



Do Asymmetric Currency Price Fluctuations and Oil Price Shocks Matter for Growth in Nigeria? Evidence from Non-Linear Analysis

Asimetrik Döviz Kuru Dalgalanmaları ve Petrol Fiyat Şokları Nijerya'nın Büyümesinde Önemli Midir? Doğrusal Olmayan ARDL Analizinden Bulgular

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ABSTRACT

This paper examines the nexus between exchange rate fluctuations, oil price shocks, and growth in Nigeria, considering misspecification issues, endogeneity bias, and small sample size, which have not received adequate attention. Using a non-linear ARDL model, findings show that accounting for oil price and exchange rate asymmetries is important in explaining growth in the country for the period 1981-2016. The results also indicate that in the long-run, an exchange rate depreciation has a significant positive impact on growth. A negative oil price shock exerts a positive long-run effect on growth while higher oil prices have a negative impact. The oil price impact not only validates the Dutch disease hypothesis, but also reflects the government's limited fiscal buffers and savings over time. Contemporaneously, oil price shocks affect growth distinctly as high oil prices boost growth while negative shocks retrogress productivity. While the impact of currency depreciation on growth was found to be positive, an appreciation hurt growth in the short term. The findings reinforce the need for the government to urgently minimize the country's vulnerability to global crude oil markets as well as dependence on imports to stabilize the Nigerian Naira/ US dollar exchange rate.

Keywords: Oil price, Exchange rate, Economic growth, Asymmetries, Non-linear ARDL

JEL Classification: Q43, F31, O40

ÖZ

Bu çalışma yeteri kadar dikkate alınmayan yanlış tanımlama sorunlarını, içsellik problemini ve küçük örneklem boyutunu göz önünde bulundurarak döviz kuru dalgalanmaları, petrol



DOI: 10.26650/ISTJECON2020-0006

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Submitted/Başvuru: 09.03.2020

Revision Requested/Revizyon Talebi:
27.04.2020

Last Revision Received/Son Revizyon:
03.05.2020

Accepted/Kabul: 15.05.2020

Citation/Atıf: Shuaibu, M. (2020). Do asymmetric currency price fluctuations and oil price shocks matter for growth in Nigeria? Evidence from non-linear analysis. *İstanbul İktisat Dergisi - Istanbul Journal of Economics*, 70(1), 17-46.
<https://doi.org/10.26650/ISTJECON2020-0006>



fiyat şokları ve Nijerya'nın büyümesi arasındaki ilişkiyi incelemektedir. Doğrusal olmayan ARDL modeli kullanılarak elde edilen bulgular, ülkenin 1981-2016 dönemindeki büyümesini açıklamada petrol fiyatlarının ve döviz kuru asimetrisinin önemli olduğunu göstermektedir. Sonuçlar ayrıca uzun vadede döviz kurunun değer kaybetmesinin büyümede önemli bir pozitif etkisinin olduğunu belirtmektedir. Petrol fiyatlarındaki negatif şok uzun vadede büyümeyi pozitif bir şekilde etkilerken, yüksek petrol fiyatlarının ise olumsuz etkisi vardır. Petrol fiyatlarının etkisi sadece Hollanda hastalığı hipotezini geçerli kılmaz, aynı zamanda hükümetin zaman içindeki sınırlı mali tamponlarını ve tasarruflarını yansıtmaktadır. Eş zamanlı olarak, petrol fiyat şokları büyümeyi farklı şekilde

etkilemektedir. Yüksek petrol fiyatları büyümeyi artırırken, negatif şoklar verimliliği düşürür. Döviz kurunun değer kaybetmesinin büyüme üzerinde pozitif etkisi bulunurken, değer kazanması kısa vadede büyümeye zarar vermektedir. Elde edilen bulgular hükümetin ülkenin küresel ham petrol piyasalarına olan kırılganlığını, aynı zamanda Nijerya Nairası/Dolar kurunu dengede tutmak için ithalata bağımlılığını acilen en aza indirmesinin gerektiğini desteklemektedir.

