ASYMMETRIC EFFECTS OF OIL PRICE AND EXCHANGE RATE ON TRADE BALANCE IN NIGERIA: A NONLINEAR ARDL APPROACH

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ABSTRACT

Little is known on the asymmetric effects of oil prices and exchange rate on the trade balance in Nigeria. This paper therefore, examined whether Nigeria's trade balance is responding asymmetrically to changes in oil price and exchange rate using the nonlinear autoregressive distributed lag model with monthly time series data for the period 1999M1 to 2019M12. The study found that Nigeria's trade balance significantly responded asymmetrically to changes in oil price, such that the effect of rising oil price is more pronounced. In addition, the study found that Nigeria's trade balance significantly responded asymmetrically to changes in exchange rate, such that the significant negative effect of depreciation was more prominent. Moreover, the study found no evidence of the J-curve effect in Nigeria. This research has significant policy implications for policymakers in Nigeria.

Keywords: Trade Balance, Crude Oil Price, Exchange Rate, Asymmetry, Nonlinear ARDL

JEL classification: C22, F31, Q43, F14, F41

1. Introduction

External trade is an important factor that enhances economic growth (UNCTAD, 2018). This is because external trade not only allows a country to consume beyond its production frontier but also exerts influence on the economy through efficient allocation of resources via spillover of new knowledge of technological innovations among trading partners, improvement in business competitiveness, and large market size that leads to economies of scale (Long, Raff and Stähler, 2011; Gorodnichenko, Kukharskyy and Roland, 2015). Based on a theoretical model and a set of empirical studies, natural resources and exchange rate are key factors that promote this trade. For instance, conventional growth theory provides detailed explanation on how natural resource endowment raises output, which in turn improves trade (Solow, 1956; Romer, 1990). In addition, the elasticity model of trade balance illustrates that exchange rate depreciation improves trade performance (Krueger, 1983). The empirical enquiries by Rebucci and Spatafora (2006) and Huntington (2015) confirm this conventional wisdom that export receipt from a given volume of crude oil is beneficial while Bahmani-Oskooee and Zhang (2014); Igue and Ogunleye (2014) reinforced the hypothesis about the crucial role of exchange rate in ensuring improvement on trade. Russia is an evidence case study that generated a successful economic transition through an effective depreciation of the value of the ruble that led to Russia’s cost-price structure in the non-oil sector, in line with the global competitive market (Letiche, 2006).

Thus, in an oil-rich economy like Nigeria, crude oil exports and persistent depreciation of the naira are expected to put the economy on the path of improved external trade. However, trade has not performed as expected in Nigeria, and this may be due to the fluctuations in oil price and unstable exchange rate. For instance, as global oil prices dropped sharply after 2014, Nigeria’s economy was severely hit, with aggregate balance of trade deficits of about ₦2.2 trillion in 2015 and dwindled government revenues (NBS, 2017), all of which culminated in a recession in 2016, signifying an underperforming economy. This is a pointer that global commodity prices mostly influence the economy, making the country vulnerable to external shocks, and resulting in the description, ‘boom–bust trade cycles’. To illustrate the point better, Nigeria’s imports and exports rose by 35% and 27% respectively in 2011, following a 40% rise in oil price, but following the shock arising from a 46% sharp drop in international oil market price in 2015, imports still accounted for 5% rise while exports trade value disproportionately degenerated to ₦8.85 trillion, representing a 32% decline, the highest in relation to other countries in Africa (AU, 2018; CBN, 2019). As a result, in 2011, trade balance rose to ₦4.24 trillion representing a 10% increase, while in 2015, trade recorded a deficit of ₦2.2 trillion, representing a 32% decline. This observed fluctuation of global oil prices suggests an asymmetric relationship with trade balance.

Besides, the movement of exchange rate in the form of appreciation and devaluation are conventionally believed to produce different effects on trade balance: whereas appreciation is assumed to diminish balance of trade via more imports and less exports, devaluation is presumed to improve balance of trade by boosting exports and discouraging imports. This suggests the reason why the World Bank and the IMF propose currency depreciation as a perquisite for addressing deficit balance of payments (Bhattarai and Armah, 2013; Eke, Eke and Obafemi, 2015). However, this conventional expectation seems not to be true in reality as another school of thought abiding by experience revealed that the effect of depreciation on trade balance follows a time path – in the short run, the effect deteriorates trade balance but in the long run, the effect starts to enhance the trade balance (Magee, 1973; Bahmani-Oskooee, and Kanitpong, 2018). This time path effect is called the J-curve effect. The J-curve phenomenon states that the policy of devaluation of a country's currency to boost trade first worsens the trade balance in the short run, and afterward improves the real trade balance in the long-run (Magee, 1973). Magee (1973) argued that the initial negative response arises if the instantaneous effect of currency devaluation increases the cost of imports to a greater extent than the immediate effect of an increase in domestic output vis-à-vis export revenue. This exchange rate adjustment behaviour suggests also an asymmetric relationship between exchange rate and trade balance. The most challenging fact is that Nigeria has been experiencing several currency devaluations/depreciation starting from ₦2.02 to US $1 during the SAP era in 1986 to ₦361 per US $1 as at the second quarter of 2020 (CBN, 2020), yet, Nigeria has continued to experience huge and persistent trade deficit despite the presumed J-curve pattern. This challenge has dominated Nigeria’s external economic scenery for over two decades.

Consequently, some studies in the extant literature have sought to address this challenge of rising trade deficit. These studies suggest that the fluctuations in crude oil prices and/or exchange rate could offer a possible explanation to Nigeria's rising trade deficit since the oil sector contributes over 90 percent of the country's export earnings while exchange rate adjustments influence transaction costs and trade competitiveness. In other words, changes in oil price and exchange rate directly affect trade performance (Anoke, Odo, and Ogbonna, 2016; Bahmani-Oskooee, and Kanitpong, 2017; Ahad, and Anwer, 2020), but whether the relationship is nonlinear remains unknown in Nigeria. Though a number of empirical studies have investigated this relationship, especially in the highly industrialized economies, some important gaps still exist especially in developing economies like Nigeria. For instance, there is a dearth of empirical studies on the oil price-trade performance nexus based on the nonlinear model in Nigeria except Ogbonna and Ichoku (2022) that focused on bilateral trade. Besides, existing studies on the exchange rate-trade performance relationship in Nigeria could not use high frequency data that captures the exchange rate dynamics faster and better to investigate whether J-curve effects exist in Nigeria. Therefore, the specific objectives of this study are to: (i) ascertain if Nigeria's trade performance responds asymmetrically to changes in oil price and exchange rate; (ii) ascertain if there is evidence of the J-curve pattern in the response of Nigeria's trade to changes in exchange rate. The remaining sections of the paper are organized as follows. Section 2 presents a literature review and value addition, while the data and methods used are presented in Section 3. The results are presented and discussed in Section 4, while Section 5 concludes the paper.

