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Exchange Rate Movements on Sectoral Stock Prices of Nigerian Firms: Is there Evidence of Asymmetry?

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Abstract

Using firm-level weekly closing stock prices of Nigerian firms, this study gives a new insight into the possible asymmetry in exchange rate and stock prices relationship. The Linear ARDL (Pesaran et al., 2001) and Non-Linear ARDL (Shin et al., 2014) framework are adapted into panel data form to explore the responses of stock prices to exchange rate movements. Exchange rate is measured using Naira exchange value to US Dollar for the main analysis while Naira to Britain Pound Sterling is used for robustness check. Findings from the empirical analyses suggest that the relationship between exchange rate and stock prices is largely symmetry for most of the firms, except those in few sectors like conglomerates, consumer goods and financial services. Thus, this result supports empirical arguments that exposure of stock prices of firms in developing countries to exchange rate is identical in the long-run regardless of whether the domestic currency appreciates or depreciates.

Key words: Exchange rate, Stock prices, Asymmetry, Panel ARDL, Non-linear ARDL

JEL Classification: F10, G15

Exchange Rate Movements on Sectoral Stock Prices of Nigerian Firms: Is there Evidence of Asymmetry?

1.0 Introduction

Theoretical and empirical studies have established that exchange rates and stock prices are intrinsically linked. Traditional trade theory asserts that trading activities at the international level is affected by the exchange rate changes. The domestic currency exchange value to currencies of other countries have implications on the international competitive advantage, income and output of a country (Franke, 1991). The stock market performance is important in the international capital flow of a country, both inflow and outflow. While exchange rate could enhance or hinder the performance of the stock market, the reverse is also possible. Exchange rate movements have effects on stock prices in several directions. For example, the dominance of export oriented firms in a country will facilitate gains in international competitiveness thus they will export more, earn more profits and increase in share prices with possible appreciation in exchange rate. In another vein, the depreciation (appreciation) in a domestic currency reduces (enhances) the international competitiveness of domestic firms and their cash flows, thereby reducing (increasing) domestic stock prices. Hence, despite its numerous amount empirical research circle is not saturated of the understanding on how exchange rates and stock markets co-move, especially for international investors and policy makers.

Existing studies that have investigated the relationship between exchange rate and stock prices have evolved over time by investigating the causation between the two macro finance variables. Other studies have also examined the short-run and long-run relationship by establishing cointegration between exchange rate and stock returns. The conclusions of these studies have been largely divided. However, the common characteristics of most of these studies is the assumption of symmetry (linearity) in the effects of exchange rate movement on stock price determination. It is assumed that currency depreciation (appreciation) induces an increase (decrease) in stock prices (Bahmani-Oskooee and Saha, 2016).

Studies have emerged in recent times to study the possible asymmetry in the stock prices exposure to exchange rate (see Miller and Reuer, 1998; Apergis and Rezitis, 2001; Koutmos and Martin, 2003; Bartram, 2004). Koutmos and Martin (2003) in their study supported the asymmetry argument by decomposing exchange rate movements into their negatives (appreciation) and positives (depreciation) using the partial sum concept. With reference to financial theory, Bartram (2004) argues that a depreciation of home currency can cause an increase in cost of transactions in foreign currency which in turn causes a domestic client to default which does not happen when there is appreciation in domestic currency.

Except for few studies namely; (see Hsu, Yau and Wu, 2009; Bahmani-Oskooee and Saha, 2016), these asymmetry-based studies have largely considered the relationship exchange rate exposure and stock market using country-aggregate indices. However, growing literature have revealed that the stock prices reaction at different sectoral and firm level to exchange rate movement could differ. Moreover, estimates of exchange rate exposure of individual firm's stocks prices are more important and could better inform policy than the use of aggregate indexes of industries, sectors or countries.

In the light of the foregoing discussions, this study examines the possibilities of asymmetry in the relationship between exchange rate and stock indices at individual firm's stock level in Nigeria. This study contributes to existing literature in the following ways. By examining the relationship at firm's level rather than using aggregate market or sectoral indexes, the study adds to literature that have acknowledge that the exposure of stock markets to macroeconomic variables like exchange rate are better captured at disaggregated level as different firms could be affected differently. Also, using data from the Nigerian stock market will further strengthen the empirical evidence on the relationship between the two macroeconomic variables from a developing country perspectives.