Anahtar kelimeler: Petrol fiyatı, Döviz kuru, Ekonomik büyüme, Asimetrisler, Doğrusal olmayan ARDL

JEL Sınıflaması: Q43, F31, O40

1. Introduction

Since the tumultuous oil price shocks of the 1970s and structural adjustment-driven exchange rate reforms that started in the 1980s, debate on the response of economic growth has remained a contentious issue. This is because crude oil plays an important role in the economy and its effect is a function of whether a country is a net importer and/or exporter of oil. An important channel through which oil price shocks are transmitted is the exchange rate channel (Mensah, Obi, & Bokpin, 2017; Fedoseeva, 2017; Englama, Duke, Ogunleye, & Ismail, 2010; and Alley, 2018). A common consensus is that oil shocks represent vulnerabilities for both exporters and importers of the product, whereby the shocks are transmitted via trade. Thus, a fall in the price of crude oil leads to a depreciation of the Naira exchange rate, as the accumulation of reserves slows down. This could affect the ability of the monetary authority to intervene in the foreign exchange market. The exchange rate amongst other macroeconomic indicators fell on the back of lower oil prices and weak global demand for oil (Prest, 2018).

In terms of estimation approaches, an array of tools has been used to assess the nexus with a focus on how oil price and exchange rate independently affect growth. The DSGE technique was used by Idrisov, Kazakova, and Polbin (2015); VAR models by Pershin, Molerob, and de Graciab (2015) for Botswana and Kenya; Wesseh and Lin (2018) for Liberia; Mordi and Adebisi (2010), Aliyu (2009) and Osigwe (2015) for Nigeria; Lorusso and Pieroni (2018); and Economou (2016). However, most of the studies are marred by several empirical issues that warrant further scrutiny. First, they do not account for inherent asymmetries in the dynamics of oil price and exchange rate. Second, they do not consider endogeneity bias. Finally, previous studies do not use inappropriate measures of variables and ignore inherent exchange rate and oil price asymmetries that characterize this important nexus. These issues are addressed using the non-linear ARDL model proposed by Shin, Yu, and Greenwood-Nimmo (2014). Endogeneity and residual correlation are overcome in this framework because the lagged levels or first difference regressors are serially uncorrelated and the model is thus shielded from omitted lag bias (Arize, Malindretos, & Igwe, 2017). Furthermore,

the transmission of oil price shocks to the foreign exchange market, and the consequent impact on output performance, especially in a small, open oil-dependent economy, makes this study imperative.

Nigeria serves as an important case study because it is a small, open, importing, and exporting economy, characterized by high consumable import elasticity and over-reliance on oil for over 90% of its export earnings. Indeed, these factors put together contributed to the 2016 recessionary pressure (Shuaibu, 2018). The issues around the origin of and recovery from the 2016 recession in Nigeria have been well documented in reports by the Central Bank of Nigeria (2017), World Bank (2017) and International Monetary Fund (2017). The crux of the issue is that an efficient exchange rate and revenue management strategies are important for sustained growth. To provide better insight for macroeconomic management, policy formulation, and implementation, a decomposition of the impact of asymmetric oil price shocks and exchange rate volatility on output performance is imperative to better assess the impact of exchange rate dynamics and oil price shocks on growth in Nigeria.

Against this backdrop, this study examines the asymmetric impact of exchange rate volatility and oil price shocks on economic growth in Nigeria, utilizing annual data between 1981 and 2016. The sequence of the paper is as follows: Following this introduction section, Section 2 reviews relevant theoretical and empirical literature. Section 3 discusses the nonlinear ARDL approach. Data description and the model is presented in Section 4. The empirical analysis and discussion of findings are highlighted in section 5. Section 6 concludes and highlights some policy implications.