2. Literature Review

The theoretical link between oil price, exchange rate and trade balance could be traced to the gravity model which was first presented by Timbergen (1962) in the analysis of international trade. Deardorff and Stern (1998) supported the theoretical validity of the gravity model by showing its consistency with the Heckscher–Ohlin trade model of homogeneous goods and that substantial explanation of causes of variation in trade across economies is embedded in the gravity equation. Other empirical works have also provided support that the gravity model is applicable to non-homogeneous goods (Anderson, 1979; Helpman and Krugman, 1977; Bergstrand, 1985).

From an empirical standpoint, studies have shown that trade liberalization, economic integration, market size, institutional frameworks, exchange rate, global commodity prices, and border effects influence external trade. However, global commodity price level and exchange rate are two major factors with lack of unanimity of their effect on trade that have attracted the attention of scholars to robustly and dynamically examine their impacts on trade. Indeed, there exists broad empirical literature on the influence of crude petroleum price and exchange rate on trade performance. However, this empirical review would be divided into two strands of argument. The first strand would be previous works based on the linear effect whereas the second would be based on the nonlinear effect.

First, numerous empirical studies across the globe have investigated the effect of crude petroleum prices and exchange rate on the external trade in different economies with different methodologies outside the nonlinear approach, but the findings are widely divided on the nature of the relationships existing between them. For example, some studies believe that a rise in crude petroleum price benefits the oil-exporting countries, however, the uncertainties embedded in rising prices could exert a negative influence. Other analytical traditions have come to the conclusion that crude petroleum price increase cannot buy development in external trade in oil-importing countries. Rafiq, Salim and Bloch (2009) used forecast error variance decomposition (FEVD), impulse response functions (IRF), and the Granger-causality test extracted from the VAR model to examine crude petroleum price volatility on trade balance for Thailand. The Granger causality results revealed unidirectional causality running from crude petroleum price volatility to trade balance. FEVD and IRF augmented the earlier findings that trade balance responds negatively to variations in crude petroleum price volatility but diminishes over time. Arouri, Tiwari and Teulon (2014) used impulse response function (IRF) to evaluate the lead-lag association between crude petroleum price and trade balance based on the frequency domain framework for India. Their findings show bidirectional causality between oil price and trade balance. Further results from IRF show that trade balance responds negatively to crude petroleum price shocks. Hassan and Zaman (2012) used Granger-causality to examine oil price and trade balance for Pakistan. The findings show that crude petroleum price Granger-cause trade balance and not otherwise and that crude petroleum prices induce most trade imbalance in Pakistan. Allegret, Mignon and Sallenave (2015) used the Global Vector Autoregressive (GVAR) model to examine the connectedness of crude petroleum price shocks and global imbalance among 18 oil-importing economies and 12 oil-exporting economies.

Focusing on the exchange rate and trade balance relationship, some findings based on the linear model confirm no significant relationship between exchange rate and trade balance, whereas others argue that exchange rate fluctuation significantly contributes to changes in trade balance. Some studies that find no evidence of association between exchange rate and trade balance include: Laffer (1977), Salant (1976), Miles (1979), Liew, Lim and Hussain (2003), Wilson and Tat (2001), Hatemi and Irandoust (2005), and Anoke, Odo, and Ogbonna, (2016). Even though a plethora of previous studies have associated exchange rate as an insignificant factor on trade balance, of course, the empirical evidence is not uniformly one-sided regarding the relationship among the variables. Some studies find robust evidence of association between exchange rate and trade balance which include Arize (1994); Bahmani-Oskooee and Zhang (2014).

The extant literature on Nigeria-specific studies of exchange rate and trade balance based on linear function have evolved following various studies. Ogbonna (2009) used a vector error correction approach distilled from the Engle-Granger (1987) VAR methodology, to estimate the impact of exchange rate on trade balance in Nigeria. The analysis indicates that exchange rate has a weak influence on trade balance. Further findings suggest that accounting for contractionary monetary and fiscal policy would improve trade balance. The findings are consistent with Ogbonna (2011), who applied the OLS estimation technique to study the effect of exchange rate variation on trade performance for the sample period 1970 to 2005. Igue and Ogunleye (2014) argued that gradual devaluation of Nigeria’s currency would help to boost external trade performance in their analyses of the effect of exchange rate on trade balance in Nigeria. The paper used a vector error correction mechanism derived from the VAR model and selected the lag order at one to estimate the model. The study found that there is a significant positive relationship between exchange rate and trade balance. Again, the result shows that devaluation of the naira enhances trade balance in the long run. On the contrary, Loto (2011) argued that devaluation in an import-dependent economy such as Nigeria will impede trade balance. The OLS result shows that depreciation of the naira does not promote external trade and that the Marshall-Lerner condition is not valid for Nigeria. This result is consistent with Anoke, Odo, and Ogbonna (2016) who found an insignificant impact of depreciation on trade performance in Nigeria. Omojimite and Akpokodje (2010) analysed the effect of exchange rate reform on trade balance in Nigeria using the OLS and the generalized method of moments (GMM) estimation techniques. The study discovered that devaluation of the real exchange rate level via reform increased non-oil exports slightly.

In general, the major drawback of the linear approach emanates from the fact that the association between oil price and trade balance and between exchange rate and trade balance could be nonlinear and thus, the linear model will become highly misleading and problematic in presentation and interpretation, thereby obscuring the real association between the variables.

Second, following the recent doubt on the credibility of the linear model to analyse the effect of oil price and exchange rate on trade balance, a nonlinear approach emerged. However, there exists a small but growing number of empirical literature on the nonlinear model. This new line of enquiry has generated a comprehensive understanding of the link between oil price and trade balance and between exchange rate and trade balance. Focusing on the oil price and trade balance relationship, Rafiq, Sgro and Apergis (2016) argued that the nonlinear approach is capable of capturing the asymmetric market information by decomposing the positive shock from the negative shock. Their study confirms that a rise in crude petroleum price is positively associated with oil trade balance in oil-exporting countries while oil-importing economies are substantially insulated from positive crude petroleum price shocks. However, a fall in crude petroleum price is more favourable to oil-importing countries because the volume effect will surpass the price effect, whereas stable crude petroleum price is more appropriate to oil-importing countries than a fall in crude petroleum price. Jibril, Chaudhuri and Mohaddes (2020) extended the work of Rafiq, Sgro and Apergis (2016) by accounting for the sources of crude petroleum price shocks. The study found evidence of asymmetric effects of crude petroleum price shocks on trade balance and that the asymmetric association hinges on the source of the shock. Specifically, the findings indicate that demand shock emanating from a rise in global economic activities worsens trade balance for oil-importing economies but improves them for oil-exporting economies, while demand shock emanating from a fall in global economic activities has akin effects instead of a reverse. Moreover, a fall in crude petroleum price is only harmful to oil-importing economies if the shock originates from global aggregate demand suggesting that a fall in crude petroleum price improves trade balance only if the source of shock originates from the supply side. Raheem (2017) was the first to apply the Shin, Yu, and Greenwood-Nimmo (2013) nonlinear approach to the analysis of crude petroleum price shocks on components of external trade. The study found the presence of an asymmetric association on exports in the long term in high trading countries, whereas an asymmetric association exists on imports in the short term in oil-importing countries but in the long term in oil-exporting countries. In a similar study, Ahad and Anwer (2020) adopted the non-linear ARDL framework introduced by Shin, Yu and Greenwood-Nimmo (2013) and found the asymmetric effect of crude petroleum price shocks on deficit balance of trade of the economy of Pakistan.