Furthermore, the study accounts for possible asymmetries in exchange rate exposure of firms following the nonlinear ARDL framework proposed by Shin et al., (2014). Recent studies that have tried to separate short-run exposure from long-run following the methodology of Shin et al., (2014) include Cuestas and Tang (2015), Bahmani-Oskooee and Saha (2015; 2016). Cuestas and Tang (2015) found that the long-run exposure of stock returns to exchange rate of 31 Chinese industries is symmetric. On the contrary ~~the~~ Bahmani-Oskooee and Saha (2015) employes Shin et al. (2014) nonlinear ARDL approach to show that changes in the nominal effective exchange rate of the U.S. dollar have asymmetric effects on S & P 500 index. Given the number of cross sections (firms) and periods considered in this study, the NARDL is adapted into a panel ARDL framework [also known as Pooled Mean Group (PMG). Thus this study serves as a pioneer to evaluate the nonlinear relationship between exchange rate and firm-level stock prices using NARDL framework in panel model form to account for possible asymmetries from a developing country perspectives. For robustness, the exchange rate proxy used in the main estimation is changed in order to verify whether the estimates obtained are sensitive to variable proxy.

The rest of this paper is structured as follows. Section 2 provides a review of literature. Section 3 details the methodology procedure. It also includes data issues and preliminary analyses. In Section 4, the estimations results are presented and discussed including discussions on the robustness. Section 5 concludes the paper.

2.0 Literature Review

The exchange rate exposure of a firm or an industry refers to the stock price and/or economic value sensitivity to movements in exchange rates (Jayasinghe and Premaratne, 2014). Thus, economic and finance literature has witnessed tremendous debates on the evaluation on the linkage between the two fundamental macro finance variables. Theoretical arguments on the relation between exchange rate and stock returns could be grouped into two strands based on the direction of causality. Dornbusch and Fisher (1980) proposed an exchange rate model which focuses on movements of exchange rate on international competitiveness and trade balances. According to the authors, depreciation of domestic currencies improves the international competitiveness of domestic firms and consequently their cash flows thereby increasing their stock prices. In a similar vein, appreciation of domestic currencies deteriorates the international competitiveness of domestic firms and consequently their cash flows thereby reducing their stock prices.

Theoretical models suggest that changes in the value of stocks may affect exchange rate through the demand for money transmission mechanism (Gavin, 1989). The two prominent classical theoretical strands on the relation between stock prices and exchange rate are the ‘flow-oriented’ and ‘stock-oriented’ models. Dornbusch & Fisher (1980) proposed the flow-oriented models of exchange rates which focus on the current account or the trade balance. The model asserts that the currency movement of a country will affect its international competitiveness and balance of trade position, which in turn affects the country's real income/output and subsequently stock prices. On the other hand, the stock-oriented models proposed differently by Frankel (1983) and Branson (1993) assert innovations in the stock price affect exchange rates via the capital account. Stock prices reductions discourages capital flows into the economy as a result of reductions in demand for local assets by foreign investors thereby reducing the value of domestic currencies. In other words, the performance of the stock market may affect the demand for money, with the subsequent changes in interest rates causing exchange rates to appreciate or depreciate (Moore and Wang, 2014)

From the empirical angle, numerous studies have extensively examined the relationship between exchange rate and stock prices. Findings from causality-based studies have found four evidences – evidence of unidirectional causality from exchange rate to stock prices and from stock prices to exchange rates, absence of causality and bi-directional causality [see for example, Abdalla and Murinde (1997), Chow et al. (1997), Ajayi et al. (1999), Granger et al. (2000), Nieh and Lee (2001), Yang and Doong (2004), Phylaktis and Ravazolo (2005), Aloui (2007), Pan et al. (2007), Diamandis and Drakos (2011), Lin (2012)]. Other strands of empirical studies on the relationship between stock prices and exchange rates has also attracted several methodologies. Prominent methodologies in literature include cointegration methods (Phylaktis and Ravazzolo, 2005), vector autoregression (VAR) approach (Pan et al., 2007), autoregressive conditional heteroskedastic [ARCH] - based models such as EGARCH by Chikili et al., (2011), Bivariate UEDCC-GARCH model (Caporale, Hunter and Ali, 2014). Other methods used in empirical literature include Markov Regime Switching models (Chikili and Nguyen, 2014), dynamic conditional correlation [DCC] model (Wong and Li, 2010). The few papers that have employed the Nonlinear ARDL of Shin et al. (2014) to examine exchange rate-stock price are Cuestas and Tang (2015), Bahmani-Oskooee and Saha (2015; 2016).

