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Exchange rate dynamics and stock market performance in Nigeria: Evidence from a Nonlinear ARDL Approach

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Abstract

This study investigates asymmetry in the impact of exchange rate on the Nigerian stock market using Nonlinear ARDL model by Shin et al. (2014), and it is the first study to do so. From the trend review, changes in the dynamics of exchange rate - stock market relationship was noticed, and this was accounted for using Bai and Perron (2003) multiple structural breaks test. Empirical findings from this study reveal that there is long run but no short run exchange rate asymmetry effect on the Nigerian stock market. Furthermore, the results suggest that banking sector recapitalization only affects the short run dynamics of stock – market exchange rate relationship. By implication, the Nigerian stock market adjust spontaneous or becomes more volatile after banking sector recapitalization. The policy implication from this study is that exchange rate policy cannot be used to correct short run disequilibrium in the Nigerian stock market, as it takes long term for the market to respond to changes in exchange rate. This is regardless of whether the policy being introduced is a revaluation or a devaluation policy.

Keywords: Exchange rate, Stock prices, NARDL, Asymmetry, Bank sector recapitalization, Nigeria

JEL classification: F31, G15

1. Introduction

Investigation on the relationship between stock market and exchange rate is of particular interest to portfolio investors, financial analysts, finance researchers and monetary authorities. This is particularly important to appreciate the appropriate portfolio management and hedging strategies, and the effect of exchange rate policy of monetary authority on the stock market performance. Whether a country practiced a fixed, floating or an intermediate exchange rate regime, a change or shift in exchange rate in the form of appreciation/revaluation or depreciation/devaluation may be expected to impact the stock market performance. But, could positive and negative changes in exchange rate have symmetric impact on stock market performance? In order words, does stock market reacts symmetrically to equal magnitude of exchange rate appreciation/revaluation and depreciation/devaluation? It may be interesting to investigate this.

Both from the theoretical and empirical points of view, the relationship between exchange rate and stock market have been mixed and inconclusive. The two theoretical models often used to explain this relationship are the portfolio balance or stock models by Branson (1983) and Frankel (1983) and the monetary or flow model by Dornbusch and Fischer (1980). These two models support different direction of relationship and causality between the two markets. According to the stock model, the causality is from stock market to exchange rate. The model proposed that higher stock returns will attract foreign investors and lead to increase in demand for domestic currency. Hence, a negative relationship ensues as higher stock market returns lead to lower exchange rate[1].

According to the flow model however, it is assumed that the causality moves from exchange rate to stock market. Accordingly, it proposed that exchange rate depreciation increases the international trade competitiveness of firms and increase their present value of cash flow and stock returns by implication. Hence, a positive relationship is evident as higher exchange rate leads to higher stock returns (see Salisu and Oloko, 2015). In the finance literature, other theories that could explain the effect of exchange rate of stock prices include Efficient Market Hypothesis (EMH) developed by Fama (1970) and the Arbitrage Pricing Theory (APT) developed by Ross

[1] Exchange rate is defined here as the units of domestic currency per unit of foreign currency. Hence, a lower exchange rate is appreciation while a higher exchange rate is depreciation.

(1976).[2] Meanwhile, as exchange rate depreciation would also make import prices more expensive, and potentially lead to lower stock returns, Bahmani-Oskooee and Saha (2016) concluded that the overall effect of changes in exchange rate could be positive or negative, depending on whether firms are export oriented or largely dependent on imported inputs.

Majority of the empirical studies on exchange rate – stock market relationship have not only found mixed results but have also focused on the determination of the direction of causality. For instance, Aftab (2015) found that exchange rate and stock price are negatively related in China. Abdalla and Murinde (1997) investigated exchange rate – stock market dynamics in India, Korea, Pakistan and the Philippines, and found a unidirectional causality from exchange rates to stock prices in three out the four countries considered. Dahir et al. (2017) investigated exchange rate – stock market nexus for BRICS and found mixed results; ranging from positive and negative relationship to uni-directional, bi-directional and no causal relationship. And also, Noman et al. (2012) investigated the causality between stock market and exchange rate in Bangladesh and find no causality between the two markets.

However, with the increasing recognition of nonlinearity in the exchange rate effect, recent studies are beginning to investigate non-linearity in the effect of exchange rate on stock market. The non-linearity effect of exchange rate has been observed on inflation (see Caselli and Roitman, 2016; Baharumshah et al., 2017), on export (see Verheyen, 2013) and on macroeconomic fundamentals (see Junttila and Korhonen, 2011; Kempa and Riedel, 2013). Few studies that have observed non-linearity effect of exchange rate on stock market include Ho and Huang (2015), Bahmani-Oskooee and Saha (2016) and Ajaz et al. (2017).

Basically, Ho and Huang (2015) investigated non-linearity and asymmetry in the causal relationships between the stock indexes and exchange rates of Brazil, Russia, India, and China (BRIC) using LM test for causality in variance. Bahmani-Oskooee and Saha (2016) investigated exchange rate asymmetric effect on stock market of Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. using Nonlinear ARDL approach. They found that exchange rate changes have asymmetric effects on stock prices in the short run. Also, Ajaz et al. (2017) investigated asymmetric effect of exchange rate and interest rate on the stock prices of

[2] See Ajaz et al. (2017) for a review.

India using Nonlinear ARDL approach. They found that exchange rate does not have same and equal effect on the stock prices of Indian. Meanwhile, no study has been done to account for nonlinearity effect of exchange rate on stock prices in respect of an African country.