Focusing on exchange rate and trade balance, Bahmani-Oskooee and Fariditavana (2015) argued that some extant literature found no significant effect of exchange rate on trade balance both in the short and long terms because of the inefficiency in the use of the linear model to capture the true nature of the relationship. The authors stressed that once an asymmetric approach is presented with a model that captures the nonlinear exchange rate adjustment behaviour, devaluation of currency could substantially affect trade balance while appreciation may be negligible. Consequently, the study established that devaluation of currency substantially affects trade balance while appreciation may be negligible for the US, Japan, China, and Canada using the nonlinear ARDL approach. A similar result was found in a transition economy; Nusair (2017) followed the econometrics procedure of Bahmani-Oskooee and Fariditavana (2015) to examine the J-curve effect of exchange rate movement on trade balance for transition economies. Hence the study adopted the Shin, Yu and Greenwood-Nimmo (2013) nonlinear methodology for 16 transition economies using time series data spanning 1994 quarter one to 2015 quarter two. The estimation result overwhelmingly showed that trade balance deteriorates in the short term but improves in the long term thereby supporting the J-curve patterns. The paper argued that the linear model assumption could be responsible for the inability of previous studies that based their study on linear function to identify the J-curve effect. The author submits that the nonlinear model is fundamental when examining the effect of exchange rate adjustment behaviour on trade balance. Arize, Malindretos and Igwe (2017) employed a nonlinear error correction and cointegration model distilled from the NARDL framework propounded by Shin, Yu, Greenwood-Nimmo (2013) to investigate the varying effect of appreciation and depreciation on trade balance for 8 developing Asian economies. The empirical result revealed evidence that exchange rate adjustment is asymmetric in the long term for the majority of the economies studied while half of the economies studied exhibited asymmetric effect in the short term. The study further found that depreciation has a substantial effect than appreciation in the long run. Bahmani-Oskooee and Kanitpong (2017) studied the nonlinear and asymmetric effect of exchange rate changes on trade balance across 7 Asian economies using the NARDL framework developed by Shin, Yu and Greenwood-Nimmo (2013) using quarterly time series with different sample data for each country. The result of the error correction and cointegration approach indicates evidence of asymmetric effect in the relationship between exchange rate changes and trade balance for Malaysia, Thailand, Korea, and Singapore in the short run whereas in the long run, asymmetric effect was detected for three economies only, which included Korea, Japan, and Indonesia.

The extant literature based on the nonlinear model in Nigeria-specific studies is evolving. Apanisile and Oloba (2020) used logistic smooth transition (LSTAR) and exponential smooth transition (ESTAR) to decompose exchange rate changes into partial sum processes of appreciation and depreciation and applied NARDL to investigate the differential effect of appreciation and depreciation on Nigeria bilateral trade with the Republic of Benin. The study found that exchange rate changes respond asymmetrically to Nigeria bilateral trade with the Republic of Benin and to be specific, appreciation of domestic currency had only significant negative effects. A similar study by Onatunji (2019) also found that the relationship between exchange rate and trade is asymmetric. To underscore the impact of financial development on the exchange rate-trade nexus, Sambo, Farouq and Isma'il (2021) investigated the moderating effect of financial development on the relationship between exchange rate volatility and trade balance in Nigeria. The study adopted the NARDL approach over the period 1980 to 2019. The study found that financial development amplified the positive effect of real exchange rate changes on Nigeria trade with the rest of the world. The study concluded that exchange rate volatility–trade relationships depend on the level of financial development.

One important observation about the extant literature reviewed in Nigeria is that most of the studies presumed a linear association between crude oil price and trade balance and as such used a linear model to investigate this relationship (Olayungbo, 2019; Bala, Chin, and Mustafa, 2022). Furthermore, most of the studies that applied the nonlinear methodology to study this relationship focused on developed and emerging countries. Surprisingly, the extant literature for Nigeria has been silent on the asymmetric effect of oil price changes on trade balance. Moreover, the unsettled matter has however been whether this asymmetry is present in various economies. This study would therefore be a pioneering effort in Nigeria using the recently developed nonlinear ARDL framework of Shin, Yu and Greenwood-Nimmo (2013) to position an inquiry on the relevance of asymmetric effect of oil price changes on trade performance for the following reasons.

First, to assume that the effect of oil price is symmetry when it is asymmetry in reality may lead to wrong policy suggestion(s) on exchange rate policy. Second, since Nigeria is an oil-dominant economy, understanding the asymmetric effect of oil price fluctuation would provide policy makers with the much-needed guidance if oil price hike and plunge of equal magnitude have different effects on trade balance. Third, the few studies on the J-curve effect in Nigeria used low frequency data. This study used high frequency data to avoid making inference on results that may suffer from time aggregation bias since global oil price and exchange rate regimes are notoriously volatile and their effect on trade balance can be short-lived. Thus, higher frequency data is substantial in capturing oil price and exchange rate dynamics. Fourth, most of the previous studies in Nigeria arbitrarily fixed the lag order at one or two, which means that the dynamics of the model may not have been sufficiently accounted for. This study used the general-to-specific approach of Greenwood-Nimmo and Shin (2013), beginning with a maximum lag order of six (6) months. This ensures that the model dynamics is not arbitrarily misspecified because omission of such variables could bias a model toward overstating the influence of the included variables.

3. Methodology

3.1 Data

The study employed monthly time series data over the period January 1999 to December 2019. To enable the study capture the evolution of the flexible exchange rate regime which was reintroduced in 1999 as well as availability of data informed the time scope in this study. In addition, the study used higher speed monthly data in order to capture the oil price and exchange rate dynamics faster and better. The variables of interest in this study include trade balance (TRADE), oil price (OIL), real effective exchange rate (EXR) and index of industrial production (Y). The trade balance data were obtained from the Direction of Trade Statistics (DOT) of the International Monetary Fund (IMF). Due to poor quality concerns about trade data on services (Kilian, Rebucci and Spatafora, 2009) and the challenge of data availability, it is worthy to note that in this study, trade balance does not contain trade in services. The global Brent crude price and exchange rate data were obtained from International Financial Statistics (IFS) of the International Monetary Fund (IMF). The data for the index of world industrial production, a proxy for world economic activities was obtained from the Federal Reserve Bank of Dallas. Table 1 reports the descriptive statistics of the data based on its indexed representation, while Table 2 reports the Zivot-Andrews unit root test results based on the logged data. The descriptive statistics indicate that the data exhibited some variability.