Despite the differences in methods and empirical findings of these studies, the common features of these studies is that the inclusion of exchange rate as an explanatory variable when modelling stock price determination, is assumed to have a symmetric (linear) impact on stock prices. This implication of this assumption is that if currency depreciation induces stock price increase, the reverse will happen when there is currency appreciation. However, recent theoretical and empirical arguments have established that the relationship could be asymmetry (nonlinear). Companies' reaction to movements in exchange rates may differ in terms of their price setting as well as sales and quantities adjustments which eventually build up their market shares Bahmani-Oskooee and Saha (2016). Bartram (2004) argues that nonlinear foreign exchange rate exposures result if cooperate cash flows are a nonlinear function of exchange rates. Other factors that could account for asymmetry include default risk. A depreciation of domestic currency can lead to an increase in cost of transactions involving foreign currency which in turn could cause a domestic client to default. However, this does not happen when domestic currency appreciates.

Increasing number of studies have accounted for asymmetries when modelling exchange rate movement (See Koutmos and Martin, 2003 and Hsu, Yau and Wu, 2009). These authors decompose exchange rate changes into their depreciations and appreciations using the partial sum concept and estimate exchange rate exposure models using standard empirical methods. Recent studies that applied the NARDL method to estimate the symmetric and asymmetric behaviour of exchange rate on stock prices include Cuestas and Tang (2015) [monthly data from each of the 31 Chinese industries], Bahmani-Oskooee and Saha (2016) [Standard & Poor 500 Index], and Bahmani-Oskooee and Saha (2016) [monthly data from Brazil, Canada, Chile, Indonesia, Japan, Korea, Malaysia, Mexico, and the U.K]. The authors found that exchange rate have asymmetric effects on stock prices, although mostly in the short run. The superiority of the NARDL methodology has been argued empirically to several other methodologies in a number of ways, most especially when considering asymmetries in the relationship between variables under investigation. First, the model can simultaneously accommodate short run and long run asymmetries in the relationship between variables. Second, the model does not require similar of order of integration of the variables. Third, the computation procedure for NARDL is simple compare to other models that can account for asymmetries (Van Hoang et al., 2016).

From the foregoing discussion, this study use the NARDL framework to estimate the possible asymmetric short run and long run effect of exchange rate changes on stock prices. Contrary to the aggregate stock indices used in previous studies, the exchange rate exposure of stock prices is considered at firm level. However, to account for possible individual firm heterogeneity, the asymmetry framework is adapted into the panel ARDL. Hence, we have a panel NARDL. The next section detailed the empirical model and estimation procedure.

3.0 Model and Methodology

Studies on exchange rate and stock prices have been generally classified into two groups based on their models (Bahmani-Oskooee and Saha, 2015). The first category of studies rely upon a bivariate model between exchange rate and stock price index. Thus they exclude other variables that could possibly affect the relationship between the two variables. On the other hand, the second group of studies extended the bivariate model into a multivariate model that accommodates additional variables that could affect the relationship. Following extant literature, the baseline model for this study is specified as:

$$SP_{i,t} = \Lambda + \Phi EXCH_{i,t} + \varepsilon_{i,t} \quad [1]$$

Where Λ is the constant term and Φ is the parameterof the model. *SP* denotes the logarithm of stock price for firm '*i*' at period '*t*' and *EXCH* is the nominal effective exchange rate.

The standard framework of Pesaran et al., (2001) is followed in the model specification. The symmetric ARDL follows a conditional Error Correction Mechanism (ECM) model which accommodates both the short run and long run effects between the dependent and explanatory variables within a framework. Given the longitudinal nature of the series, the ARDL model is specified in panel form, which is also regarded known as the Pooled Mean Group (PMG). The panel-ARDL/PMG allows for parameter heterogeneity across cross sectional units which calls for extreme caution when interpreting parameter averages as in homogeneous panel models. The PMG model of Eq. [1] is specified as:

$$\Delta SP_{i,t} = \alpha_0 + \alpha_1 SP_{i,t-1} + \alpha_2 EXCH_{i,t-1} + \sum_{k=1}^{N_1} \lambda_k \Delta SP_{i,t-k} + \sum_{k=0}^{N_2} \varphi_k \Delta EXCH_{i,t-k} + \mu_{i,t} \qquad [2]$$

The short run parameter estimates are obtained as λ and φ. The long run parameters for the intercept term is computed as α_0/α_1 and for the slope term is α_2/α_1. Since in the long run it is assumed that $\Delta SP_{i,t}$ and $\Delta EXCH_{i,t-k}$ both equal to 0.