This study proposed to fill this gap by examining effect of exchange rate nonlinearity on the stock prices of Nigeria. Nigeria is the largest economy in Africa and her stock market is one of the best three in Africa. According to Oloko (2017), Nigerian stock market provides potential portfolio diversification gains for US and UK portfolio investors. More importantly, Nigeria is one of the oil exporting countries practicing managed floating exchange rate regime, hence, the inference from this study could be beneficial to policymakers and investors in other similar countries such as the Algeria and Iran. Meanwhile, some of the past studies on the dynamic relationship between stock market and exchange rate in Nigeria such as Oyinlola et al. (2013), Zubair (2013) and Salisu and Oloko (2015) found evidence suggesting non causality from exchange rate to the Nigerian stock market. Meanwhile, as these studies assume linearity in exchange rate, their results may have been exaggerated.

Nonlinearity in the effect exchange rate on Nigerian stock prices may be significant as Nigerian stock market has performed differently under different changes in exchange rate. For instance, between January 1985 and August 1991, December 1991 and March 1993 and December 1998 and December 2003, exchange rate depreciation was correlated with increase in stock prices. Contrarily, between November 2008 and November 2011, and October 2014 and April 2017 exchange rate depreciation was correlated with negative stock prices. As Nigeria is practicing managed float exchange rate system, this presupposes that the effect of exchange rate depreciation/devaluation on stock prices could be positive or negative. Exchange rate appreciation/revaluation was only observed between December 2003 and February 2008, and was correlated with increase in stock prices. The 2004 banking sector recapitalization was also observed to have changed the dynamics of stock market – exchange rate relationship in Nigeria.

This study will examine nonlinearity effect of exchange rate on stock market performance of Nigeria using Nonlinear Autoregressive Distributed Lag (ARDL) model. This will be similar to Bahmani-Oskooee and Saha (2016) investigated exchange rate asymmetric effect on stock market of Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K. using Nonlinear ARDL approach. However, this study will be different by testing and accounting for

the significance of structural break for Global Financial Crisis (GFC) and Nigerian banking sector recapitalization policy. The finding from this study will provide useful information to domestic and foreign portfolio investors in Nigeria, portfolio managers, investment analysts and the Nigerian government.

The remainder of this study shall be organized as follows. Section 2 shall discuss data and preliminary analysis. Section 3 shall deal with model specification. Section 4 shall focus on the presentation and interpretation of results, while Section 5 shall conclude the paper and discuss policy recommendation.

2. Data and Trend Analysis

This study uses monthly Nigerian All Share Index (ASI) and the Naira USD exchange rate (EXR) for the period 1985M01 to 2017M07. The data were obtained from the Central Bank of Nigeria (CBN) database. EXR is the official monthly average exchange rate per USD. By definition, a positive change in exchange rate will mean depreciation while a negative change will imply appreciation. Figure 1a shows the relationship between the Nigerian exchange rate and stock index over the period under consideration while figure 1b shows the relationship under difference episodes of changes in exchange rates. The relative quantitative changes are presented in Table 1.

From figure 1a, it appears a positive relationship exists between exchange rate and stock prices before the stock market crash of 2008, which was prompted by the contagion effect of the US originated Global Financial Crisis. Apparently, it appears that as exchange rate depreciates, stock market prices increases before the stock market crash. However, after the stock market crash, the relationship appears vague; exchange rate depreciates consistently but stock market prices appreciate and depreciate under the period of exchange rate depreciation.