Table 1. Summary Statistics of the Variables

Variable	No. Obs.	Mini	Max	Mean	Std. Dev.	J-B Prob.
TRADE	252	1.08	5.78	2.10	0.78	0.000
OIL	252	10.20	133.90	62.43	30.98	0.000
EXR	252	63.85	133.68	96.19	18.13	0.003
Y	252	80.55	144.81	111.64	18.62	0.001

Source: Author's computation.
Notes: Trade denotes the trade balance with the rest of the world; OIL denotes crude oil price; Y denotes index of industrial production; J-B Prob denotes Jarque-Bera Probability; No. Obs denotes number of observation.

The summary statistics of the data employed in this study are presented in Table 1. The statistics show that the time series is balanced with 252 observations for all the variables. Nigeria's trade with the rest of the world measured as a ratio of export over import on average was 2.1 within the study period. The minimum and maximum values were 1.08 recorded in 2017M10 and 5.78 recorded in 2000M07, respectively. The standard deviation of 0.78 shows that the series was tightly clustered around its mean value. Global crude oil price has a standard deviation of 30.98, which shows greater variability over the period. The study observed that the lowest global crude oil price of US$10.2 per barrel was recorded in 1999M02, and the highest of US $133.9 per barrel was recorded in 2008M07. The mean value of real effective exchange rate was 96.19, which is high. On the premise of the probability value of Jarque-Bera statistics, all the variables under consideration were not normally distributed. This nature of the data series therefore calls for normalization of the variables; hence, these data were first indexed to the 2010 base year (2010 = 100) to maintain uniform scaling. Finally, the entire dataset was logged prior to estimation. This data compilation methodology is consistent with the global NARDL data methodology which has been used by Shin, Yu, Greenwood-Nimmo (2013) with great success.

Table 2. Results of Zivot-Andrews Unit Root Tests

Variable	Level I(0) t-Statistics	Level I(0) Break location Model	First Difference I(1) t-Statistics	First Difference I(1) Break location Model	Order of integration	Chosen break point: Year and Month
trade	-4.1327	A	-15.3028***	A	1(1)	2009M05
oil	-5.2073**	A			I(0)	2014M07
exr	-6.9247***	C			1(0)	2016M06
Y	-5.8784***	C			1(0)	2008M08

Notes: *, ** and *** indicates significance at 10%, 5% and 1% level respectively. The reported statistics are computed using the logged data indexed with base year 2010Y = 100 representation. A denote break location that permits a change in the level form; C denote break location that permits a change in the variable at both level and the slope of the trend.

Source: Author’s computation.

3.2 Unit Root Analysis of the Time Series

The NARDL approach does not need the stationarity of series, as it could be used regardless of whether series is integrated of I(0), I(1), or a mixture of I(0) and I(1). However, it is worthy to note that the order of integration of the series should not be higher than one. Hence, to ascertain the suitability of NARDL, the stationarity test will confirm whether the order of integration is higher than one or not. First, there is a need to test for structural breaks in the series before conducting unit root tests. This is because the presence of structural breaks in a series increases the chance of accepting the null hypothesis of unit root falsely. A key area of concern in this study is to ascertain if the variables have experienced structural changes within the scope of the study. To achieve this, the study tested the presence of structural break using Quandt-Andrews unknown breakpoint test prior to the unit root test. Quandt-Andrew's test result established the presence of structural break in the series. To conserve space, the author does not explicitly report the results of this test, but it is available on request. The Quandt-Andrews unknown breakpoint test established the obvious fact since the macroeconomic variables included in the model may have experienced several structural changes due to factors ranging from the 2008-09 Global Financial Crisis (GFC) to the global commodity shock in 2016. On the premise of the presence of structural break, the use of unit root tests that account for structural break becomes paramount. Hence, the study conducted the Zivot-Andrews unit root test to examine whether the time series contains unit root.

The results of the Zivot-Andrews test presented in Table 2 indicate that only trade variable is stationary at first difference, while other variables are stationary at level by 1% level of significance, which is consistent with the underlying requirements of the nonlinear ARDL framework. To ensure that the decision of this study to adopt the nonlinear model rather than linear model is not misplaced, this empirical study further tests for the appropriateness of the NARDL model by performing the BDS test for linear dependence. The BDS test was developed by Broock et al. (1996) to check for linearity or nonlinearity of the time series data.

Table 3. BDS Test of Nonlinearity

Dimension	OIL	EXR
2	0.1771***	0.1819***
3	0.2988***	0.3043***
4	0.3794***	0.3863***
5	0.4307***	0.4401***

Note: *, ** and *** indicates significant at 10%, 5% and 1% level significance respectively.

Source: Author's computation.

The BDS test reported in Table 3 revealed nonlinearity of the core independent variables as the null hypothesis is rejected even at 1% level of significance suggesting that the time series could be best estimated by the use of a nonlinear model. The significance of the test lies in the fact that it guides against model misspecification as using a linear model to estimate the parameter of the nonlinear model will lead to bias and inconsistent results.

3.3 Empirical Model

The empirical model of this paper emanates from the "two-country" model of trade. The model is derived from the equilibrium market environment where domestic export supply should correspond with foreign import demand, while domestic import demand should also correspond with foreign export supply. Consequently, the two-country model of trade as first proposed by Lindert (1986) is defined as:

$$TB = EX\left(EXR, Y^{a}\right) - IM\left(EXR, Y^{b}\right) \qquad (1)$$

where *a* denotes a domestic economy while *b* denotes the rest of the world economy; $EX(IM)$ denotes the volume of products exported (imported) from country *a (b)* to country *b (a)*; EXR denotes the real effective exchange rate for the products measured in country *a's* currency.

The standard specification described in equation (1) is modified to capture the crude oil price. In an oil-dependent economy like Nigeria, this study argues that national income changes as oil price fluctuates following extant literature (Rafiq, Sgro and Apergis, 2016; Baek and Choi, 2020). Thus, the economic size is vastly dependent on the export earnings, which in turn does not only rely on the volume of export but mostly on the market price. Hence, the study incorporates crude oil price in the model following Rafiq, Sgro and Apergis (2016); Baek and Choi (2020) and the trade balance model between Nigeria and the rest of the world as a reduced form equation as follows:

$$TRADE_t = \gamma + \theta OIL_t + \lambda EXR_t + \omega Y_t + \varepsilon_t \qquad (2)$$