Eq. [2] assumes that the explanatory variables have symmetric influence on stock prices. Following the discussion in the previous section that the depreciation (appreciation) of exchange rate may boost (hurt) stock prices may not hold due to changes in expectations premised on market conditions, recent trend used in accounting for asymmetry in the behaviour of economic series is followed[1]. This is achieved by decomposing exchange rate variable $EXCH$ into $EXCH_t^+$ and $EXCH_t^-$ denoting positive changes (depreciation) and negative changes (appreciation) in exchange rate respectively. These decomposed rates are defined theoretically as:

$$EXCH_t^+ = \sum_{j=1}^{t} \Delta EXCH_j^+ = \sum_{j=1}^{t} \max\left(\Delta EXCH_j, 0\right) \qquad [3]$$

$$EXCH_t^- = \sum_{j=1}^{t} \Delta EXCH_j^- = \sum_{j=1}^{t} \min\left(\Delta EXCH_j, 0\right) \qquad [4]$$

Accounting for the partial sums of exchange rate, Eq. [2] is modified into a compact error correction form to become:

[1] Similar approach has been followed in studies by Bahmani-Oskooee and Bahmani (2016); Van Hoang et al., (2016), and Salisu et al., (2016) among several other studies.

$$\Delta SP_{i,t} = \theta \xi_{i,t-1} + \sum_{k=1}^{N_1} \lambda_k \Delta SP_{i,t-k} + \sum_{k=0}^{N_2} \Delta\left(\gamma_k^+ EXCH_{i,t-1}^+ + \gamma_k^- EXCH_{i,t-1}^-\right) + \mu_{i,t} \quad [5]$$

Where $\xi_{i,t-1}$ is the error correction term and it captures the long run components in the model and its parameter (θ) is the speed of adjustment. It measures how long it takes the system to adjust to its long run equilibrium when there is a shock.

The error correction term can further be expressed as:

$$\xi_{i,t-1} = SP_{i,t-1} - \phi_0 - \phi_1^+ EXCH_{i,t-1}^+ - \phi_1^- EXCH_{i,t-1}^- \quad [6]$$

Wherein the parameters $\phi_j \left[= \alpha_j / \alpha_1 \text{ for } j = 1,2 \right]$ represents the long run parameter for each of the explanatory variables. ϕ_1^+ and ϕ_1^- are for long run positive and negative changes in exchange rate respectively while the respective short run parameters are γ_k^+ and γ_k^-

The Wald restriction test is applied to ascertain presence of long run asymmetry. The PMG estimator allows for variation in the short run intercept, slope and error variance across cross section but it constrained the long-run effects to be equal across all panels. The null hypothesis for Wald test states that there is no asymmetries, that the long run parameters of the negative and positive partial sums of exchange rate are statistically equal $\left[H_0 :\ \alpha_2 = \alpha_3\right]$ and is tested against the alternative that there is asymmetry $\left[H_1 :\ \alpha_2 = \alpha_3\right]$.

3.1 Data and preliminary analysis

The basic assumptions of the PMG estimator are that, (i) the error terms are independently distributed and serially uncorrelated with the regressors, (ii) long run relationship exist between the dependent and explanatory variables, and (iii) there is long run parameters homogeneity across all cross sections. Hence, the empirical analyses begin with the tests for cross sectional dependence (CSD) test. The CSD test is imperative because of the likelihood of substantial cross sectional dependence in the errors which may be as a result of the presence of commons shocks and unobserved components (De Hoyos and Sarafidis, 2006). Four (4) CSD tests are applied namely the Breusch-Pagan (1980) LM test; Pesaran (2004) Scaled Test; Baltagi, Feng, and Kao (2012) bias-correlated scaled LM test; and the Pesaran

(2004) cross-sectional dependence test on the stock price series[2]. All the CSD tests have the null hypothesis that there is no cross-section dependence and the results are summarised in Table 1.

Table 1: Cross Sectional Dependence Tests of Sectoral Stock Prices

Sector	B-P test	P-S test	BFK test	PCD test
All Sector	586746.2***	5254.73***	5254.56***	155.3***
Agriculture	842.9***	342.90***	342.9***	28.99***
Conglomerates	2266.66***	411.1***	411.09***	10.26***
Construction	725.48***	159.99***	159.98***	-1.58
Consumer Goods	17486.51***	887.29***	887.26***	29.91***
Financial Services	27541.64***	987.93***	987.89***	74.39***
Health	4276.35***	499.73***	499.72***	26.25***
ICT	551.47***	223.91***	223.91***	-9.07***
Industrial Goods	13000.63***	831.44***	831.42***	20.28***
Natural Resources	245.67***	173.01***	173***	15.67***
Oil & Gas	688.71***	151.77***	151.76***	16.83***
Services	8047.86***	589.8***	589.78***	15.16***

B-P indicates the Breusch-Pagan (1980) LM test, P-S is the Pesaran (2004) Scaled Test, BFK indicates Baltagi, Feng, and Kao (2012) bias-correlated scaled LM test, and PCD is the Pesaran (2004) cross-sectional dependence test. The null hypothesis for each of the tests is that there is no cross-section dependence. The exchange rate value is similar across all firms, hence, the CSD tests is expected to be significant for both exchange rate series (USD and GBP).
*** indicates statistical significance at 1% level and hence, the null hypothesis is not rejected.

