Oil Price and Stock Market Nexus in Nigeria: An Asymmetric Cointegration Based on Non-Linear Ardl Approach

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ABSTRACT

This paper examined the asymmetric nexus between oil price and stock prices in Nigeria using nonlinear autoregressive distributed lag model (NARDL) to capture both long-run and short-run asymmetric relations. To achieve this, monthly time series data from 2014m1 to 2023m6 were gathered from the Central Bank of Nigeria (CBN) and the Nigeria Exchange Group (NGX). The estimation results confirmed the existence of both long-run and short-run asymmetry behaviour of stock prices in Nigeria. Precisely, in the long-run, interest rate, exchange rate and oil price increase tend to increase stock price levels in Nigeria. Similarity, in the short-run, only oil price increase seems to increase stock prices while oil price decrease seems to decrease stock prices in Nigeria. Furthermore, the empirical findings from asymmetric effect show that negative changes in exchange rate fell sharply due to decrease in oil price which further translate to stock price, suggesting the existence of feed backs from oil to stock markets. The paper recommends that investors should invest in Nigerian stock market in that a hike in oil price leads to appreciation in domestic currency, which translate to appreciation in stock price in Nigeria and vice versa. This suggests that investment in stock market can be used as a tool to ease the domestic currency pressure to a sustainable level. Hence, the need to maintain stable oil prices cannot be overstressed.

Key words: oil price, exchange rate, interest rate, stock price, NARDL

INTRODUCTION

Oil price has always been a matter of concern for the world economy. Predicting the oil price is one of the hardest tasks for the analysts. Western countries believe that oil price is still linked to the development that took place back in 1970 and 1980 with the emergence of persian gulf countries and OPEC nations (Carollo, 2012). So, the base of the oil price index was laid in the 1970s. Main factors that affect the oil price are oil supply and demand, oil production cost, oil inventory levels and US dollar exchange rate (Li and Liu, 2011). Unexpected fluctuations in the supply of the crude oil negatively affect the prices (Fawley et al., 2012). For example, oil prices will go up if OPEC decides to cut the production unexpectedly. Higher demand for oil can also put pressure on the oil price. A growing world economy leads to higher demand for industrial commodities such as crude oil (Fawley et al., 2012). Higher demand for crude oil in emerging markets like China and India pushes the global oil demand and its price (Fawley et al., 2012). A rise in oil production increases the supply of oil in the market which sometimes causes oil price to drop.

The stock market is a place where companies issue shares to the investors through initial public offering to raise share capital and stocks of these publicly listed firms are traded (Economic Times, 2020). Stock markets give opportunities to the investors to increase their assets (Zhang et al., 2014). Every stock market has its own index. A market index is basically a smaller subset of the stock market which helps the stakeholders compare the current performance with past performance (Caplinger, 2020). The index can be of different types such as price weighted index, market capitalization index and all share index, etc.

The relationship between oil prices and stock returns is inspired by the cash flow hypothesis, which perceives a positive and a negative effect of oil price on stock returns. The negative effect emerges as higher oil prices reduce cash flows, earnings, and dividends by increasing production costs. Stock returns are negatively impacted because of declining dividends. The positive effect emerges when oil prices decline during a phase such as the COVID-19 pandemic, which saw oil prices subdued and at historical lows (Devpura and Narayan 2020). Such low oil prices have a positive effect on cash flows because they reduce the cost of production, keeping other factors constant. The positive and negative effect of oil prices on stock returns are also a result of the response of monetary authorities to changes in oil prices

The structure of the Nigerian economy as being an oil State has made activities in most sectors of the economy dependent, directly or indirectly, on either crude oil production, demand and supply for crude oil. Studies have also shown the reliant of public administration, current account balance, stock market performance, inflation, financial sector performance, among others on crude oil price shocks (Lacheheb & Sirag, 2019; Sek, 2017; Omotosho, 2020; Chang, Mohsin, Gao & Taghizadeh-Hesary, 2023; Bibi, Haq & Rashid, 2021; Joo & Park, 2021; Le & Chang, 2015; Jibir & Aluthge, 2019; Abdel-Latif, Osman & Ahmed, 2018).

The capital market, apart from being a conduit for monetary policy transmission, plays a critical role in fostering economic growth by mobilizing capital for financing investment agenda. The market regulates the sale and purchase of financial instruments such as stocks, among others. The performance of corporate or quoted firms, its attractiveness to investors and the ability to mobilise capital for expansion is gauged, among other things, by the firm's stock price. Thus, stock price becomes a key ingredient in the formulation of investment decisions, either by market players and/or policy makers (Kisswani & Elian, 2017). This prompts the need to untangle the factor(s) that may shore up the price of stocks or exert plummeting effects on stock price.

According to Bjornland (2009) and Jimenez Rodriguez and Sanchez (2005), an increase in oil prices is projected to have a favourable influence on an oil-exporting country's income. The increased revenue is expected to stimulate expenditures as well as investments resulting in higher productivity and lower unemployment. In such cases, stock markets typically respond positively.

Therefore, while rising crude oil price is positive for oil-producing countries as their revenue, national saving and investment improved. However, the same cannot be said about Nigeria being unarguably the biggest importer of refined petroleum products on the continent has not benefited much from such development overtime. The country's macro-economic fundamentals such as inflation, fiscal deficit and current account deficit (CAD) have not improved meaningfully over the last couple of years, a large part of which can be attributed to importation of refined oil and subsidy (though removed in May 2023).

The Nigerian Exchange Group (NXG) has experience dwindling performance in recent years probably due to unstable or fluctuation in Nigeria's oil revenue occasioned by the inability of the country to harness and utilize the opportunity provided by the international oil market. Nigeria is at a point now where rising oil prices might not be a good thing because although oil production might go up and crude oil revenue may increase, which in some sense is a good thing, the fiscal cost of PMS subsidy and gasoline subsidy have also gone up. Nigeria's oil production increased by 3.8 per cent to 1.306 million bpd in February 2023, from 1.258 million bp/d recorded in the corresponding period of 2022 and is working to realise an average of 2.2 million barrels per day (bpd), including condensate (Nigerian National Petroleum Company Limited 2023). At the same time, the country has spent N4.6 trillion on subsidy in 2022 (Klynveld, Peat, Marwick, and

Goerdeler 2023).