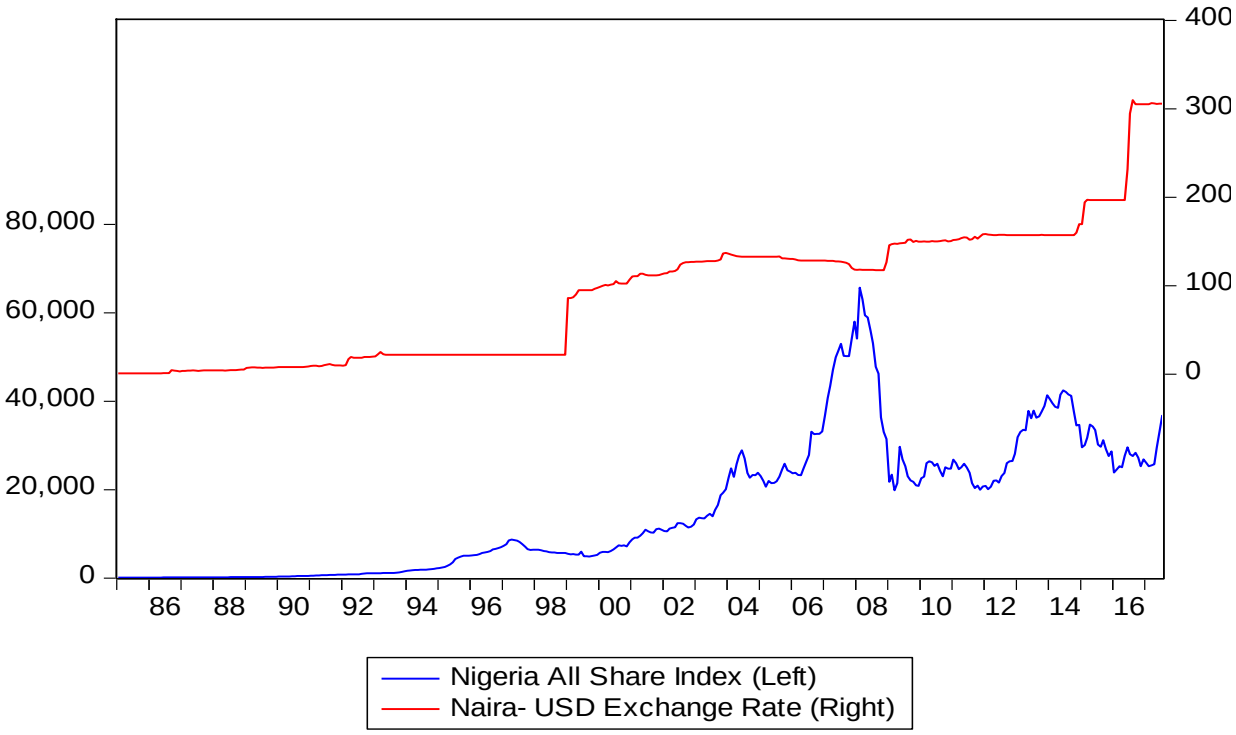
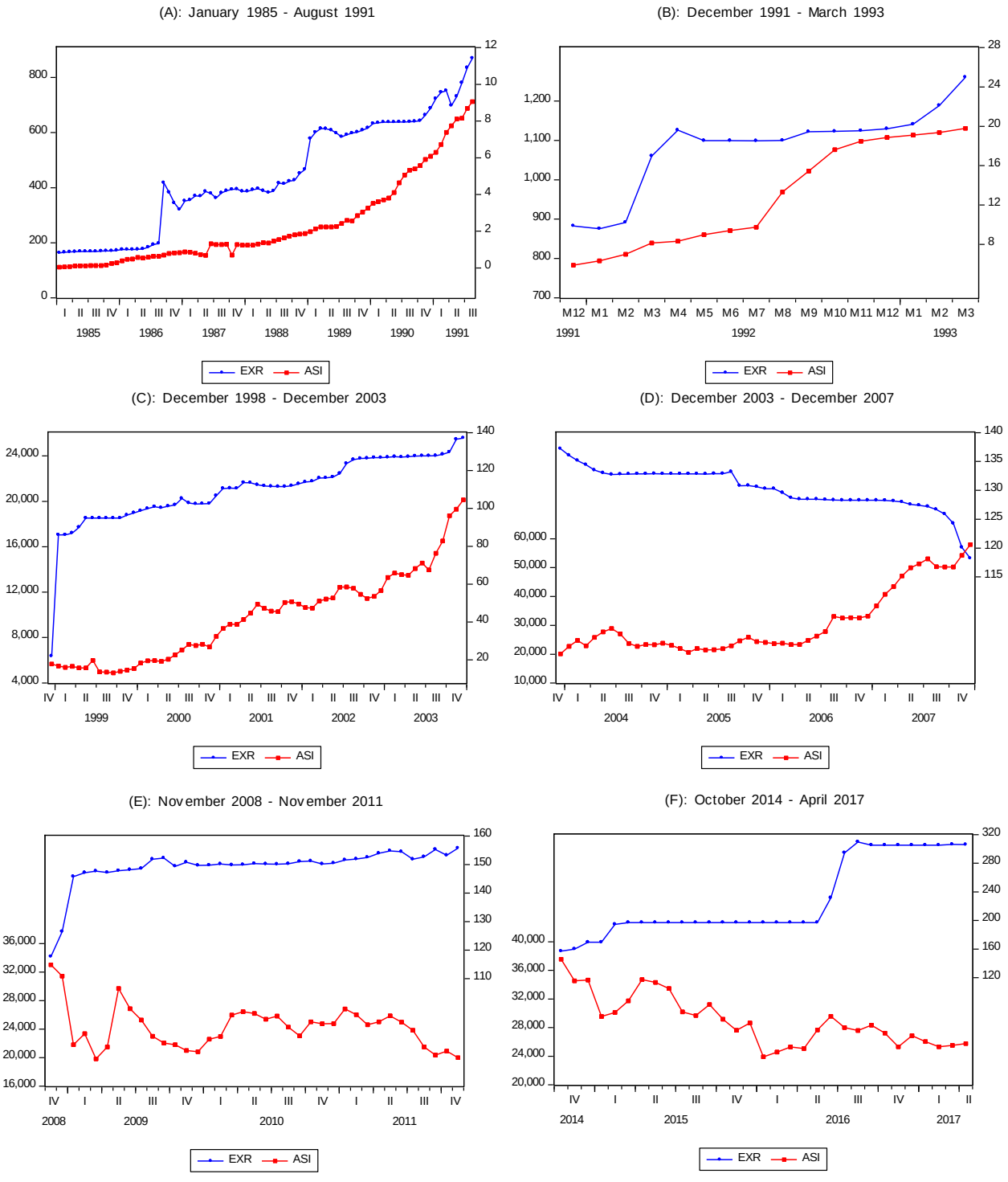


Figure 1a: Exchange rate and Stock market dynamics in Nigeria (1985M01 to 2017M07)

Meanwhile, to visualize the effect of positive and negative changes in exchange rate on stock prices, the dynamics relationship between stock prices and exchange rate was examined under different quadrants of exchange rate dynamics (see Figure 1b). As evidenced from the figure, Naira-USD exchange rate depreciates for most of the period under consideration, as exchange rate only appreciates in one out of the six quadrants identified. Specifically, exchange rate only appreciates under quadrant D which corresponds to the period from December 2004 to December 2007.

Figure 1b: Disaggregated exchange rate and stock market relationship in Nigeria



Source: Compiled by the author

Table 1 presents the quadrants analyses in quantitative term to facilitate easy analysis. As may be observed, between January 1985 and August 1991, December 1991 and March 1993 and December 1998 and December 2003, exchange rate depreciation was correlated with increase in stock prices. Specifically, exchange rate depreciated by 93% under Panel A, by 83.9% under Panel C and by 30.7% under B, while stock prices appreciated by 93%, by 71.8% and by 60% under the respective Panels. This presumes that higher rate of exchange rate depreciation is correlated with higher rate increase in stock prices. This may not however be sacrosanct, as stock prices fell by 65% and 45.7% under Panel E and F respectively, while exchange rate depreciates by 24.4% and 48.7%.

