests were employed in addition to the ones displayed above. The Breusch and Godfrey serial autocorrelation LM tests confirmed the absence of correlation in the residual term and the White heteroskedasticity, with and without cross terms all revealed no incidence of correlation between the error term and the variables. The distribution of the error term was found to be IID, meaning, independently and identically distributed. The short run dynamics of the variables was also examined by performing bivariate Granger causality tests.

The results though not reported confirmed strong Granger causality in the basic and crisis models, but, no significant causation in the pre-crisis model. The lack of causation in the pre-crisis sample is not surprising given the low level of market activities in the pre-consolidation era coupled with the policy of guided deregulation in the foreign exchange market. The total market capitalization, for instance stood at an average of 1.5 trillion naira between 2001 and 2006. Within the space of 2007 and 2008, the market capitalization short up to an average of over 9.5 trillion naira. All share index, which up to 31st December, 2006 stood at N33, 189. 30 more than doubled in the first quarter of 2008. Another driving force is the huge inflow of crude oil money into the economy between the same period of 2007 and 2008, which resulted into high monetization of the economy.

V. Conclusions and Recommendations

This paper examined the long run and short run interactions between stock prices and exchange rate in Nigeria based on a sample from 1st February, 2001 to 31st December, 2008. Three models were derived from the sample, albeit pre-crisis, crisis and basic models. The paper set out by testing the time series properties of the series using ADF and PP tests. Following were standard bivariate cointegration tests, using both the Engle and Granger and the Johansen and Juselius methodology, as well as standard and modified Granger causality tests. Results showed that all the series are I(1) and evidence of cointegration, although could not be established using the Engle and Granger two step procedure was, however, discovered using the Johansen and Juselius tests. Cointegration implies the existence of long run equilibrium relationship between the stock prices and exchange rate. According to Baharom, *et al* (2008), under the efficient market hypothesis, the existence of cointegration implies that market participants can use the growth of the exchange rates as a trading rule in order to exploit abnormal profit.

Furthermore, evidence of short run and long run dynamic interactions, the latter reinforcing the former, were established using the standard bivariate and modified Granger causality tests. In particular, strong evidence of long run bidirectional causation was found in all the three samples. This is consistent with theoretical underpinnings and it implies that a positive development in one variable positively drives the other. A boom, for instance, in stock market prices causes exchange rate appreciation in Nigeria and vice versa.

In terms of policy relevance, the findings implied that monetary authorities in Nigeria are not constrained to take stock market developments into account in achieving their exchange rate policy objective because of the symbiotic nature of their relationship. In view of these, the paper recommends measures that would promote greater stability and efficiency of the Nigeria's foreign exchange market. There is the need also for the government to promote greater deepening of the market and its integration with other global markets across the world. Government and regulators should prepare the market against such backlash of huge withdrawals as was witnessed towards the end of 2008. Although this paper uses a fairly large sample of 2065 observations, but given that trends in the global events which have direct impact on the Nigeria's capital and foreign exchange markets still unfold, possible extensions of this study can be carried out in the area or by applying a similar and or different methodology.

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