Previous studies have made many efforts to pinpoint how stock markets are affected by volatility in global oil prices (Ashamu, Adeniyi and Kumeka 2016, Musa, Maijama, Shaibu and Muhammad 2019, Emmanuel and Ekpenyong 2019, Agbo 2021, Akachukwu 2022, Musa, Awolaja, Jerry, Okedina, Uduakobong and Olayinka 2022). While some of these studies conclude that negative and positive oil price shocks have a positive long-run influence on oil and gas stock prices, others indicate that it has effect on individual firms in the Banking sector oil price and economic growth. However, most of the above-mentioned studies either focused on the influence of oil prices changes on oil and gas stock prices or growth in Nigeria, with none looking at the asymmetric nexus between oil price and stock prices. To the best of our knowledge, no study has been conducted particularly, in Nigeria to examine the asymmetricnexus between oil price and stock price since the removal of oil subsidy.

In this study, we revisited the oil price-stock price debate, examining whether stock prices respond asymmetrically to oil price changes, particularly bonny lite crude oil prices as it relates to Nigeria. The non-linear autoregressive distributed lag (NARDL) method which Shin, Yu & Greenwood-Nimmo (2014) developed was used to decompose bonny lite crude oil price into positive and negative shocks and their impact on stock price examined.

The rest of the work is organized as: Section 2 is where reviews of theories linking the subject matter were made, in addition to reviewing past studies. Section 3 is where we summarized the methodology used. The results are presented in Section 4 and discussed. The study concludes and offers recommendations in Section 5.

LITERATURE/ EMPIRICAL REVIEW

This section reviewed empirical and theoretical papers related to oil price and stock market, asymmetric effect of oil price and stock market and the non-linear relationship between oil price, stock market in Nigeria.

Empirical literature

The impact of oil price volatility on the economy and stock market returns has recently piqued the interest of politicians and economists alike. Early empirical research on this relationship demonstrated that oil has a detrimental impact on these two; namely, the country's economy and stock market, if the country is an oil importing country, and a positive impact if the country is oil exporting.

Many scholars suggest that the effect of oil prices on stock markets is an indirect effect that is fed through macroeconomic variables. A growing body of research demonstrates an inverse association between oil prices and stock market returns. Jones and Kaul (1996) were the first to demonstrate the negative influence of oil price on stock markets, which arises because oil price is a risk factor for stock markets. Miller and Ratti (2009), Nandha and Faff (2008), O'Neill et al. (2008), Park and Ratti (2008), Driesprong et al. (2008), and Ciner (2001) all show evidence for such a negative relationship. According to Sadorsky (1999), oil price volatility has an effect on stock returns. In his study on the effect of oil price volatility on European stock markets, Oberndorfer (2009) agrees.

Degiannakis et al. (2018) conduct a literature study on the relationship between the oil price and the stock market. Their assessment concludes that whether research is conducted using aggregate stock market indices, sectoral indices, or firm-level data, and whether stock markets operate in net oil-importing or net oil-exporting countries, has a significant impact on the causal relationships between oil and stock markets.

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Furthermore, conclusions differ depending on whether studies utilize symmetric or asymmetric changes in oil prices, or whether they concentrate on unexpected changes in oil prices. Finally, they discover that most research suggest that oil price volatility transmits to stock market volatility and that integrating stock market performance metrics enhances projections of oil prices and volatility.

For an oil importing country, any increase in oil prices will have the reverse effect; see LeBlanc and Chinno (2004) and Hooker (2002). Oil price increases will raise production costs because oil is one of the most essential production elements (Arouri and Nguyen, 2010; Backus and Crucini, 2000; Kim and Loungani, 1992). The increased cost will be passed on to consumers, resulting in decreased demand and, as a result, lower consumer spending; see, for example, Bernanke (2006), Abel and Bernanke (2001), Hamilton (1996), Hamilton (1988a, 1988b), and Barro (1984). Decreased consumption may result in decreased output and, as a result, more unemployment; see Lardic and Mignon (2006), Brown and Yucel (2002), and Davis and Haltiwanger (2001). In such a circumstance, stock markets would respond unfavorably; see Sadorsky (1999) and Jones and Kaul (1996).

Bildirici and Badur (2018) discovered a bidirectional causality from crude oil price to stock market in India, an oil importing country. Higher oil prices may raise production costs in oil-importing countries, and stock market returns may fall due to lower profitability and dividends, implying that higher oil prices have a negative influence on the Indian capital market (Fang and You, 2014). Sharma (2018) employs a vector autoregressive (VAR) framework to estimate the linear interdependencies between worldwide crude oil prices and Indian stock market indices from January 2010 to January 2017. Crude oil futures prices, the Nifty index, and the BSE energy index were used in the analysis. All of the time series are non-stationary at level and stationary at first difference, according to the enhanced Dickey-Fuller and Philips-Perron unit root tests. The absence of a cointegrating component, i.e. the absence of a long run relationship, is revealed by the cointegration test. All time series are captured as endogenous variables in the VAR model, while independent variables are analyzed at two lags. The Energy Index is very well described by the lagged values of crude oil futures prices, the Nifty index, and the BSE energy index, according to the results. When one standard deviation shocks are applied to stock indices, the impulse response function demonstrates that crude oil prices are negatively affected.

Aggarwal and Manish (2020) evaluated the effect of the oil price on the Indian stock market. The analysis relied on monthly information provided from the Bombay Stock Exchange (BSE) and the World Bank from January 2000 to November 2018. The BSE index is used as the dependent variable, while the oil price, inflation, exchange rate, and real interest rate are used as the independent variables. Because most economic data is non-stationary, the Augmented Dickey-Fuller (ADF) unit root test is employed to ensure that variables are stationary. To test for long-run association across time series datasets, the Auto Regressive Distributed Lag (ARDL) model was used, and the bound testing test approach to cointegration was applied. Their findings reveal that changes in oil prices have a large and favorable impact on Indian stock market returns in both the long and short run. Inflation and real interest rates have a negative link with the Indian stock market, but the impact is minor in the long run. The exchange rate log has a favorable relationship with the Indian stock market, but it is also minor. Shabbir et al. (2020) investigate the impact of gold and oil prices on the Pakistani stock market. The findings of the data study revealed that gold and oil prices had a substantial impact on the stock market.