Exchange rate appreciation/revaluation was only observed between December 2003 and February 2008, and was correlated with increase in stock prices. Particularly, exchange rate appreciated by 16.1% while stock prices increased by 69.3%. As both exchange rate appreciation and depreciation lead to increase in stock prices, two possibilities may by suspected. It is either stock price does not respond to changes in exchange rate or that stock prices respond symmetrically to change in exchange rate, which will imply that nonlinearity is not significant. However, this needs to be examined empirically.

Table 1: Partitioned stock market – exchange rate relationship

	January 1985 to August 1991		
Panel A	Start	End	% Change
Stock Prices (Index)	111	712	84%
Exchange Rate (N/USD)	0.8	11.4	93%
	December 1991 to March 1993		
Panel B	Start	End	% Change
Stock Prices (Index)	783	1131	30.70%
Exchange Rate (N/USD)	9.9	25	60%
	November 2008 and November 2011		
Panel C	Start	End	% Change
Stock Prices (Index)	5673	20129	71.80%
Exchange Rate (N/USD)	22	137	83.40%
	December 2003 and February 2008		
Panel D	Start	End	% Change
Stock Prices (Index)	20129	65652	69.30%
Exchange Rate (N/USD)	137.2	118.2	-16.10%
	November 2008 and November 2011		
Panel E	Start	End	% Change
Stock Prices (Index)	33026	20003	-65.00%
Exchange Rate (N/USD)	118	156	24.40%
	October 2014 and April 2017		
Panel F	Start	End	% Change
Stock Prices (Index)	37550	25759	-45.70%
Exchange Rate (N/USD)	157	306	48.77%

Source: Compiled by the authors.

Furthermore, the dynamic relationship between exchange rate and the Nigerian stock market appears to be consistent under the first three and the last three quadrants. Basically, positive relationship appears to be dominant under the first three quadrants while negative relationships are dominant under the last three quadrants. Meanwhile, as the point of diversion corresponds to the 2004 banking sector recapitalization, it may be interesting to empirically examine whether 2004 banking sector recapitalization introduce significant change in the dynamic relationship between the Nigerian exchange rate and stock prices.

Notably, the Central Bank of Nigeria (CBN) pronounced in July 2004 that the capital base of Money Deposit Banks (MDBs) in Nigeria be increased from N2billion to N25billion (See Kanu and Hamilton, 2015). This arrangement resulted into unprecedented cases of mergers and acquisition among banks and monumental issue of primary and secondary share capital by the surviving banks. Eventually, 89 Commercial Banks in Nigeria reduced to 25 banks through mergers, acquisition and liquidation while the Nigerian stock market also witnessed unprecedented patronage (See Kanu and Hamilton, 2015). According to Adegbaju and Olokojo (2008), this banking recapitalization increased the level of financial liberalization of Nigeria and exposed the fragility and vulnerability of the Nigerian financial system. Hence, the observation that the relationship between stock market and the Nigerian exchange rate dynamics changed after the Banking sector recapitalization should be ignored.

Table 2 presents the descriptive statistics for exchange rate and stock prices under the full sample, as well as under the period before and after the 2004 banking sector recapitalization policy. From the number of observations, it is evident that the period covered by the period before Recapitalization is more than the period covered after Recapitalization. The full sample period analysis reveals that the average value of exchange rate between 1985M01 and 2017M07 is N90.07/USD while the average value of the Nigerian stock index is 15295.25 basis points. Meanwhile, comparing this average values with the corresponding average values before and after the Banking sector recapitalization, it appears there was increasing rate of exchange depreciation and stock market appreciation after Recapitalization.

Table 2: Descriptive Statistics

	Full Sample		Before Banking Recapitalization		After Banking Recapitalization	
Statistics	**ASI**	**EXR**	**ASI**	**EXR**	**ASI**	**EXR**
Mean	15295.25	90.07	4694.62	41.57	31094.91	162.37
Median	9591.60	111.60	1989.70	22.00	26874.62	151.86
Maximum	65652.38	309.73	28887.40	137.22	65652.38	309.73
Minimum	111.30	0.82	111.30	0.82	19851.89	117.72
Std. Dev.	15116.24	75.72	5612.19	46.38	10218.57	48.27
Skewness	0.87	0.58	1.74	0.98	1.34	2.07
Kurtosis	3.04	2.97	6.53	2.20	4.16	6.59
Jarque-Bera	49.59	21.60	240.37	43.51	55.89	196.06
Probability	0.00	0.00	0.00	0.00	0.00	0.00
Observations	391	391	234	234	157	157

Source: Computed by the author

Furthermore, the rate at which the maximum values deviated from the mean and medium values for both ASI and EXR is very large after Recapitalization, compared to under full sample and before recapitalization. This indicates that the prices of ASI and EXR are relatively higher after recapitalization. For exchange rate specifically, it was recorded relatively highest level of skewness and kurtosis after the recapitalization. This indicates higher probability of peakedness (relative to kurtosis) and skewness above the average (positive skewness). By implication, exchange rate appears to depreciate than the normal after recapitalization. Hence, the decision to partition the empirical analysis into pre and post banking sector recapitalization can be further justified.

3. Methodology

Notably, this study proposed to use Nonlinear ARDL model proposed by Shin et al. (2014) to examine the asymmetry in the effect of exchange rate on Nigerian stock market. NARDL model is a recently developed method of cointegration analysis that account for asymmetry in the relationship between dependent and explanatory variables. It is an extension of the ARDL model by Pesaran et al. (2001) which assumes symmetric relationship. To account for asymmetry, Shin et al. (2014) assumes nonlinearity in the model, and therefore decomposed the nonlinear

explanatory variable into positive and negative values, which are calculated as partial sum of positive and negative difference, respectively.