where $TRADE$ denotes the trade balance between Nigeria and the rest of the world defined in this study as the ratio of Nigeria's value of exports with the rest of the world over the value of imports from the rest of the world. The aforementioned ratio is widely applied in the literature to measure trade balance (Ahad and Anwer, 2020; Apanisile and Oloba, 2020; Baek and Choi, 2020). The inherent advantages of measuring trade balance as a ratio are threefold. One, whether domestic or foreign currency is applied for the measurement of imports and exports, the trade ratio is indifferent to the currency units. Two, if the trade balance is expressed in terms of exports minus imports, the outcome is usually deflated by the domestic price index to get the real balance of trade and hence the outcome generally depends on the price index year used. However, trade ratio is indifferent to price index year used and also indifferent to nominal or real exchange rate thereby overcoming this measurement challenge. Third, if the trade balance is expressed in terms of difference between exports and imports, the equation cannot be logged because of the potential negative values, whereas trade ratio allows the trade balance equation to be estimated by natural logarithm form. EXR is the Nigerian naira to US dollar real effective exchange rate. The exchange rate is defined in a way that a rise in EXR implies a real depreciation of the naira against the rest of the world measured in US dollars, while a fall in EXR implies that Nigeria's currency is overvalued and as such its goods are overpriced, leading to high imports and depressed exports. Control variable Y is the global demand for export measured by the index of world industrial production. All variables were expressed in logarithmic form to be denoted in small case letters. OIL is the crude oil price.

To test for cointegrating relationships, this study employed the NARDL model since most macroeconomic variables can react differently to crude petroleum price fluctuations and exchange rate adjustment behaviour. By decomposing the regressors in equation (2) into partial sum processes of positive and negative changes in the regressors in order to capture the respective increases and decreases in these regressors, the study is able to express equation (2) as an asymmetric cointegrating relationship of the form:

$$TRADE_t = \gamma + \theta^{+}OIL_t^{+} + \theta^{-}OIL_t^{-} + \lambda^{+}EXR_t^{+} + \lambda^{-}EXR_t^{-} + \omega Y_t + \varepsilon_t \tag{3}$$

where:

$OIL_t^{+} = \sum_{j=1}^{t} \Delta OIL_j^{+} = \sum_{j=1}^{t} \max(\Delta OIL_{j,} 0)$ and $OIL_t^{-} = \sum_{j=1}^{t} \Delta OIL_j^{-} = \sum_{j=1}^{t} \min(\Delta OIL_{j,} 0)$ are the partial sum processes of positive and negative changes in OIL_t; $EXR_{i,t}^{+} = \sum_{j=1}^{t} \Delta EXR_j^{+} = \sum_{j=1}^{t} \max(\Delta EXR_{j,} 0)$ and $EXR_{i,t}^{-} = \sum_{j=1}^{t} \Delta EXR_j^{-} = \sum_{j=1}^{t} \min(\Delta EXR_{j,} 0)$ are the partial sum processes of positive and negative changes in EXR_t; and Δ is the first difference operator.

Here, the decomposition of each regressor into partial sum processes assumes an initial threshold value of zero following Greenwood-Nimmo and Shin (2013). This decomposition split the crude oil price and the exchange rate regressors in the ratios 55:45 and 51:49 respectively in favour of the positive regime. Thus, the study does not worry about any bias in favour of either the positive or negative regime.

Since nonlinear autoregressive distributed lag (NARDL) is an extension of linear autoregressive distributed lag (ARDL) developed by Pesaran, Shin and Smith (2001), the study first specifies equation (2) as ARDL where the long-run information is integrated with short-run dynamic information in error-correction format thus:

$$\Delta TRADE_t = \gamma + \rho TRADE_{t-1} + \theta OIL_{t-1} + \lambda EXR_{t-1} + \omega Y_{t-1} + \sum_{j=1}^{p-1} \phi_j \Delta TRADE_{t-j} + \sum_{j=0}^{q-1} (\pi_j \Delta OIL_{t-1}) + \sum_{j=0}^{q-1} (\psi_j \Delta EXR_{t-1}) + \sum_{j=0}^{q-1} (\varpi_j \Delta Y_{t-1}) + e_t \quad (4)$$

To enable the study compute both short-run and long-run asymmetries, the study expressed equation (3) as a nonlinear ARDL(p,q) model in its error correction, form where the study assumed that trade performance is explained by its past values, by current and past values of positive and negative oil price and exchange rate, and by current and past values of index of industrial production as follows:

$$\Delta TRADE_t = \gamma + \rho TRADE_{t-1} + \theta^+ OIL^+_{t-1} + \theta^- OIL^-_{t-1} + \lambda^+ EXR^+_{t-1} + \lambda^- EXR^-_{t-1} + \omega Y_{t-1} + \sum_{j=1}^{p-1} \phi_j \Delta TRADE_{t-j} + \sum_{j=0}^{q-1} (\pi_j^+ \Delta OIL^+_{t-j} + \pi_j^- \Delta OIL^-_{t-j}) + \sum_{j=0}^{q-1} (\psi_j^+ \Delta EXR^+_{t-j} + \psi_j^- \Delta EXR^-_{t-j}) + \sum_{j=0}^{p-1} \varpi_j \Delta Y_{t-j} + e_t \quad (5)$$

where: ρ is the speed of adjustment; while $\beta^+ = -\frac{\theta^+}{\rho}$, $\beta^- = -\frac{\theta^-}{\rho}$, $\alpha^+ = -\frac{\lambda^+}{\rho}$, $\alpha^- = -\frac{\lambda^-}{\rho}$ and $\eta = -\frac{\omega}{\rho}$ are the asymmetric long-run parameters. ϕ_j embeds the autoregressive parameters, while ε_t is the white noise process.

To ensure that the dynamics of the cointegrating relationship in equation (5) is not arbitrarily misspecified, the study used the general-to-specific lag selection procedure starting with an initial maximum lag length of 6 with a unidirectional 5% decision rule. The specification in equation (5) is consistent with some recent studies, such as Gulay (2019), Ongan, Ozdemir and Isik (2018), and Kocaarslan, Soytas and Soytas (2020), among others.

The study examined the prevalence of long-run symmetry and short-run additive symmetry using the standard Wald coefficient restriction test. In the case of long-run symmetry, the null hypotheses evaluated were $\mathcal{H}_0: \beta^{+} = \beta^{-}$ and $\mathcal{H}_0: \alpha^{+} = \alpha^{-}$. In the case of short-run additive symmetry, the null hypotheses evaluated were $\mathcal{H}_0: \sum_{j=1}^{q-1} \pi_j^{+} = \sum_{j=1}^{q-1} \pi_j^{-}$ and $\mathcal{H}_0: \sum_{j=1}^{q-1} \psi_j^{+} = \sum_{j=1}^{q-1} \psi_j^{-}$. Basically, this model revealed two significant kinds of asymmetries upon which this study seeks to ascertain which includes long-run or short-run asymmetry.

4. Results and Discussion

Table 4 presents the estimation results of the long-run and short-run effects based on the nonlinear ARDL model. Two estimated model results are presented in Table 4, the first (Model 1) is a model without the index of industrial production. The second (Model 2) introduced the index of industrial production. This modelling approach enabled us to assess the consistency of the results.