Zhang et al. (2021) utilizes daily Japanese stock market data from 01/04/2020 to 03/17/2021 to investigate whether COVID-19 has influenced the relationship between oil prices and stock return projections. They provided a fresh contribution to the literature by investigating whether the COVID-19 pandemic had altered this predictability relationship. Using an empirical model that accounts for seasonal effects, return-related control variables, heteroskedasticity, persistency, and endogeneity, they showed that COVID-19 reduced the influence of oil prices on stock returns by almost 89.5%. This means that when COVID-19 impacted economic activity and destabilized financial markets, the impact of oil prices on stock returns decreased. This discovery could have ramifications for trading techniques that rely on oil prices.

In a study conducted for Norway by Bjrnland (2008), where stock returns were incorporated into a structural VAR model, it was discovered that a 10% increase in oil prices increased stock returns by 2.5%, with robust results for linear and non-linear measures of oil prices. The author found that the Norwegian economy responds to rising oil prices by raising aggregate wealth and demand, while highlighting the significance of monetary policy shocks in particular as driving forces behind stock price volatility in the short run.

Hälldahl and Refaet (2020) investigated the relationship between crude oil prices and stock markets in Sweden and Norway. Using linear regression models, they discovered that the Swedish and Norwegian stock markets have a positive relationship with crude oil prices. Because Norway is an oil exporting country, this supports the theory that crude oil prices have a beneficial impact on the Norwegian stock market. However, their findings refute a prediction of a negative link for an oil-importing country like Sweden. The authors also investigated the relationship between exchange rates (Swedish krona and Norwegian krone) and oil price, indicating that oil price is considerably adversely connected with Swedish krona and Norwegian krone.

Hasan and Mahbobi (2013) discovered that the impact of oil prices on the Canadian stock market has been steadily increasing over the second period. The effect in Taiwan’s stock market was remarkably comparable to the effect in the US stock market. Finally, the findings revealed that all three shocks had a considerable positive impact on Hong Kong’s stock return.

Malik and Ewing (2009) discovered an adverse relationship between the volatility of oil price returns and the returns of three stock market sectors in the United States (technology, health care, and consumer services). Chiou and Lee (2009) achieved comparable results. Specifically, Chiou and Lee (2009) discovered evidence that oil price volatility had a negative impact on the S&P500 index using an Autoregressive Conditional Jump Intensity (ARJI) model. More crucially, their research found that higher oil price volatility has an unexpected asymmetric negative effect on S&P500 returns.

Alamgir and Amin (2021) use a Nonlinear Autoregressive Distributed Lag (NARDL) model to explore the interactive relationship between oil prices and the stock market in four South Asian nations from 1997 to 2018. They discover a positive link between the global oil price and the stock market index, and the stock market index’s response to positive and negative oil price shocks is asymmetric. Their findings also show that higher global oil prices drive stock values, implying that South Asian countries do not adhere to the Efficient Market Hypothesis (EMH).

Arouri and Rault (2010) investigated the responsiveness of Gulf Cooperation Council (GCC) stock markets to oil price changes and shocks from 1996 to 2009 using linear and nonlinear models. Oil price adjustments elicited strong reactions in the Kingdom of Saudi Arabia, Oman, Qatar, and the United Arab Emirates. According to the study, the relationship between oil prices and stock markets in the aforementioned GCC countries is switching and nonlinear. The study, on the other hand, discovered that changes in oil prices have little effect on stock market returns in Kuwait and Bahrain.

Arouri and Rault (2012) analyzed the long-term relationship between oil prices and the GCC stock market for the first time, employing bootstrap panel co-integration techniques and the Seemingly Unrelated regression (SUR) method. They analyzed monthly data from January 1996 through December 2007. They discovered a substantial link between oil prices and stock markets in the Gulf Cooperation Council countries. This illustrates that, with the exception of Saudi Arabia, increases in oil prices always have a beneficial impact on stock prices in all GCC countries. As a result, the analysis demonstrates that there is a link between oil prices and stock returns. However, the researchers point out that the long-term relationship between oil prices and stock markets varies in every country, depending on the economic structure.

Wavelet approaches have only recently been applied to the co-movement of stock markets and oil prices. Jammazi and Aloui's (2010) study was a pioneer in this paradigm. The authors discovered that the influence of oil prices in developed stock markets (France, Japan, and the United States) was asymmetric, but the link was negative overall, particularly in the short run, by combining the wavelet and MSVAR. According to Vo (2011), oil prices and the OECD stock markets have a lead/lag relationship. The OEDC's stock markets led oil prices at low frequencies (in the long run). During the US financial crisis, Vavrina (2012) used wavelet methods to examine the relationship between four major global stock markets and four important commodities. Oil prices co-moved with all stock markets on medium and big scales in the second half of 2009.

Mishra and Debasish (2022) investigate the relationship between global crude oil price changes and equity market volatility in India and China, two fast rising economies. They employed wavelet decomposition and the maximal overlap discrete wavelet transform (MODWT) to divide the time series into short, medium, and long-term frequencies. They also employed continuous and cross wavelet transforms to investigate the variance among variables, as well as wavelet coherence analysis and wavelet-based Granger causality analysis to determine the direction of causality between variables. The continuous wavelet transform depicts significant volatility in the WTIR (return series of West Texas Instrument crude oil price) over short, medium, and long time periods. The volatility in the CNX Nifty is noted over short and medium time periods. SCIR, the Chinese stock index, has very low fluctuation in the short run but high variance in the long and medium term. The correlation between crude oil price variations and the CNX Nifty is negligible, and there is bidirectional causality between global crude oil price swings and the Chinese equities market.