For this study, the basic model explaining the effect of exchange rate on stock market is specified as below.

$$InASI_t = \alpha + \beta InEXR_t + \gamma InLDR_t + \varepsilon_t \quad (1)$$

where $InASI_t$ is the log of the Nigerian All Share Index, $InEXR_t$ is the log of official Naira/USD exchange rate and $InLDR_t$ is the log of prime lending rate for Nigeria. Lending rate is included to a control variable in the model. While the coefficient of exchange rate (β) could be positive or negative, depending on whether majority of firms are export oriented or largely dependent on imported inputs (Bahmani-Oskooee and Saha, 2016), the coefficient of lending rate (γ) is expected to negative, as lending rate serves as cost to the firm which would tend to reduce firms' returns when high.

In the original framework of Pesaran et al. (2001), the ARDL empirical specification for equation (1) can be presented as below:

$$\Delta InASI_t = \rho InASI_{t-1} + \beta InEXR_{t-1} + \gamma InLDR_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \lambda_{2j} \Delta InEXR_{t-j} + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (2)$$

Equation (2) is a standard ARDL model, which comprises of both long run and short run estimates. The long run parameters for the intercept and slope parameters are computed as; $-\frac{\alpha_0}{\rho}$, $-\frac{\beta}{\rho}$ and $-\frac{\gamma}{\rho}$ for intercept, coefficient of exchange rate and coefficient of lending rate respectively, since $\Delta InASI_t = \Delta InEXR_t = \Delta InLDR_t = 0$ in the long run. However, the short run estimates are obtained as λ_{1i}, λ_{2j} and λ_{3j} for All share index, Exchange rate and lending rate, respectively. Meanwhile, as the variables in first differences can accommodate more than one lag, optimal lag length for the ARDL model is using Akaike Information Criterion (AIC). The preferred ARDL model is used to test for long run relationship in the model. This approach of

testing for cointegration is referred to as Bounds testing as it involves the upper and lower bounds. The test follows an *F* distribution and therefore, if the calculated F-statistic is greater than the upper bound, there is cointegration; if it is less than the lower bound, there is no cointegration and if it lies in-between the two bounds, then, the test is considered inconclusive.

To determine the speed of adjustment in a cointegrating ARDL model, equation (2) can be re-specified to include an error correction term as follows:

$$\Delta InASI_t = \delta \upsilon_{t-1} + \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \lambda_{2j} \Delta InEXR_{t-j} + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \quad (3)$$

where υ_{t-1} is the lagged error correction term calculated as $\upsilon_{t-1} = InASI_{t-1} - \alpha_0^* - \beta^* InEXR_{t-1} - \gamma^* InLDR_{t-1}$, and α_0^* , β^* and γ^* equal $-\frac{\alpha_0}{\rho}$, $-\frac{\beta}{\rho}$ and $-\frac{\gamma}{\rho}$, respectively.

However, considering Nonlinear ARDL to account for asymmetry in the effect of exchange rate on Nigerian stock market, exchange rate is decomposed into positive and negative changes following Shin et al. (2014). Accordingly, positive exchange rate ($InEXR_t^+$) and negative exchange rate ($InEXR_t^-$) is defined as follows:

$$InEXR_t^+ = \sum_{j=1}^{t} \Delta InEXR_j^+ = \sum_{j=1}^{t} \max\left(\Delta InEXR_j, 0\right) \quad (4)$$

$$InEXR_t^- = \sum_{j=1}^{t} \Delta InEXR_j^- = \sum_{j=1}^{t} \min\left(\Delta InEXR_j, 0\right) \quad (5)$$

Hence, the nonlinear form of equation (2) can be expressed as:

$$\begin{aligned} \Delta InASI_t = {} & \alpha_0 + \rho InASI_{t-1} + \beta_1 InEXR_{t-1}^- + \beta_2 InEXR_{t-1}^+ + \gamma InLDR_{t-1} + \\ & \sum_{i=1}^{N1} \lambda_{1i} \Delta InASI_{t-i} + \sum_{j=0}^{N2} \left(\lambda_{2j}^- \Delta InEXR_{t-j}^- + \lambda_{2j}^+ \Delta InEXR_{t-j}^+ \right) + \sum_{j=0}^{N3} \lambda_{3j} \Delta InLDR_{t-j} + \varepsilon_t \end{aligned} \quad (6)$$

and the short run error correction model will be:

$$\Delta InASI_t = \tau\xi_{t-1} + \sum_{i=1}^{N1}\lambda_{1i}\Delta InASI_{t-i} + \sum_{j=0}^{N2}\left(\lambda_{2j}^{-}\Delta InEXR_{t-j}^{-} + \lambda_{2j}^{+}\Delta InEXR_{t-j}^{+}\right) + \sum_{j=0}^{N3}\lambda_{3j}\Delta InLDR_{t-j} + \varepsilon_t \quad (7)$$

where the error correction term, $\xi_{t-1} = InASI_{t-1} - \alpha_0^* - \beta_1^* InEXR_{t-1}^{-} - \beta_2^* InEXR_{t-1}^{+} - \gamma^* InLDR_{t-1}$

and, α_0^*, β_1^*, β_2^* and γ^* represent $-\frac{\alpha_0}{\rho}$, $-\frac{\beta_1}{\rho}$, $-\frac{\beta_2}{\rho}$ and $-\frac{\gamma}{\rho}$, respectively. Given this definition, therefore, the long run model would be specified as:

$$InASI_t = \alpha_0^* + \beta_1^* InEXR_t^{-} + \beta_2^* InEXR_t^{+} + \gamma^* InLDR_t + \delta D\_BCAP \quad (8)$$

Hence, λ_{2j}^{-} and λ_{2j}^{+} captures short run impact of negative and positive changes in exchange rate respectively, while β_1^* and β_2^* captures the long run impact of negative and positive changes in exchange rate respectively. In this study, negative changes in exchange rate indicate appreciation while positive changes indicate depreciation.