Table 4. Nonlinear ARDL Estimation Results

		Model 1		Model 2	
	Variables	Value		Value	
Panel A					
Long-run coefficient estimates					
P	initial trade	-0.2046***	[-4.2396]	-0.2315***	[-4.7093]
β^{+}	oil^{+}	0.8655***	[3.4828]	0.8163***	[3.6123]
β^{-}	oil^{-}	-0.3963	[-1.4667]	-0.3615	[-1.5079]
α^{+}	exr^{+}	-4.6948***	[-3.4392]	-4.3267***	[-3.3962]
α^{-}	exr^{-}	0.2066	[0.2934]	0.3446	[0.5589]
η	y			0.6672	[0.6152]

		Model 1		Model 2	
	Variables	Value		Value	
Panel A					
Short-run coefficient estimates					
π^{+}	oil^{+}	0.1480	[-6.1234]	0.1604	[0.6429]
π^{-}	oil^{-}	-0.0464	[3.3652]	-0.1330	[-0.6590]
ψ^{+}	exr^{+}	-1.6788	[2.5584]	-1.7035**	[-2.0356]
ψ^{-}	exr^{-}	0.4362	[-2.1975]	0.4136	[0.8968]
π_1^{-}	oil_{t-1}^{-}	0.4626**	[2.5584]	0.4087**	[2.2777]
π_4^{-}	oil_{t-4}^{-}	0.5616***	[3.3652]	0.4194**	[2.4388]
ϖ (-3)	y_{t-3}			4.2566***	[2.6848]
Panel B					
Long-run Symmetry					
$H_0 : \beta^{+} = \beta^{-}$		6.3109**		7.3580***	
$H_0 : \alpha^{+} = \alpha^{-}$		7.2670***		8.6546***	
Short-run Symmetry					
$H_0 : \sum_{j=1}^{q-1} \pi_j^{+} = \sum_{j=1}^{q-1} \pi_j^{-}$		3.8615**		3.9464**	
$H_0 : H_0 : \sum_{j=1}^{q-1} \psi_j^{+} = \sum_{j=1}^{q-1} \psi_j^{-}$		3.8662**		3.9756**	
Panel C					
Diagnostics					
F_{PSS}		29.9847***		34.1332***	
t_{BDM}		-4.2396***		-4.7093***	
BG Test (NR^2)		8.6357		5.1393	
ARCH test		4.3458		6.1456	

Note: *** p<0.01, ** p<0.05, * p<0.1; parenthesis denotes t-Statistic; the notation for the estimated coefficients relates to the NARDL model of Equation 5 where $\beta, \alpha, and\ \eta$ are the long-run coefficients of oil price, real effective exchange rate and index of industrial production respectively, while $\pi, \psi, and\ \varpi$ are the long-run coefficients of oil price, real effective exchange rate and index of industrial production respectively; the long-run coefficients are computed as $\beta^+ = -\theta^+/\rho$, $\beta^- = \theta^-/\rho$, $\alpha^+ = -\lambda^+/\rho$, $\alpha^- = -\lambda^-/\rho$ *and* $\eta = -\omega/\rho$ $\beta^+ = \beta^-$ *and* $\alpha^+ = \alpha^-$ is the Wald test of long-run symmetry for oil price and exchange rate respectively while $\sum_{j=1}^{q-1}\pi_j^+ = \sum_{j=1}^{q-1}\pi_j^-$ *and* $\sum_{j=1}^{q-1}\psi_j^+ = \sum_{j=1}^{q-1}\psi_j^-$ is the Wald test of short-run symmetry for oil price and exchange rate respectively; both Wald statistic are distributed as $\chi 2$ with one degree of freedom. F_{PSS} denotes the statistics of the Pesaran, Shin, and Smith (2001) bound test and t_{BDM} denotes the statistics of Banerjee, Dolado, and Mestre (1998). The critical values for F_{PSS} and t_{BDM} are reported in Table 4; the BG test is the Breusch–Godfrey serial correlation test. It is distributed as $\chi 2$ with 4 degrees of freedom; ARCH test is autoregressive conditional heteroscedasticity test for equal spread of the error variance.

Source: Author’s computation.

4.1 Nigeria’s Trade Performance Responds Asymmetrically to Changes in Oil Price and Exchange Rate

The major focus of the result presented in Table 4 is the sign and size of the coefficients for the increases and decreases in oil price. The result reveals that an increase in crude oil price has a positive and significant impact on trade performance indicators in all cases while the impact of oil price decline is negative but negligible. This implies that a positive shock in global crude oil price is associated with improvement in trade performance in Nigeria and this result is similar to the study of Baek and Kwon (2019) for the oil exporting country of Algeria, while Ahad and Anwer (2020) also found a similar result for Pakistan. As expected for an oil-dependent economy, the possible reason could be on the basis of revenue effect from oil export. On the other hand, negative shocks in global crude oil price decreases trade balance though not significantly different from zero and the result is consistent with the findings of Baek, Ikponmwosa and Choi (2019) for the case of Iran and Saudi Arabia. The insignificant effect of a decrease in oil price is not surprising, especially in Nigeria with a mono economy structure that depends hugely on import and as such, the negative revenue effect due to a decline in oil price could be quite offset by high demand from oil-importing countries. The unexpected result is in line with some previous studies that found a decline in oil price to be negatively related to trade balance (Baek, Ikponmwosa and Choi, 2019).

Obviously, since a positive change in oil price has significant positive impact while a negative change has negligible effect, there seems to be evidence of asymmetry in oil price fluctuation. To further validate this claim of asymmetric effects, this study reported the Wald test on these coefficients to know if they are significantly different to support asymmetric effects. Table 4 reports that the Wald tests of 6.31 from Panel B of Model 1 and 7.35 from Panel B of Model 2 are statistically significant, affirming the asymmetric effect between positive and negative changes in oil price on trade performance in the short and long terms. In fact, this is a clear departure from the one-tailor fits all kinds of adjustment in the case under symmetric impact analysis. Thus, one of the most significant findings that emerge from the empirical results is that global crude oil price has an asymmetric effect on trade performance in Nigeria. This is consistent with the findings of Baek and Kwon (2019) who proved, in the case of Algeria, an oil-dominant economy, that the effect of oil price increase and decrease is asymmetric in the short and long terms. Ahad and Anwer (2020) also found a similar result.

Focusing on the exchange rate and trade balance result, the nonlinear coefficient estimates as reported in Panel A of Table 4 for the long-run model show that positive changes in exchange rate, which reflect depreciation of the naira against foreign currency, impedes trade performance in Nigeria while negative changes in exchange rate, which reflect appreciation of the naira against foreign currency enhances trade performance but the effect is not significantly different from zero. The finding is in agreement with the previous study of Sambo, Farouq and Isma’il (2021) for Nigeria, who found that a positive real effective exchange rate is negative while the effect of a negative change in exchange rate is negative, though the result is not in accordance with the theoretical prediction. However, the possible reason for this unexpected finding is not unconnected with the fact that Nigeria’s import demand is inelastic. As earlier stated, Nigeria is a mono-economy, characterized by high dependence on commodity imports with little import-substituting industry. This implies that the response of trade balance to depreciation will be negligible or even negative. The finding is consistent with the current reality in Nigeria as continuous depreciation of the naira has not yielded any significant improvement in trade over the years. This finding also aligns with the study of Bahmani-Oskooee and Kanitpong (2017), who found that depreciation of the yen impeded trade balance in Japan, whose import demand is also inelastic.