Abdullah et al. (2014) used Dynamic Conditional Correlations Analysis using wavelets to investigate the co-movement of Islamic Stock Indexes (ISIR) and commodities. The findings revealed that the link between ISIR and oil prices was weak at both the small and medium time scales, but robust at the big time scale. Rithuan et al. (2014) discovered, using MODWT analysis, that oil prices drove Saudi Arabian stock markets in the short run, but the tendency reversed in the long run. Oil prices drove the Oman stock market in both the short and long run. The CWT11 analysis revealed that the ISIR were not substantially correlated to oil prices, except in the long run for Kuwait, Bahrain, and Qatar.

In African stock markets Aye (2016), who evaluated the effect of oil price shocks on the Johannesburg Stock Exchange discovered that oil price shocks have a negative and marginally significant influence on the Johannesburg Stock Exchange. According to the study, an increase in oil prices reduces stock market profits from 50% to 20%. He also stated that the impact of oil price shocks on the South African stock market is asymmetric.

Sanusi and Kapingura (2022), using DCC-GARCH, time-varying VAR, and multivariate Markov regime switching models, investigate the dynamics of the oil price, exchange rate, and stock market performance in South Africa. From 2003(01) through 2019(7), monthly data on oil price, exchange rate, and market capitalization were used to calculate stock performance. The DCC-GARCH model findings reveal that the dynamic conditional correlation across variables was stable with few exceptions. The empirical findings of time-varying VAR demonstrate the existence of feedbacks from the stock market to the oil price. The results of the Markov regime switching VAR model reveal that exchange rate and market capitalization have considerable effects on oil price during a boom time. The study suggests that stock market performance can assist policymakers reduce the irregular variations in oil prices.

In Kenya, Gatuhi and Macharia (2013) discovered a positive correlation between diesel prices and stock market performance. Chisadza et al. (2013) revealed that South African stock market returns responded positively to an increase in oil prices generated by a positive shock to demand and negatively to supply shocks.

Some empirical research have also been conducted in Nigeria to study this relationship. Nsisong and Ebong (2016), for example, used vector autoregressive (VAR) and co-integration techniques to simulate the dynamic relationship that exists between crude oil prices, stock market indices, and economic growth. The findings demonstrated that the series have a long-term and durable association. Adaramola (2012) and Ogiri, Amadi, Uddin, and Dubon (2013) studied the long-run and short-run dynamic effects of oil price volatility on Nigerian stock market behavior from 1985 to 2009 utilizing quarterly data from the time period in question. Surprisingly, the findings found that the stock market has a large beneficial impact on the price of oil. Furthermore, the Granger causality test found strong evidence that causality runs from oil price shock to stock returns, implying that differences in Nigerian stock market performance are explained by changes in oil prices.

Similarly, Babatunde et al. (2013) explored the interactive link between oil price shocks and stock market behavior in Nigeria. Their findings indicated that Nigerian stock market returns had a favorable but minor impact on oil price shocks, but that the effects reverse over time depending on the sort of oil price shock.

According to Asaolu and Ilo (2012), a spike in oil prices led in a decrease in Nigeria stock returns. However, considering Nigeria's standing as a significant oil producer, the authors suggested that the government ensure that oil revenues have a beneficial impact on stock markets. Adebiyi et al. (2009) demonstrated that oil prices had a negative impact on stock returns in Nigeria and that market volatility was explained by oil price volatility.

Effiong (2014) first investigates the relationship between disaggregated oil price shocks and Nigeria's stock market between 1995:1 and 2011:12. The study, on the other hand, uses aggregate stock returns to assess the effects of oil price shocks on the stock market. The use of aggregate stock returns obscures the effects of oil price shocks on specific industries. Onyeke et al. (2020) recently examined the effects of oil price shocks on sectorial stock returns, however they failed to account for other components of oil prices, such as global oil supply and demand.

Awolaja and Musa (2017) provide empirical evidence that the effect of oil prices on stock prices is symmetric in the short term and asymmetric in the long run. Because of the symmetry, the effect of a given magnitude of positive and negative oil price shocks on the oil and gas stock market index would be the same.

Osah and Mollick (2023) utilize monthly data from 1990 to 2020 to evaluate how stock returns respond to oil prices for 12 major economies: six oil-exporting countries and six oil-importing countries. They first established varying effects of oil price returns in the short term, whereas increases in volatility (changes in VIX or geopolitical risk) have negative effects on stock markets in country-by-country analysis. Long-run positive oil price effects on stock markets are shown using dynamic OLS (DOLS) estimators for oil exporters and rather modest negative evidence for oil importers. Increases in interest rates have a significant detrimental impact in the long run. Panel analyses, together with structural breaks, give more light on these results. Their findings reveal that the DOLS long-run method provides complementary insights: oil prices and bond yields show predicted indicators, but volatility has a mixed effect on stock markets.

The literature reviewed above shows that the relationship between oil prices and stock market performance has been studied in a number of industrialized and emerging economies, with varied results. Based on the foregoing, the current study intends to concentrate on the aforementioned relationships in Nigeria. The goal is to investigate the implications of oil price volatility on the Nigerian stock prices.

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Theory Literature

The Arbitrage Pricing Theory (APT) developed by Ross (1976) underpins the study. The theory proposes a different way of tying macroeconomic fundamentals to stock market returns, although it is an extension of the Capital Asset Pricing Model (CAPM), which is based on the mean variance framework and is anchored on the assumption of the process generating security. This shows that CAPM is a one factor hypothesis, implying that the market has a single independent variable-risk premium. CAPM and APT share some assumptions, including competitive marketplaces, homogeneous expectations, and frictionless capital markets.