The CSD results reveal a statistically significant result. Hence, the null that the series are (weakly) cross sectional dependent is not accepted at 1% level. For robustness, the firms are further classified into their respective sector based on the Nigerian Stock Exchange[3] (NSE) classification. The results further confirmed the presence of cross section dependence in the stock price series for all firms.

The stationary properties of data series are further tested. Testing for unit root properties of panel data series have been distinguished in literature into basically first generation and second generation panel unit root tests. The fundamental difference between the first and second generation tests is that the former are based on assumption of no cross section dependence while the latter assume that there is cross section dependence. Following the presence of cross-section dependence in the series (see Table 1), the Pesaran (2007) unit root tests which is robust to the presence of cross-section dependence is used. The Maddala and Wu (1999) test which allows also for heterogeneity in the autoregressive coefficient but

[2] The exchange rate value is uniform for all cross sections, hence, perfect cross section dependence exists

[3] Visit http://www.nse.com.ng/Issuers-section/listed-securities/ for list of industries and sectoral classification

ignores cross-section dependence in the data is further applied and the results are summarised in Table 2.

Table 2: Unit Root Tests Result for Stock Prices

Sector	Maddala & Wu (1999)		*I(d)*	Pesaran (2007)		*I(d)*
	Level	**1st Diff.**		**Level**	**1st Diff.**	
All Sector	-1.5668*		*I(0)*	-1.805	-6.146***	*I(1)*
Agriculture	1.1592	-14.0745***	*I(1)*	-2.110	-6.190***	*I(1)*
Conglomerates	-0.4164	-19.9043***	*I(1)*	-1.822	-6.190***	*I(1)*
Construction	0.6584	-17.0960***	*I(1)*	-1.663	-6.190***	*I(1)*
Consumer Goods	-0.3154	-35.7937***	*I(1)*	-1.807	-6.190***	*I(1)*
Financial Services	-1.8999**		*I(0)*	-2.051	-6.190***	*I(1)*
Health	1.3313	-24.1377	*I(1)*	-1.697	-6.190***	*I(1)*
ICT	-0.1377	-14.0745	*I(1)*	-2.573	-6.190***	*I(1)*
Industrial Goods	-1.1933	-32.3893	*I(1)*	-1.802	-6.190***	*I(1)*
Natural Resources	-0.7757	-11.4917	*I(1)*	-2.625*		*I(0)*
Oil & Gas	0.5066	-18.1700	*I(1)*	-1.216	-6.190***	*I(1)*
Services	-1.7429**		*I(0)*	-2.180	-6.190***	*I(1)*

*** indicates statistical significance at 1% level. Both tests are conducted with the null hypothesis of no-unit root in the series.

The panel unit root tests results summarised in Table 2 shows that the stock price series contains unit root for all the sectors, except for financial and service sectors that both reported level stationarity using the Madalla and Wu test but non-stationary when cross sectional dependence is considered.

4.0 Presentation and Discussions of Results

One of the requirements for the application of Pesaran et al., (2001) model is that the variables could be I(0), I(1) or a combination of both I(0) and I(1), however, none of the series could be I(2). Following the unit root tests results presented in Table 2, the study proceed to estimate both the linear and non-linear models. The main novelty of this study is centred on the evaluation of the likelihood of firms' stock prices exposure to exchange rate being asymmetry or otherwise in nature. Therefore, the empirical analyses begin with the Wald test for asymmetries. The results for all the sectors is summarised in Table 3.

The non-significance of the F-statistics of the Wald tests suggest that treating the exposure of stock prices to exchange rate differently for exchange rate depreciation or appreciation that is asymmetry behaviour, matters for only three sectors out of the eleven sectors considered in the empirical analysis. The three sectors whose relationship between their stock prices and exchange rate exposure are the conglomerates, consumer goods and financial services sectors. On the other hand, the Wald test statistics reported for the agriculture, construction, health, ICT, industrial goods, natural resources, oil & gas and the services sectors are not statistically significant, hence, the null hypothesis of no asymmetry evidence is not rejected. Thus, this results suggest that the exposure of stock prices of firms in these eight sectors to exchange rate movement is identical at least in the long-run regardless of whether the Nigerian Naira appreciates or depreciates against the US dollar.