Meanwhile, as this study also proposed to examine whether there is a change in the dynamic relationship between the Nigerian stock market and exchange rate as suggested by our trend review, it would essentially important to introduce dummy variable for structural break around the periods of banking sector recapitalization in Nigeria to examine this effect. To account for structural break for banking sector recapitalization in NARDL model, equations (7) and (8) is modified to produce equations (9) and (10), which indicate short run and long run NARDL models respectively.

$$\Delta InASI_t = \tau\xi_{t-1} + \sum_{i=1}^{N1}\lambda_{1i}\Delta InASI_{t-i} + \sum_{j=0}^{N2}\left(\lambda_{2j}^{-}\Delta InEXR_{t-j}^{-} + \lambda_{2j}^{+}\Delta InEXR_{t-j}^{+}\right) + \sum_{j=0}^{N3}\lambda_{3j}\Delta InLDR_{t-j} + \sum_{j=0}^{N4}\delta_j\Delta D\_BCAP_{t-j} + \varepsilon_t \quad (9)$$

$$InASI_t = \alpha_0^* + \beta_1^* InEXR_t^{-} + \beta_2^* InEXR_t^{+} + \gamma^* InLDR_t + \delta^* D\_BCAP_t \quad (10)$$

where D_BCAP is the dummy for bank recapitalization; it takes the values of 0s before the period of recapitalization and 1s thereafter. The coefficient for this dummy, δ^* represents the rate of change in stock prices after bank recapitalization. If this is found to be negative and significant, it shows that stock prices decreases on the average after bank recapitalization; if it is found to be positive and significant, it implies that stock prices increases on the average after bank recapitalization; and if it is not signification, it implies that there is no significant change in the dynamics of stock prices in the pre and post banking sector recapitalization.

Meanwhile, as equations (9) and (10) only explain the case of Asymmetric model, equations (1) and (3) can be modified with dummy for bank recapitalization, hence, the linear (symmetric) model would be specified as;

$$\Delta InASI_t = \tau\xi_{t-1} + \sum_{i=1}^{N1}\lambda_{1i}\Delta InASI_{t-i} + \sum_{j=0}^{N2}\lambda_{2j}\Delta InEXR_{t-j} + \sum_{j=0}^{N3}\lambda_{3j}\Delta InLDR_{t-j} + \sum_{j=0}^{N4}\delta_j\Delta D\_BCAP_{t-j} + \varepsilon_t \quad (11)$$

$$InASI_t = \alpha_0^* + \beta^* InEXR_t + \gamma^* InLDR_t + \delta^* D\_BCAP_t \quad (12)$$

Equations (11) and (12) thus present the symmetric model for the analysis. The variables and parameters of the model remain as previously defined. This model becomes the optimal model when there is no significant difference between the estimates for negative and positive changes in exchange rate. This would imply that the assumption of nonlinearity is invalid, implying that linear (symmetric ARDL) model is appropriate.

4. Empirical Result and Discussion

Empirical analysis of this study is based on the estimation of equations (9) and (10) and equations (11) and (12) for nonlinear asymmetric and symmetric models respectively. Basically, equations (11) and (12) present the short run and long run models for symmetric (linear) ARDL, while equations (11) and (12) present the short run and long run models for asymmetric (nonlinear) ARDL model. Meanwhile, to empirically determine the period of bank

recapitalization, Bai and Perron (2003) multiple structural break test is employed[3]. The structural break result as presented in the Table 3 identified five significant structural breaks, among which is 2006M08. This period may be suspected as being the beginning of the impact of period of the banking recapitalization policy, which was introduced in 2004M07. Of course, period lag is expected to exist between policy implementation and impact period. Hence, the dummy for banking recapitalization in the model was defined as 0s before 2006M08 and 1s from and after 2006M08.

Table 3: Result of structural break test

Break Test	Break dates	F-statistic	Scaled F-statistic	Critical Value**
0 vs. 1 *	1995M03	164.93	494.79	13.98
1 vs. 2 *	2001M04	79.87	239.60	15.72
2 vs. 3 *	1990M04	102.75	308.25	16.83
3 vs. 4 *	2012M10	20.71	62.12	17.61
4 vs. 5 *	**2006M08**	**70.07**	**210.20**	**18.14**

Source: Author's computation

Table 4 presents the estimation result for the main analysis. It comprises of the results from symmetric and asymmetric models under full sample, before recapitalization and after recapitalization. The table is also sectionalized to report separately, the short run, critical bounds, long run and model diagnostics. While the short run and long estimates present the main empirical analyses, critical bound and model diagnostics examine the existence of cointegration and robustness of the model, respectively.

[3] Bai and Perron (2003) can detect more than one significant structural break. See Salisu et al. (2016) for review and model specification of this test.