According to Ross (1976), the Arbitrage Pricing Theory (APT) allows for the effective correlation of macroeconomic variables with stock market performance. A useful theory for explaining stock market performance is the Arbitrage Pricing Theory (APT) (Ajao, 2013). Although most empirical papers on APT emphasize the theory’s ability to explain returns on individual securities, its utility in explaining aggregate stock market framework cannot be ruled out, where changes in a specific macroeconomic factor may become responsive to changes in an underlying systemic risk factor that determines future returns. Almost all of the previous empirical studies on APT theory that link the viability of the aggregate economy to stock market returns have been focused on establishing a short run nexus between macroeconomic factors and stock price in terms of first difference, assuming trend stationarity.

At equilibrium, the APT advocates that expected return on security i $E(R_i)$ will be given by;

$$E(R_i) = R_{FR} + {}_{i1}(F_1 - R_{FR}) + {}_{i2}(F_2 - R_{FR}) + {}_{in}(F_n - R_{FR})$$

Where:

$E(R_i)$ = Expected rate of return on security

${}_{i1}$ = Sensitivity of security 1 to economic factor 1

${}_{i2}$ = Sensitivity of security of security 1 to economic factor 2

F_2 = Expected value of factor 2

F_n = Expected value of factor n

= Beta coefficient

R_{FN} = Risk free rate of return (Rose, 1976)

In explaining stock market returns, we limit this study to key macroeconomic factors like oil price volatility, Exchange rate and Interest rate. Stemming from the above, we hypothesize that:

H_1: Oil price volatility has no significant impact on stock market returns in Nigeria.

H_2: There is no causality between selected macro-economic variables and stock market returns in Nigeria.

RESEARCH METHODOLOGY

The methodology employed in achieving the stated objectives of this research work is discussed in this Section. Accordingly, research technique and data model specification and the Augmented ARDL Bounds Test of Cointegration have delineated in this subsection.

Methodology and Data

Although many studies have examined the impact of oil price shocks on stock market performance in Nigeria (see Agénor & Montiel, 2015; Ndikumana et al., 2021), these studies fail to consider the existence of nonlinearity and the impact of structural shocks on these factors. Therefore, following the work of Lacheheba and Sirag (2019) and Alamgir and Bin Amin (2021), this paper chose to adopt the nonlinear autoregressive distributed lag (ARDL) model to examine asymmetric nexus between oil price and stock price in Nigeria. A typical regression model based on time series data assumes a constant coefficient. A change (upward or downward) in the control variable has the same effect throughout time, which is not always the case.

Furthermore, when a shock occurs, well-known cointegration techniques such as EG-ECM, VECM, Bound testing, ARDL, and others give a constant rate of adjustment (constant ECT) to long-run equilibrium. But this always cannot be real if there exists market friction (Dufrénot & Mignon, 2002). Estimation of an asymmetry relationship with symmetric techniques appears to be biased and may lead the policymaker to severe improper policy directions (Enders, 2008). The traditional cointegration test does not permit capturing the asymmetries in macroeconomic variables. The asymmetries are frequently practised in economic variables. Asymmetry is a basis of the human condition since nonlinearity is widely observed in the social sciences (Shin et al., 2014).

Moreover, the Non-linear Autoregressive Lagged (NARDL) Model recently proposed by Shin et al. (2014) includes asymmetries relationships both in the short and long run. Besides, the model takes the asymmetries in the dynamic modification. Furthermore, the model is applicable in a combined order of level and the first difference (Ibrahim, 2015).

Furthermore, monthly time series data from 2014m1 to 2023m6 were gathered from the Central Bank of Nigeria (CBN) and the Nigeria Exchange Group (NGX). Meaning a total number of 114 observation is used.

Model Specification

In developing the NARDL, we first introduce the asymmetric long run regression for the cointegration analysis as in Pesaran 1999, Pesaran & Sims 2001, Pesaran et al 2001 and Shin et al. (2011). The long-run component is specified as:

$$Asi_t = a_0 + a_1 Asi_{t-1} + a_2 X_t^+ + a_3 X_t^- + a_4 oil_t + a_5 exr_t + a_6 int_t + \varepsilon_t \quad 1$$

As specified in equation 1, Asi_t represents the stock market (proxied by All Share Index (ASI)), X is a vector of explanatory variables (oil price, exchange rate, and interest rate), oil represents the oil price, exr is exchange rate and int is interest rate. a = (a_0 - a_6) is the cointegrating vector holding the long-run parameters. X_t^+ and X_t^- are negative and positive with partial forms in the explanatory variables. The partial forms are simplified further as follows:

$$X_t^+ = \sum_{i=1}^{t} \Delta X_t^+ = \sum_{i=1}^{t} max(\Delta X_i, 0) \quad 2$$

and

$$X_t^- = \sum_{i=1}^{t} \Delta X_t^- = \sum_{i=1}^{t} min(\Delta X_i, 0) \quad 3$$

For example, theoretically, we expect a boom in oil price to have significant impact on stock market by lowering expected economic growth which in turns lowers company's returns expectation and subsequently, dampens stock prices the in an economy (Farzana & Sakib, 2021), this further suggests that the linkage between the selected variables in our model. Other variables that affect stock market include interest rate, oil price and exchange rate.

Equation 4 in the Non-linear ARDL form is specified as:

$$Asi_t = \alpha + \beta_1 Asi_{t-1} + \beta_2 X^+_{t-1} + \beta_3 X^-_{t-1} + \beta_4 oil_{t-1} + \beta_5 exr_{t-1} + \beta_6 int_{t-1} +$$

$$\sum_{i=1}^{p} \varphi_i \Delta Asi_{t-i} + \sum_{i=0}^{q} (\theta_i^+ \Delta X^+_{t-i} + \theta_i^- \Delta X^-_{t-i}) + \sum_{i=0}^{j} \delta_i \Delta oil_{t-i} +$$

$$+ \sum_{i=0}^{j} \eta_i \Delta exr_{t-i} + \; + \sum_{i=0}^{j} \eta_i \Delta int_{t-i} + \varepsilon_t \qquad 4$$

The variables are as earlier defined, p, q, s, k and j are the lag orders. $a_1 = -\beta_2 / \beta_1$ and $a_2 = -\beta_3 / \beta_1$ are the long-run impacts of the asymmetric effect of the explanatory variables on inflation. While $\sum_{i=0}^{q} \theta_i^+$ and $\sum_{i=0}^{q} \theta_i^-$ capture the short run symmetric effects of these explanatory variables on inflation.