Table 3: Wald Test for Asymmetry

Sector	**Wald Statistic**	**Asymmetric Evidence**	**Sector**	**Wald Statistic**	**Asymmetric Evidence**
All Sectors	1.3963 [0.2373]	No	***Health***	0.0280 [0.8671]	No
Agriculture	1.6160 [0.2039]	No	***ICT***	0.3672 [0.5447]	No
Conglomerates	2.8000* [0.0944]	Yes	***Industrial***	1.7236 [0.1893]	No
Construction	2.1591 [0.1419]	No	***Natural Resources***	0.8320 [0.3620]	No
Consumer Goods	4.345** [0.0372]	Yes	***Oil & Gas***	0.8610 [0.3536]	No
Financial Services	22.0960 [0.0000]	Yes	***Services***	0.1652 [0.6844]	No

The test for joint significance of the asymmetries is carried out using the Wald test. The null hypothesis is that the positive and negative changes are jointly insignificant, hence, they are not different from zero, with the alternative that the changes are jointly significant. Probability values are in brackets, while ***, **, and * indicate significance at 1%, 5% and 10% respectively.

Following the appraisal of the role of asymmetries or otherwise using the Wald tests, the nature of the relationship between stock prices and exchange rate in terms of signs and statistical significance of the estimated coefficients is evaluated. Presented in Table 4 are summaries of the symmetry and asymmetry estimates obtained from the empirical implementation of the panel ARDL (Eqn. 2) and NARDL (Eqn. 5) models respectively. In estimating both models, a maximum of four lags is imposed on both the dependent and the regressors. However, only the preferred result for each of the sectors is summarised and presented in Table 4, based on the tests for asymmetry.

The sign of the coefficient reported for oil and gas sector is positive and statistically significant, while it is negative but also significant for the construction, health and services sectors. These imply that exchange rate movements symmetrically affect stock prices of firms in the oil and gas sector negatively but positive for the construction health and services sectors. The coefficients of exchange rate for the agriculture, conglomerates, ICT, industrial goods and natural resources sectors are not significantly different from zero. This indicate that the stock prices of firms in these sectors are not significantly affected by alteration in the exchange rates of Naira to Dollar.

The sign of the coefficients exchange rates reported for both consumer goods and financial services sectors show a somewhat different results from what is obtained for other sectors. First, asymmetry matters for both sectors. Hence, the reaction of stock prices of firms in these sectors to appreciation and depreciation in exchange rates is expected to be different. Secondly, it is found out that the coefficients of positive changes in exchange rate (depreciation) does not statistically affect stock prices, whilst on the contrary, appreciation in exchange rate positively and significantly affect stock prices of firms in the consumer goods and financial services sectors.

Essentially, the error correction terms of the respective models (both symmetry and asymmetry) are shown to be correctly signed and theoretically correct (negative and less than one). The significant and negative signs of the respective error correction terms for the aggregate stock prices as well as the individual sectoral stock prices suggests that on average; stock prices in the short run tends to adjust to long run equilibrium given any distortions caused by shocks due to their exposure to exchange rate movement.

Table 4: Panel ARDL/Pooled Mean Group Results

Dependent Variable: Naira/US Dollar Exchange Rate (USD)

	All Sectors	**Agric.**	**Conglom.**	**Constr.**	**Cons. Gd.**	**Fin. Serv.**	**Health**	**ICT**	**Ind. Gds.**	**Nat. Res.**	**Oil&Gas**	**Services**
	Symmetry	**Symmetry**	**Asymmetry**	**Symmetry**	**Asymmetry**	**Asymmetry**	**Symmetry**	**Symmetry**	**Symmetry**	**Symmetry**	**Symmetry**	**Symmetry**
Long Run Estimates												
LUSD	-0.1133***	-3.6855		-0.1161*			- 2.2081***	0.4976	-0.1523	-0.2435	0.9037***	-0.1843**
	(0.0368)	(4.3255)		(0.0691)			(0.7605)	(1.065)	(0.1457)	(0.1801)	(0.3013)	(0.0824)
$LUSD^{+}$			-0.0328		0.0305	0.0036						
			(0.0502)		(0.0321)	(0.0185)						
$LUSD^{-}$			0.0672		0.1089***	0.1211***						
			(0.0549)		(0.0304)	(0.0185)						
Short Run Estimates												
Constant	0.0272***	0.0984**	0.0077	0.0477*	0.0242***	0.0041	0.1217***	-0.0083	0.0382	0.0465***	-0.0007	0.0331***
	(0.0032)	(0.0448)	(0.0059)	(0.0269)	(0.0056)	(0.0049)	(0.0394)	(0.0051)	(0.0083)	(0.0154)	(0.0059)	(0.0091)
ΔLSP(-1)	0.0517***			0.1645			0.0851	0.2169***	0.1035***			0.0254
	(0.0156)			(0.1537)			(0.0523)	(0.0814)	(0.0391)			(0.0449)
ΔLUSD	0.0723***	0.1997***		0.0563*			0.2286**	-0.0013	0.0031	-0.0283	-0.0273	-0.0387
	(0.0174)	(0.0205)		(0.0335)			(0.1032)	(0.0036)	(0.0278)	(0.0253)	(0.0613)	(0.0286)
$\Delta LUSD^{+}$			0.0006		0.0791*							
			(0.0005)		(0.0449)							
$\Delta LUSD^{-}$			-0.0001		-0.0003	0.0007**						
			(0.0006)		(0.0003)	(0.0003)						
ECT_{-1}	-0.0172***	-0.0048*	-0.0084***	-0.0118**	-0.0013***	- 0.0009***	- 0.0103***	-0.0068*	- 0.0139***	- 0.0143***	-0.0197**	- 0.0274***
	(0.0022)	(0.0025)	(0.0024)	(0.0058)	(0.0003)	(0.0003)	(0.0034)	(0.0035)	(0.0027)	(0.0031)	(0.0091)	(0.0093)
Lag Structure	(2, 1)	(1, 1)	(1, 1, 1)	(2, 1)	(2, 1, 1)	(1, 1, 1)	(2, 1)	(2, 1)	(2, 1)	(1, 1)	(1, 1)	(2, 1)