In the short term, the result from Table 4 shows that the coefficient of the error-correction term is negative and strongly significant. This is what the study would expect if there is co-integration between trade balance and other regressors. The magnitude of this coefficient (-0.20 for Model 1 and -0.23 for Model 2) implies that nearly 20% (23%) of any disequilibrium between trade balance and other variables is corrected within one month for Model 1 (Model 2). The result also indicates that the coefficient of positive changes in real effective exchange rate is negatively related to changes in balance of trade and also statistically significant at 5% level only for Model 2. On the other hand, the coefficient of the negative changes in real effective exchange rate is positively related to changes in trade balance but statistically insignificant. This was also found in past studies, such as Apanisile and Oloba (2020) and a clear evidence of an asymmetric effect of positive and negative real exchange rate. Therefore, if the study relied only on the linear model where depreciation and appreciation are assumed to have identical opposite effects as earlier studies did, the result would have been misguided that exchange rate adjustment behaviour follows symmetric effects in Nigeria.

In what follows, the study performs the Wald tests to confirm the presence of asymmetry even though a mere inspection of the differences in the positive and negative exchange rate adjustment above strongly predict asymmetry in both the short and long terms. The results of the Wald tests, which follow the χ^2 distribution with one degree of freedom, are presented in Panel B of Table 4. The study finds that both short-term and long-term asymmetries are present in the model. This finding is consistent with the study of Apanisile and Oloba (2020); Sambo, Farouq and Isma'il (2021). Arize, Malindretos and Igwe (2017) also found similar results. This finding is in accordance with the earlier theoretical discussion. As such, the asymmetric adjustment could be associated with price rigidities, quantity restrictions and/or adjustment costs.

4.2 Is There Evidence of the J-Curve Pattern in the Response of Nigeria's Trade to Changes in Exchange Rate?

Table 4 shows no evidence of the J-curve effect in trade balance between Nigeria and the rest of the world since a positive exchange rate has positive but insignificant coefficients in the short run followed by negative and significant coefficients of positive exchange rate change in the long term. The finding is consistent with the study by Nusair (2017) for the developing economies of Estonia, Latvia, Lithuania and Macedonia. However, the finding is not in line with the previous study by Nasir and Leung (2019) who found the J-curve effect in the US. The index of industrial production, which is a proxy for the world demand for exports introduced in the model, exhibits a positive but insignificant impact on trade performance in Nigeria and the reason is not difficult to decipher. The oil sector contributes about 90% of Nigeria's export earnings, however, due to Nigeria membership of OPEC with output quota, oil export volume remains unchanged irrespective of an increase in world output.

4.3 Diagnostic Tests

The post-diagnostic tests, which include serial correlation test and heteroscedasticity test were performed to assure the robustness of the model. Panel C of Table 4 presents the results of the tests. Serial correlation causes the standard errors of the coefficients to be smaller than they actually are and high R-squared. The Breusch-Godfrey Lagrange Multiplier (LM) test for serial correlation was adopted by the study. The null is that there is no serial correlation. The results in Panel C of Table 4 indicate that the Breusch-Godfrey LM test statistic is not significant. Consequently, the study fails to reject the null hypothesis of no residual serial correlation, and concludes that the model is free from autocorrelation. The study also examined the presence of heteroscedasticity using the Breusch-Godfrey-Pagan test. The null hypothesis tested is that the residual is homoscedastic (i.e. the variance of the residual exists and is constant). The results of the heteroscedasticity test indicate that the critical probability value is below the computed probability value of the chi-square (X^2). Thus, the study fails to reject the null hypothesis that the model's residuals are homoscedastic. Next, the study turns to the linear model as specified in equation (4) to highlight how it differs from the nonlinear result. Thus, the study fails to reject the null hypothesis that the model's residuals were homoscedastic. To assure that short- and long-term coefficient estimates are stable, the CUSUM and CUSUMSQ tests were applied, following Pesaran et al. (2001), to establish if the model residuals of the optimum error correction were stable in the short and long terms. Theoretically, the test for model stability would be said to be reliable in the short and long terms if the CUSUM and CUSUMSQ lines plot lie within the 5% critical bounds. Thus, the study presents the graphical test result in Figures 1 and 2.