Before estimating the NARDL model, the study performs the bounds tests to examine the presence of co-integration. Specifically, we test the null hypothesis that $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6 = 0$ via the Wald F-test and the recently developed and innovative augmented ARDL bounds test. In this wise, the augmented ARDL is an improvement on the traditional bounds test.
Lastly, the long-run asymmetric cumulative-dynamic multiplier effects of a 1% change in the explanatory variables as:

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{X^+_{t-1}}, \; m_h^- = \sum_{j=0}^{h} \frac{\partial y_{t+j}}{X^-_{t-1}}, \; h = 0, \; 1, \; 2 \qquad 5$$

In equation 5 as $h \to \infty$, $m_h^+ \to a_1$ and, $m_h^- \to a_2$

The Augmented ARDL Bounds Test of Cointegration

The F-statistics and the t-statistics from the traditional ARDL bounds test is a necessary but not a sufficient condition for to detect whether or not there is a long run relationship between the dependent and the explanatory variables (see Sam et al., 2018). The reason for this is the presence of both I(0) and I(1) variables and their treatment as dependent variable in the model. In fact, one of the requirements for valid inference about the existence of cointegration between the dependent variable and the regressors is that the dependent variable must be I(1) (Pesaran et al., 2001). However, it is possible that the dependent variable is I(0) and I(1) independent variables and cointegration is still found. This case is known as a degenerate case.

Suppose in equation 5, $H_0: a_2 = \ldots = a_6 = 0$, then the insignificance of other exogenous variables in the model, cannot be rejected. As such, the model reduces to the standard ADF. This shows that if a_1 is significantly negative, then stationarity is established. If this is the case, the variable will be reckoned as I(0).

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This is shown by the ADF in equation 6

$$Asi_t = a_0 + a_1 Asi_{t-1} + \sum_{j=1}^{P-1} \delta_j \, Asi_{t-j} + \varepsilon_t \qquad 6$$

The fact that Asi_t is stationary at levels means that a_1 must be significant whether or not the coefficients on other variables are significant. In this case,cointegration can still be found not because there is one, but because the significance of the (lag of) dependent variable dominates the joint test and because only a subset of the associated alternative hypothesis is being considered (see Sam et al., 2018). Therefore, in addition to the F-statistics and the t-statistics from the traditional bounds test, it is important to carry out an additional F-test on the lagged levels of the regressors. With this test, the assumption of an I(1) dependent variable is not required.

RESULT AND ANALYSIS

This section presents the empirical estimates and other necessary tests based on the procedure stated in the methodology which includes: the Summary Statistics, unit root, BDS nonlinear test, Nonlinear ARDL estimate and post estimation tests.

Table 1. Descriptive Statistics

	ALSHI	EXBDC	INTR	OIL_PRICE
Mean	32211.58	337.7477	13.03409	61.62977
Median	30957.80	360.4550	13.50000	58.78000
Maximum	44343.65	494.7000	14.00000	114.6000
Minimum	21300.47	166.8500	11.00000	14.28000
Std. Dev.	5926.214	97.96527	0.984931	20.63176
Skewness	0.327189	-0.411908	-0.585405	0.855994
Kurtosis	1.903571	2.132896	1.947475	3.751820
Jarque-Bera	5.978006	5.245318	9.088219	12.81915
Probability	0.050338	0.072610	0.010630	0.001646
Sum	2834619.	29721.80	1147.000	5423.420
Sum Sq. Dev.	3.06E+09	834955.8	84.39773	37033.24
Observations	114	114	114	114

Note: The asterisks ***, ** and * are respectively the 1%, 5% and 10% significance level. Source: Authors' collection and calculation.

The results in the table 1 above indicate the mean of all share index is 32211.58. the skewness and kurtosis are 0.327189 and 1.903571 respectively, indicating that all share index is positively skewed and that the distribution is platykurtic, which indicates that the degree of peakiness is not high. Meanwhile, exchange rate and interest rate are negatively skewed, but oil price is positively skewed with mean of 337.75, 13.04 and 61.63 respectively. The Kurtosis for oil price is 3.75, indicating that the distribution is leptokurtic. The total number of observation as seen on the table is 114.

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Table 2. Unit root test

VARIABLE	ADF TEST STATISTICS		PP TEST STATISTICS	
	I(0)	I(1)	I(0)	I(1)
ALSHI	-1.033476	-8.528826***	-1.416387	-8.534922***
OIL_PRICE	-2.202462	-8.813090***	-2.336289	-8.826794***
INTR	-0.722750	-5.408402***	-1.492150	-10.33575***
EXBDC	-1.309812	-6.858038***	-1.110731	-6.829790***

Note: The asterisks ***, ** and * are respectively the 1%, 5% and 10% significance level. Source: Authors' collection and calculation.

Table-2 shows the result for the unit root test of the macroeconomic variables. In order to reject the Unit Root, the test statistics must be less than the critical value at 5% level of significance in absolute term. The output of unit root tests indicates that all share index, oil price, interest rate and exchange rate are not stationary at level I(0), but became stationary after taken their first difference I(1). It implies that none of the variable is I(2).

Brock–Dechert–Scheinkma (BDS) Test for Nonlinearity

The oil price may have a nonlinear relationship with stock price due to structural changes in the oil price. If there is no further detection of whether there is a nonlinear relationship between them, estimation results would produce estimation bias because nonlinear relationship information would be neglected (Ji and Fan 2016).

Here, this research also chose to use the nonlinearity Brock–Dechert–Scheinkma (hereafter BDS) approach proposed by (Broock, Scheinkman, Dechert and LeBaron, 1996) to further detect the evidence of nonlinearity in the series. The null hypothesis in the BDS test with independent and identical distribution was rejected, which means that the time series had nonlinear characteristics under different dimensions (m = 2, 3, 4, 5 and 6). As presented in Table 4.7, the BDS test results show that the null hypothesis of linear dependence was rejected at the 5% level, thus indicating that the nonlinear Granger causality model was more suitable for detecting the short-run relationship between the oil price, exchange rate and inflation than the linear model.