Symmetry and Asymmetry denote symmetric and asymmetric models respectively. ΔLUSD is the long run coefficient of exchange rate, while $\Delta LUSD^{+}$ and $\Delta LUSD^{-}$ respectively capture positive and negative changes in exchange rates in the long run. Standard errors are presented in parenthesis, while ***, **, and * denotes significance at 1%, 5% and 10%.

4.1 Robustness Checks

In this section, the robustness of the regression results is evaluated in terms of the significance or otherwise of asymmetries as well as the nature of the relationship between stock prices and exchange rate. Recall that in the main estimation, exchange rate is measured using the exchange value of Naira to US Dollar. However, for robustness purpose the exchange rate proxy is changed to Naira to Great Britain Pounds Sterling exchange value in order to verify whether the relationship between stock prices and exchange rate is sensitive to variable proxy[4].

The evidence of asymmetry show variations with the main analysis when the proxy for exchange rate is changed (see Table A1). The Wald results show support for symmetric model in the relationship between stock prices and exchange rate for the sectors under investigation. Contrary to the support for asymmetry model obtained in the main analysis for the Conglomerates, Consumer Goods and Financial Services sectors, the robustness result support symmetry model for all the sectors.

Lastly, the nature of relationship between stock prices and exchange rate in terms of size and magnitude of coefficients as well as optimal lag length selected is largely similar to the results of the main estimation. The robustness result show that the change in exchange rate proxy does not matter in the relationship between exchange rate and stock prices for all the sectors.

5.0 Conclusion

This study examines the dynamics of stock prices response to exchange rate movements. Both the Linear and Non-Linear panel ARDL framework are explored to explore the possible asymmetries in the relationship between stock prices and exchange rate movement in Nigeria. Weekly firm level data set expressed in industry-wide panel forms were used to proxy the stock prices, while weekly data of Naira exchange to US dollar (USD) is used for the main analyses. On the other hand, the Great Britain Pound Sterling (GBP) is for robustness. The study commence its empirical analysis with the tests for cross sectional dependence (CSD) in order to determine the likelihood of substantial cross sectional dependence in the errors, which may be due to the presence of commons shocks and unobserved components. The four CSD tests employed are: Breusch-Pagan (1980) LM test, Pesaran (2004) Scaled Test, Baltagi,

[4] See the Appendix for estimation results involving GB Pounds.

Feng, and Kao (2012) bias-correlated scaled LM test, and Pesaran (2004) cross-sectional dependence test with all tests indicating rejection of the null that the series are (weakly) cross sectional dependent. The stationary properties of the series are further tested by performing the first and second generation panel unit root tests on the stock market series. The outcomes of the unit root tests show that the series are integrated of mixed order (I(0) and I(1)) thus satisfying the theoretical requirement for the application of the ARDL framework which allows for both I(0) and I(1) when modelling economic relationships.

The existence of asymmetries is empirically tested by applying the Wald test for coefficient restrictions on the partial sums of positive and negative changes in exchange rate. The non-significance of the F-statistics suggests that treating the exposure of stock prices to exchange rate differently (that is asymmetry behaviour) for exchange rate depreciation or appreciation matters only for firms in the conglomerates, consumer goods and financial services sectors in Nigeria. However, the Wald test statistics reported for agriculture, construction, health, ICT, industrial goods, natural resources, oil & gas and the services sectors suggest that the exposure of these eight sectors to exchange rate movement is symmetrical at least in the long-run regardless of whether there is appreciation or depreciation of the Naira. On the short and long run dynamics of stock price exposure to exchange rate movement, the positive and negative symmetry coefficients of exchange rates show that the aggregate stock prices tend to appreciate in the short run, but depreciate in the long-run.