Table 4: Estimation results

Variables	Full sample		Before Bank Recapitalization		After Bank Recapitalization	
	Symmetry	**Asymmetry**	**Symmetry**	**Asymmetry**	**Symmetry**	**Asymmetry**
Short run model: Dependent variable - D(InASI)						
ARDL optimal lags	(3,0,1,1)	(3,0,0,1,1)	(2,0,3)	(2,0,0,3)	(1,0,1)	(1,0,0,1)
D(InASI(-1))	0.1090**	0.1101***	0.1614***	0.1621***	-	-
D(InASI(-2))	0.1394***	0.1411***	-	-	-	-
D(LnLDR)	-0.1567***	-0.1614***	-0.1209***	-0.1258***	-0.6633**	-0.7087
D(InLDR(-1))	-	-	-0.0203***	-0.0177	-	-
D(InLDR(-2))	-	-	-0.1587***	-0.1565***	-	-
D(D_BCAP)	0.1499**	0.1496**	-	-	-	-
CointEq(-1)	-0.0128***	-0.0148***	-0.0102***	-0.0126***	-0.0283	-0.0330
Bound Testing						
Model F-stat	5.0953***	4.2793**	10.3333***	8.2915***	1.6406	1.4184
Critical Upper Bounds: Case II – Restricted Constant and No Trend						
Significant	I(1)	I(1)	I(1)	I(1)	I(1)	I(1)
10%	3.20	3.09	3.35	3.20	3.35	3.20
5%	3.67	3.49	3.87	3.67	3.87	3.67
1%	4.66	4.37	5.00	4.66	5.00	4.66
Long run model: Dependent variable - LnASI						
InEXR_NEG	-	-0.4227	-	-0.6452	-	4.8772
InEXR_POS	-	0.7849*	-	0.6674*	-	0.2334
InEXR	0.9616***	-	0.8125**	-	-1.0424	-
InLDR	0.7607	0.1393	1.3557	0.4611	7.8125	5.4188
D_BCAP	-0.3891	-0.4870	-	-	-	-
Constant	3.7342	4.7321	2.9892	4.4559	-6.4524	-0.0619
Model Diagnostics						
Durbin-Waston	2.0359	2.0358	2.0357	2.0345	2.0123	2.0241
Ljung Box Q(2)	0.1766	0.1731	2.7621	2.8376	2.6636	7.3398**
Ramsey RESET	1.6178	1.5410	0.2441	0.0569	0.4093	0.5362
No. of obs. Included	388	388	256	256	120	120

Source: Compiled by the author

Under the full sample analysis, both symmetric and asymmetric models confirm that exchange rate does not have significant short run impact on the Nigerian stock market. However, in the long run, exchange rate appears to have significant impact on stock market. Basically, under the symmetric model, exchange rate has positive significant effect on the Nigerian stock market. This implies that higher exchange rate leads to higher stock market prices. In order words, stock market appreciates and exchange rate market depreciates, and vice versa. This result suggests that exchange rate depreciation attract more demand for Nigerian stocks and boost Nigerian stock market in the long run and not in the short run. This result is still partially in line with the findings of Oyinlola Oyinlola et al. (2013), Zubair (2013) and Salisu and Oloko (2015) found evidence suggesting non causality from exchange rate to the Nigerian stock market, as their studies only considered short run analysis. By implication, this result is suggesting that exchange rate policy cannot be efficient to correct short run disequilibrium in the Nigerian stock market.

In addition, although the structural break for bank recapitalization is significant in the short run, it is negative but not statistically significant in the long run. This implies that stock market performance declined on the average after recapitalization, but not at a statistically significant magnitude. This is confirmed by both symmetric and asymmetric models. Meanwhile, asymmetric model addresses the basic fact of examining whether negative and positive changes in exchange rate have equal magnitude of effect on stock market. Empirical evidence suggests that this is the case in the short run but not in the long run. Evidently, in the short run, both negative and positive changes in exchange rate have no significant impact on the Nigerian stock market. But, in the long run, the impact is asymmetric. While, positive changes in exchange rate have positive significant impact on stock market, negative changes in exchange rate have negative but insignificant impact on stock market. By implication, 1 percent depreciation in exchange rate increases stock market performance better than 1 percent exchange rate appreciation. The appreciation in the Nigerian stock market due to both appreciation and depreciation in exchange rate is alarming; however, this was also noted in our trend review in section 2.

More so, the significance of banking sector recapitalization dummy only in the short run implies that banking sector recapitalization only affects the short run dynamics of stock – market exchange rate relationship. And notably, the result evidently shows that long run relationship

does not exist after banking sector recapitalization unlike before recapitalization. This is judged by the upper bound testing critical values, which is lower than the Bound test F-statistic for the pre- banking sector recapitalization and higher for the post- banking sector recapitalization. By implication, the Nigerian stock market adjust spontaneous or becomes more volatile after banking sector recapitalization. This result may not pose a significant surprise as the market tends to respond to a lot of external financial and real shocks after banking sector recapitalization. This includes the 2007-2008 Global Financial Crises and the 2007 and 2014 Oil price crash.

5. Conclusion

This study investigates asymmetry in the impact of exchange rate on the Nigerian stock market using Nonlinear ARDL model, and it is the first study to do so. From the trend review, it was noticed that the dynamics of exchange rate stock market relationship has changed after the banking sector recapitalization policy introduced by the Central Bank of Nigeria in 2004. As an additional contribution to the literature, this study examines the significance of this break using Bai and Perron (2003) test, and also accounts for the break in the estimation model. Empirical findings from this study reveal that there is long run but not short run exchange rate asymmetry effect on the Nigerian stock market. Evidently, in the short run, both negative and positive changes in exchange rate have no significant impact on the Nigerian stock market. But, in the long run, the impact is asymmetric. While, positive changes in exchange rate have positive significant impact on stock market, negative changes in exchange rate have negative but insignificant impact on stock market.

Furthermore, the results suggest that banking sector recapitalization only affects the short run dynamics of stock – market exchange rate relationship. This is judged by the upper bound testing critical values, which is lower than the Bound test F-statistics for the pre- banking sector recapitalization and higher for the post- banking sector recapitalization. By implication, the Nigerian stock market adjust spontaneous or becomes more volatile after banking sector recapitalization.

The policy implication from this study is that exchange rate policy cannot be used to correct short run disequilibrium in the Nigerian stock market, as it takes long term for the market to respond to changes in exchange rate. This is regardless of whether the policy being introduced is a revaluation or a devaluation policy.