Table 3. BDS test for nonlinearity

BDS stat	Embedding dimension=m (probability)					
Variable	m=2	M=3	M=4	M=5	M=6	Raw epsilon
Alshi	0.152814**	0.254299**	0.313772**	0.345002**	0.358434**	11746.87**
Oil_price	0.158015**	0.265325**	0.334300**	0.372224**	0.390129**	34.00498**
Exbdc	0.192101**	0.327743**	0.424000**	0.490369**	0.535748**	149.2990**
intr	0.175770**	0.282531**	0.341060**	0.375240**	0.392066**	1.822113**

Note: The asterisks ***, ** and * are respectively the 1%, 5% and 10% significance level. Source: Authors' collection and calculation.

Nonlinear ARDL Result

Table 4. present the result of the nonlinear autoregressive distributed lagged models (NARDL) to discover the long-run and short-run relation among the variables in Nigeria. Since this study has been conducted with variables that are defined in dollar, rate and naira, the interpretations of these coefficients would go in the

same line (Hasan, 2017).

Table 4. Nonlinear ARDL result

Dependent Variable: All Share Index (alshi)				
Variable	coefficient	Standard error	t-statistics	p-value
C	6693.470**	2408.306	2.779327	0.0071
ALSHI(-1)	-0.157855**	0.049334	-3.199730	0.0021
OIL_PRICE+(-1)	53.69034**	26.17636	2.051100	0.0442
OIL_PRICE-(-1)	53.32657**	23.61046	2.258599	0.0272
EXBDC+(-1)	-5.327888	8.093506	-0.658292	0.5126
EXBDC-(-1)	24.83380*	14.23743	1.744261	0.0857
INTR+(-1)	574.0404	567.5112	1.011505	0.3148
INTR-(-1)	64.60230**	28.91534	2.234188	0.0283
F-statistic	5.053124		I(0)	I(1)
		5%	2.45	3.61
Long run coefficients				
D(DEXBDC^{+}(-1))	91.80644**	29.39158	3.123563	0.0025
D(DEXBDC^{-}(-1)	-34.34975**	17.18991	-1.998250	0.0491
D(DINTR^{+}(-1)	1332.995**	503.9996	2.644834	0.0098
D(DOIL_PRICE(-1)	105.8125**	36.69269	2.883750	0.0050
Adj R2	0.408610	F-statistic	4.584213	0.000005
DW	1.754951			
Se of reg	1625.556			
Serial cor	F-stat	0.708037	Prob. F(2,65)	0.4964
Heteroskedasticity	F-stat	0.756990	Prob.F(16,67)	0.7261
Wald test for symm	F-statistic	1.50324	(6, 67)	0.190
F-statistic	4.584213			

Note: The asterisks ***, ** and * are respectively the 1%, 5% and 10% significance level. Source: Authors' collection and calculation

The outcome of the NARDL regression is shown in Table 4 above. we can see that there is evidence of cointegration when the nonlinear bound test is tested as the F-statistic 5.05 is greater than the upper critical bound at 5%. These findings indicate that any wrong specification may lead to a misleading conclusion regarding whether the variables move together in the long-run or not. The result results demonstrate that the model has an average coefficient of determination. The adjusted R-squared of around 0.408610 (41%). The R-squared calculates the proportion of differences in the explanatory variables that may be attributed to changes in the dependent variable. Therefore, it could be claimed that the series fit the model fairly well. The F-statistic has a value of 4.6 and a probability value of 0.000005, or less than 1%. This suggests that the overall statistical significance of the regression model is greater than 1%. Consequently, changes in the dependent are jointly explained by all the explanatory factors. More crucially, the computed coefficients of the explanatory variables demonstrated that, with the exception of the positive points exchange rate and interest rate, almost all were statistically significant at the customary 5% or 10% levels and virtually all adhered to 'a priori' theoretical expectation. This finding is in line with that of Sharma (2018), Degiannakis,

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Filis and Arora (2018) and Sanusi & Kapingura (2022). Moreover, the serial correlation LM test reveals the absence of autocorrelation in the residuals. Similarly, the autoregressive conditional heteroskedasticity ARCH shows that the residuals have constant variance over time.

The results further indicate that, in short run, both positive and negative coefficients of oil price is statistically significance at 5 percent level. This implies that a 1 percent point positive change in oil price would lead to, on average, a 54 dollar increase in all share index in short run. Also, 1 percent point negative decrease in oil price would lead to a 53 dollar decrease in all share index. Exchange rate is statistically significance at negative point, but insignificance at positive. This suggests that a 1 percent decrease in exchange rate would lead to a 25 decrease in all share index in Nigeria. Furthermore, interest rate is statistically significance at negative point, which reveals that a 1 percent decrease in interest rate would bring about 65 dollar decrease in all share index in short run in Nigeria.

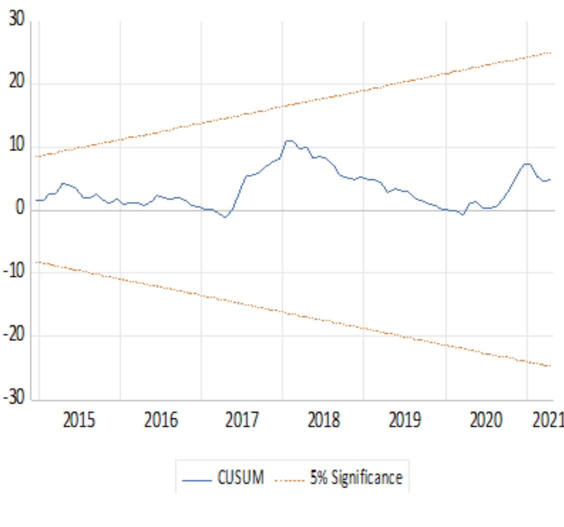
On the long run coefficients, exchange rate, interest rate and oil price effect of positive and negative changes appeared to be statistically significant at 5%. This finding conformed with Sanusi & Kapingura (2022). However, the pass-through effect of oil price on stock prices seems to be incomplete, given that only positive effect was found. The findings obtained by our study suggest that a 1% increase in oil price will lead to approximately 105 dollars increase in all stock prices. In addition, the results reveal the long-run impact of exchange rate and interest rate on stock price to be positive and statistically significant at 5%. In particular, it suggests that an appreciation in the domestic currency by 1% leads to approximately 91.8 naira increase in stock prices in Nigeria. On the contrary, a 1% decrease depreciation in domestic currency would bring about -34.3 increase in stock prices.