Furthermore, the coefficients report insignificant responses of the stock prices of firms in the Agriculture and the Industrial sectors to exchange rate movement on the one hand; whilst there is positive long-run response of stock prices of firms in the oil and gas sector to exchange rate movement. The results further confirm the peculiarity of the Nigerian economy as a monolithic economy with heavy reliance on oil sector with almost total neglect for the agriculture and industrial sectors.

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APPENDIX

Table A1: Wald Test for Asymmetry using GBP

Sector	Wald Statistic	Asymmetric Evidence	Sector	Wald Statistic	Asymmetric Evidence
All Sectors	0.8902 [0.3454]	No	***Health***	1.4937 [0.2217]	No
Agriculture	1.2735 [0.2594]	No	***ICT***	1.2676 [0.2605]	No
Conglomerates	0.0018 [0.9662]	No	***Industrial***	2.4321 [0.1189]	No
Construction	0.3175 [0.5732]	No	***Natural Resources***	0.0512 [0.8211]	No
Consumer Goods	2.0444 [0.1528]	No	***Oil & Gas***	0.1010 [0.7506]	No
Financial Services	0.0009 [0.9757]	No	***Services***	0.3305 [0.5654]	No

The test for joint significance of the asymmetries is carried out using the Wald test. The null hypothesis is that the positive and negative changes are jointly insignificant, hence, they are not different from zero, with the alternative that the changes are jointly significant. Probability values are in brackets, while ***, **, and * indicate significance at 1%, 5% and 10% respectively.

Table A2: Panel ARDL/Pooled Mean Group Results

Dependent Variable: Naira/GP Pounds Exchange Rate (GBP)

	All Sectors	**Agric.**	**Conglom.**	**Constr.**	**Cons. Gd.**	**Fin. Serv.**	**Health**	**ICT**	**Ind. Gds.**	**Nat. Res.**	**Oil&Gas**	**Services**
Long Run Estimates												
LGBP	-0.1643***	-4.6562	-0.7521	-0.1547*	-0.2360	-0.0687	-2.4449***	0.4552	-0.2340	-0.4020**	1.0453***	-0.3070***
	(0.0437)	(6.1325)	(0.6091)	(0.0804)	(0.1499)	(0.0776)	(0.8745)	(1.183)	(0.1677)	(0.1927)	(0.3842)	(0.0922)
Short Run Estimates												
Constant	0.0331***	0.1220*	0.0524***	0.0519*	0.0515***	0.0097	0.1387***	0.0252***	0.0454	0.0681***	-0.0236***	0.0563***
	(0.0034)	(0.0595)	(0.0156)	(0.0293)	(0.0104)	(0.0047)	(0.0553)	(0.0094)	(0.0092)	(0.0234)	(0.0089)	(0.0140)
ΔLSP(-1)				0.1646	0.0796*		0.0843	0.2170***	0.1040***			0.0268
				(0.1539)	(0.0450)		(0.0527)	(0.0816)	(0.0391)			(0.0448)
ΔLGBP	0.0520***	0.1978***	0.1291*	0.0452	0.1139**	0.0862***	0.1753**	-0.0164*	0.0020	-0.0088	-0.0020	-0.0250
	(0.0156)	(0.0457)	(0.0709)	(0.0295)	(0.0442)	(0.0300)	(0.0906)	(0.0095)	(0.0284)	(0.0163)	(0.0433)	(0.0281)
ECT_{-1}	-0.0174***	-0.0044***	-0.0010***	-0.0120**	-0.0122***	-0.0276***	-0.0099***	-0.0066***	-0.0139***	-0.0160***	-0.0190**	-0.0285***
	(0.0022)	(0.0022)	(0.0028)	(0.0059)	(0.0022)	(0.0067)	(0.0040)	(0.0025)	(0.0026)	(0.0041)	(0.0090)	(0.0097)
Lag Structure	(1, 1)	(1, 1)	(1, 1)	(2, 1)	(2, 1)	(1, 1)	(2, 1)	(2, 1)	(2, 1)	(1, 1)	(1, 1)	(2, 1)

Symmetry and Asymmetry denote symmetric and asymmetric models respectively. ΔLGBP is the long run coefficient of exchange rate, while $\Delta LGBP^{+}$ and $\Delta LGBP^{-}$ respectively capture positive and negative changes in exchange rates in the long run. Standard errors are presented in parenthesis, while ***, **, and * denotes significance at 1%, 5% and 10%.