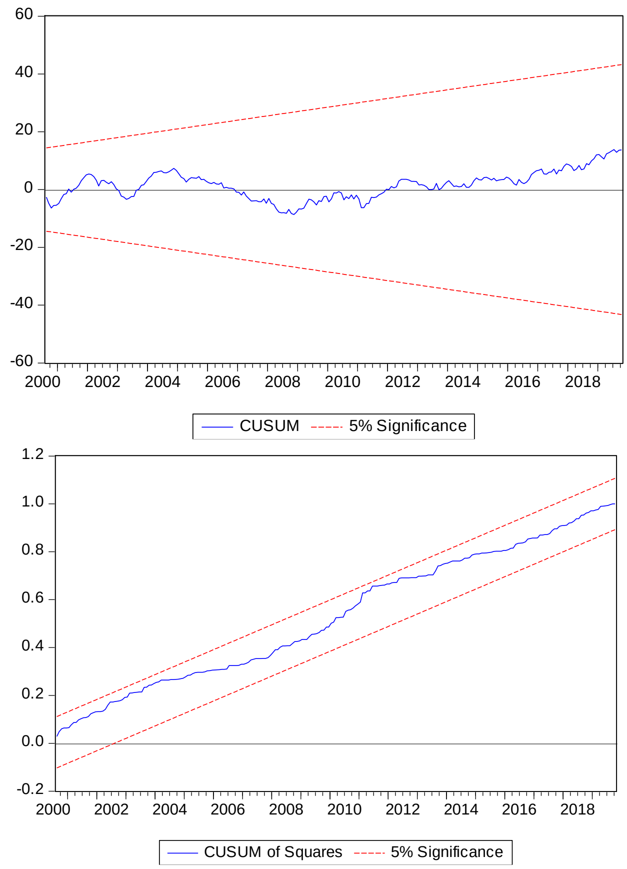

Figure 1. CUSUM and CUSUMSQ for Model 1

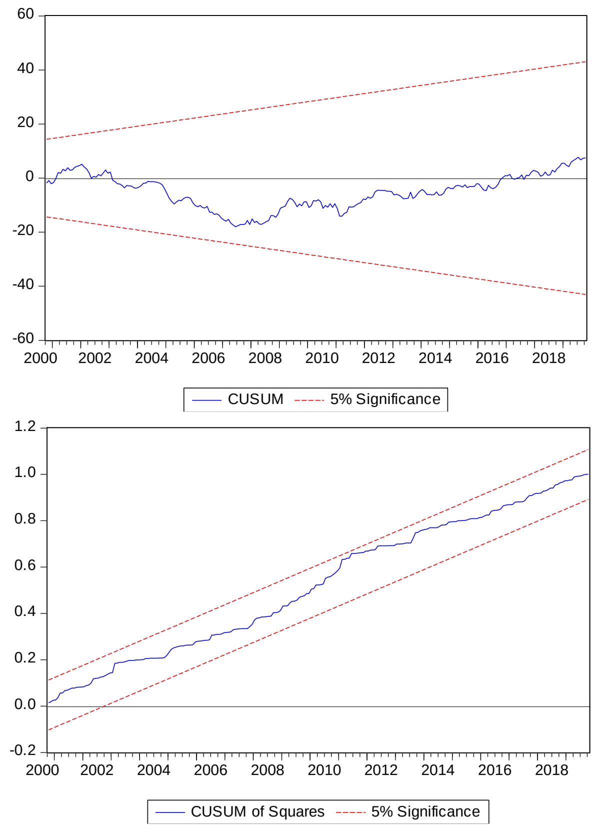

Figure 2. CUSUM and CUSUMSQ for Model 2

From the figures, it can be inferred that the model estimates seem very stable for the study period 1999M1 to 2019M12. Furthermore, a functional misspecification test was conducted using the Ramsey RESET test. The regression also passed the Ramsey's regression specific error (RESET) test, supporting that the model is well specified. In sum, the models specifications and statistical testing appear to be well justified.

4.4 Robustness Test

This study conducted a robustness test to confirm that the findings do not depend on assumptions concerning the data-generating process. If the findings rely upon data-generating processes, it suggests that the findings could likely create policy uncertainty. Therefore, this study used Western

Texas Intermediate (WTI) crude oil price as a proxy for crude oil price to ascertain the asymmetric effects of changes in oil price and exchange rate on trade performance in Nigeria. Interestingly, the patterns in the results predominantly remained the same in all cases and did not qualitatively alter the overall findings of the study, showing that the findings were not just a happenstance. The estimation results are reported in Table 5.

Table 5. Nonlinear ARDL Estimation Results

		Model 1		Model 2	
		Value		Value	
Panel A					
Long-run coefficient estimates					
ρ	Initial trade	-0.2537***	[-5.1473]	-0.2595***	[-5.0902]
β^+	oil^+	1.0916***	[4.6938]	1.0598***	[4.5970]
β^-	oil^-	-0.0573	[-0.3907]	0.0520	[0.3655]
α^+	exr^+	-4.3966***	[-4.6716]	-4.0772***	[-4.2790]
α^-	exr^-	0.0502	[0.0932]	-0.1195	[-0.2276]
η	y			0.4649	[0.4863]
Short-run coefficient estimates					
π^+	oil^+	0.1786	[0.7218]	0.1726	[0.6905]
π^-	oil^-	0.1402	[0.7191]	-0.0170	[-0.0837]
ψ^+	exr^+	-1.9104**	[-2.3047]	-1.7820**	[-2.1348]
ψ^-	exr^-	0.4798	[1.0450]	0.3758	[0.8111]
π_4^-	oil_{t-4}^-	0.4734***	[2.7364]		
ϖ (-3)	y_{t-3}			5.0437***	[3.1865]
Panel B					
Long-run Symmetry					
$H_0 : \beta^+ = \beta^-$		14.1174***		12.0035***	
$H_0 : \alpha^+ = \alpha^-$		16.3360***		14.1781***	
Short-run Symmetry					

	Model 1	Model 2
	Value	Value
$H_0 : \sum_{j=1}^{q-1} \pi_j^+ = \sum_{j=1}^{q-1} \pi_j^-$	1.1662	0.2425
$H_0 : H_0 : \sum_{j=1}^{q-1} \psi_j^+ = \sum_{j=1}^{q-1} \psi_j^-$	5.1711**	4.1518**
Panel C		
Diagnostics		
F_{PSS}	40.3219***	38.2287***
t_{BDM}	-5.1473***	-5.0902***
BG Test (NR^2)	7.4688	7.8902
ARCH test	106.1298*	125.1160

Note: *** p<0.01, ** p<0.05, * p<0.1. The notation for the estimated coefficients relates to the NARDL model in equation 5.

5. Concluding Remarks

In spite of the inherent asymmetric effect of oil prices and exchange rate changes, empirical evidence in Nigeria on the effects of oil price and exchange rate changes on trade performance remains scanty. Besides, it is still not clear from the extant literature whether there is evidence of the J-curve effect in the response of trade balance to exchange rate changes in Nigeria. To address these gaps, this study sought to: (i) ascertain if Nigeria's trade performance responds asymmetrically to changes in oil price and exchange rate; (ii) ascertain if there is evidence of the J-curve pattern in the response of Nigeria's trade to changes in exchange rate. The study became necessary following the occurrence of numerous uncertainty-inducing events in recent years, which usually result in the collapse of oil prices and exchange rate fluctuations, thereby stimulating crises in oil-exporting countries. To achieve these objectives, the study used the nonlinear ARDL framework of Shin, Yu and Greenwood-Nimmo (2013). The data covered the period January 1999 to December 2019.

The findings of the study are summarized as follows. First, the study found that Nigeria's trade performance responds asymmetrically to changes in oil price, such that the positive oil price shock effect on Nigeria's trade with the rest of the world is more prominent than the negative oil price shock effect, although the effect is more noticeable in the long-term than the short-term. This finding suggests that separating global oil price increase from global oil price decrease and incorporating nonlinearity into the model produces more robust estimates and better understanding of the nature of the relationship than the corresponding estimates of the linear model. Second, the study found that Nigeria's trade performance adjusts asymmetrically to changes in exchange rate, such that the significant negative effect of depreciation is more prominent than the positive effect of appreciation, both in the short and long runs. These findings are quite remarkable considering the fact that Nigeria's naira has been depreciating over the years without substantial improvement, if not decline, in her trade with the rest of the world. This finding suggests that separating the depreciation effects of Nigeria's naira from its appreciation, and integrating nonlinearity into the model gives more realistic estimates compared to estimates of the linear model. Third, the study found no evidence of the J-curve effect in the response of Nigeria's trade to changes in exchange rate. This suggests that the policy of depreciation of the naira will not yield significant improvement in trade balance in the long run. Therefore, policy reforms that will shield trade balance from oil price shocks and unstable exchange rate changes are needed. Such policy reforms should mainly target, not only the diversification of the economy to reduce its dependency on oil, but also ensure a conducive environment for domestic production to thrive, especially improvement in infrastructural facilities for greater competitiveness.

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