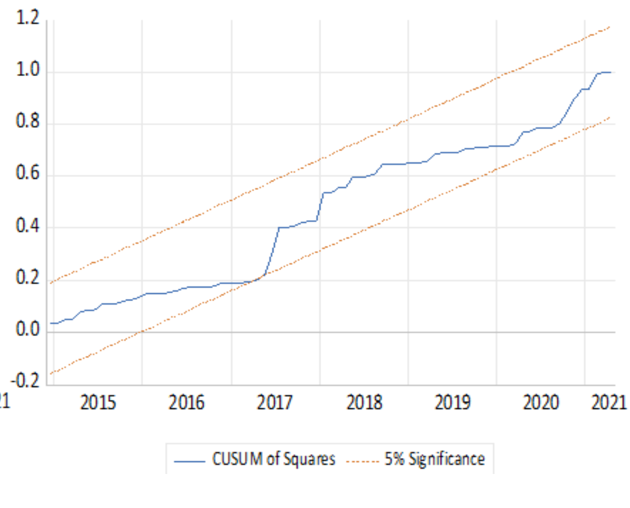
Although a higher oil price in Nigeria would increase exports revenues, which may raise foreign reserve level, domestic currency appreciates as well. This attracts foreign investors, particularly portfolio investors thereby raising stock prices in Nigeria. However, this has not been the case as the huge revenue generated from the sales of crude oil is channelled in to refined oil subsidy, which harm the economy.

Post Estimation Test

CUSUM and CUSUMSQ TESTS.

As cumulative sum of recursive residuals and cumulative sum of square of recursive residuals both are within the critical bounds at 5% significance level, our model is stable and trustworthy to estimate short-run and long-run coefficients.





Following Shin et al. (2011), we derived asymmetric cumulative dynamic multipliers that allow us to trace out the asymmetric adjustment patterns following positive and negative oil price changes to the stock prices.

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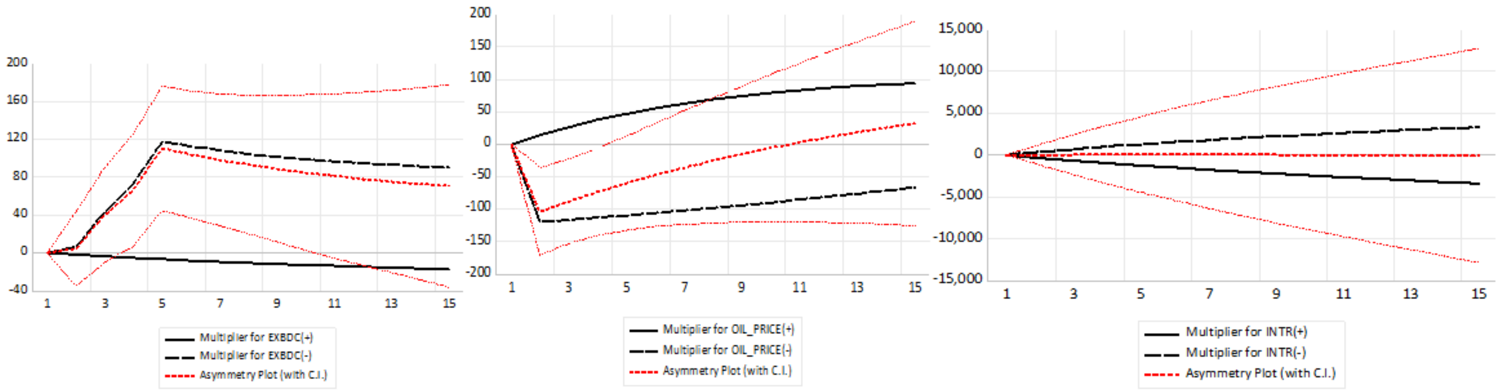
Since the oil price dencrease is significant in both the short- and long-run, we only look at the dynamic multiplier of oil price decrease on stock prices, as shown in Fig. 4. It is worth mentioning that a dencrease in oil price takes about 10 horizons to be fully transferred to the stock prices and converges with the long-run coefficient 105.8125.



CONCLUSION AND RECOMMENDATION

Sharp increases in oil price since the last three decades have drawn the attention of researchers, policymakers and economists to discuss its positive and negative effect on stock price across the globe. This paper therefore examined the asymmetric nexus between oil price and stock prices in Nigeria using nonlinear autoregressive distributed lag model (NARDL) to capture both long-run and short-run asymmetric relations. The estimated results confirm the existence of both long-run and short-run asymmetry behaviour of stock prices (Ankit Sharma et al. 2028). Precisely, in the long-run, interest rate, exchange rate and oil price increase tend to increase stock price levels (Osah and Mollick 2022) in Nigeria. Similarity, in the short-run, only oil price increase seems to increase stock prices while oil price decrease seems to decrease stock prices (Zhang, Narayan and Devpura 2021) in Nigeria. The empirical findings from asymmetric effect shows that negative changes in exchange rate fell sharply due to decrease in oil price which further translate to shock price, suggesting the existence of feed backs from oil to stock markets.

The paper recommends that investors should invest in Nigeria stock market in that a hike in oil price leads to appreciation in domestic currency, which translate to appreciation in stock price in Nigeria and vice versa. This suggests that investment in stock market can be used as a tool to ease the domestic currency pressure to a sustainable level. Hence, the need to maintain stable oil prices cannot be overstressed.

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