References

Abdalla, I. S.A. and Murinde, V. (1997). Exchange rate and stock price interactions in emerging financial markets: evidence on India, Korea, Pakistan and the Philippines, Applied Financial Economics, 7(1), 25-35.

Aftab, M., Ahmad, A. and Ismail, I. (2015). Dynamics between currency and equity in Chinese markets", Chinese Management Studies, 9(3), 333 – 354

Ajaz, T., Nain, Z. M., Kamaiah, B. and Sharma, N. K. (2017). Stock prices, exchange rate and interest rate: evidence beyond symmetry. Journal of Financial Economic Policy, 9(1), 1-19.

Adegbaju, A.A. and Olokojo, F.O. (2008). Recapitalization and Banks' Performance: A Case Study of Nigerian Banks. African Economic and Business Review, 6(1), 1-17.

Baharumshah, A. Z. Sirag, A. and Soon, S.-V. (2017). Asymmetric exchange rate pass-through in an emerging market economy: The case of Mexico. Research in International Business and Finance, 41, 247-259.

Bahmani-Oskooee, M. and Saha, S. (2016). Do exchange rate changes have symmetric or asymmetric effects on stock prices? Global Finance Journal, 31, 57-72.

Bai, J., & Perron, P. (2003). Computation and analysis of multiple structural change models. Journal of Applied Econometrics, 18, 1-22.

Branson, W. H. (1983). Macroeconomic determinants of real exchange rates. Working paper No. 801. Cambridge, UK: The National Bureau of Economic Research.

Caselli, F. G. and Roitman, A. (2016). Non-Linear Exchange Rate Pass-Through in Emerging Markets. IMF Working Paper, WP/16/1.

Chen, X., Chiang, T. C. (2016). Stock returns and economic forces—An empirical investigation of Chinese markets. Global Finance Journal, 30, 45-65.

Dahir, A. M., Mahat, F., Ab Razak, N. H. and Amin, B.-A. (2017). Revisiting the Dynamic Relationship between Exchange Rates and Stock Prices in BRICS Countries: A Wavelet Analysis. Borsa istanbul Review, doi: 10.1016/j.bir.2017.10.001

Dornbusch, R., & Fischer, S. (1980). Exchange rates and the current account. American Economic Review, 70(1), 960–971.

Fama, E. F. (1970). Efficient Capital Markets: A Review of Theory and Empirical Work. The Journal of Finance, Vol. 25, No. 2, Papers and Proceedings of the Twenty-Eighth Annual Meeting of the American Finance Association New York, N.Y. December, 28-30, 1969 (May, 1970), pp. 383-417.

Frankel, J. A. (1983). Monetary and portfolio balance models of exchange rate determination. In J. S. Bhandari & B. H. Putnam B. H. (Eds), Economic interdependence and flexible exchange rates (pp. 84–115). Cambridge, London: MIT Press.

Ho, L.-C. and Huang, C.-H. (2015). The nonlinear relationships between stock indexes and exchange rates. Japan and the World Economy 33 (2015) 20–27.

Junttila, J. and Korhonen, M. (2011). Nonlinearity and time-variation in the monetary model of exchange rates. Journal of Macroeconomics 33, 288–302.

Kanu, C. and Hamilton, O. I. (2015). Nigeria's 2005 Bank Recapitalization: An Evaluation of Effects and Social Consequences. Research Journal of Finance and Accounting, 6(17), 18-25.

Kempa, B. and Riedel, J. (2013). Nonlinearities in exchange rate determination in a small open economy: Some evidence for Canada. North American Journal of Economics and Finance, 24, 268– 278.

Maku, O. E. and Atanda, A. A (2010). Determinants of Stock Market Performance in Nigeria: Long Run Analysis. Journal of Management and Organizational Behaviour, 1(3), 1-17.

Mutiu A. O., Adeniyi, O., & Omisakin, O. (2012). The dynamics of stock prices and exchange rates: Evidence from Nigeria. West African Journal of Monetary and Economic Integration, 12(1), 67–92.

Noman, A. M., Kabir, S. H. and Bashar, O.K.M.R. (2012). Causality between stock and foreign exchange markets in Bangladesh. Studies in Economics and Finance, 29(3), 174 – 186.

Oloko, T.F. (2017). Portfolio diversification between developed and developing stock markets: The case study of US and UK investors in Nigeria. Research in International Business and Finance, in press, https://doi.org/10.1016/j.ribaf.2017.07.153.

Pesaran, M., Shin, Y. and Smith, R. (2001). Bound testing approaches to the analysis of level relationship. Journal of Applied Econometrics, 16, 289–326.

Shin, Y., Yu, B. C., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In R. Sickels, & W. Horrace (Eds.), Festschrift in honor of Peter Schmidt: Econometric methods and applications (pp. 281–314). Springer.

Ross, S. A. (1976). The arbitrage theory of capital asset pricing. Journal of Economic Theory, 13 (3), 341-360.

Salisu, A. A., Ndako, U., B., Oloko, T. F. and Akanni, L. O. (2016). Unit root modeling for trending stock market series. Borsa Istanbul Review 16(2), 82-91.

Salisu, A. A. and Oloko, T. F. (2015). Modelling spillovers between stock market and FX market: evidence for Nigeria. Journal of African Business 16 (1-2), 84-108.

Verheyen, F. (2013). Exchange rate nonlinearities in EMU exports to the US. Economic Modelling, 32, 66–76

Yang, S.-P. (2017). Exchange rate dynamics and stock prices in small open economies: Evidence from Asia-Pacific countries. Pacific-Basin Finance Journal, 46(B), 337-354.

Zubair, A. (2013). Causal Relationship between Stock Market Index and Exchange Rate: Evidence from Nigeria. CBN Journal of Applied Statistics, 4(2), 87-110.