2. A Brief Survey of the Literature

2.1. Theoretical Review

Macroeconomic models assign a key role to expectations as an integral element of the propagation mechanism for shocks (Geiger & Scharler, 2016). The authors argue that expectations about future developments determine agents' decisions,

and thus the adjustment of the economy to a shock depends on perception. The way and manner economic agents form their expectations about shocks is important, especially amidst policy uncertainty and risks. Thus, uncertainty could be higher after major internal or external shocks (Bloom, 2007). For instance, if a firm expects a negative oil price shock and potential exchange rate pressure that prompts a devaluation, uncertainty makes the firm reduce investment in capital and labor. Consequently, productivity growth declines because a pause in economic activities freezes resource allocation across agents. Also, household income and consumption are negatively affected (Guntner & Linsbauer, 2018, p. 1618). Bloom (2007) points out that in the medium term the increased volatility from the shock induces an overshoot in output, employment, and productivity as second moment shocks generate sharp downturns and recoveries.

Significant efforts have been geared towards exploring the transmission channel from oil prices to the exchange rate. The underlying principle as pointed out by Pershin et al. (2015) is that oil price changes prompt an appreciation of the exchange rate against oil-importing countries and leads to a depreciation of the domestic currency against that of oil exporting countries. This implies that a positive oil price shock forces an oil-consuming country to purchase at higher prices, thereby pumping money to oil exporting countries and thus leading to an appreciation of the domestic currency against the US dollar. However, oil-importing countries must pay more if oil prices rise and this prompts a depreciation of the importing countries' currency. If oil shocks are perceived as persistent, oil is used less in production, the productivity of capital and labor declines, and potential output falls (Mordi & Adebisi, 2010).

The impact of the exchange rate regime in use also plays a significant role in the response of output to shocks. As pointed out by Schnabl (2007), flexible exchange rates make it easy for adjustment in response to idiosyncratic shocks. This is particularly the case for a small open economy with relatively high trade (import) intensity. Exchange rate volatility is minimal under fixed regimes compared with a floating or managed-floating system. In the former scenario, the output transmission channel may be traced to the impact of low exchange rate

volatility with minimal transaction costs for trade and investment flows. This, in turn, stimulates economic growth. The flexible exchange rate regimes, on the other hand, magnify the risks associated with exchange rate volatility due to uncertainties and this creates arbitrage opportunities, breeds speculative activities, and inhibits growth.

2.2. Empirical Review

Several studies have documented the relationship between oil price, exchange rate, and economic growth but the results remain inconclusive. Mensah et al. (2017) provide evidence of cointegration between oil price and exchange rate in oil-producing economies particularly following the 2008/2009 global financial crisis. Similarly, utilizing the time-varying cointegration technique, Fedoseeva (2017) observes that the exchange rate and oil price are correlated over the short to long-term in Russia and this became more pronounced as a result of the negative oil price shock in 2014. Englama et al. (2010) make use of the cointegration and vector error correction models to show that a 1% increase in the price of oil increases exchange rate volatility by 0,54% and 0,02% in the long- and short-run, respectively, in Nigeria. Alley (2018) presents a similar argument of a direct relationship using an autoregressive distributed lag (ARDL) and vector autoregression model (VAR) models. In other words, a fall in the price of crude oil leads to a depreciation of the Naira exchange rate. The exchange rate, amongst other macroeconomic indicators, fell at the same time as international crude oil prices, in line with weak macroeconomic fundamentals and demand for oil (Prest, 2018, p. 31).

Idrisov et. al (2015) uses a dynamic stochastic general equilibrium model (DSGE) and reports that a constant increase in oil prices does not influence the long-run growth path in Russia, but determines contemporaneous transitional trends from one period to another. Pershin et al. (2015) utilized a VAR model to investigate the link between exchange rate and oil price movement in Botswana, Kenya and found no evidence of a long-run association between exchange rate and oil price shock in Kenya. This result was found to hold before and after the 2008 economic slowdown. Wesseh and Lin (2018) assess oil price and exchange

rate movement on growth in Liberia utilizing an unrestricted VAR model. The price of oil was reported to be positively related to growth. A depreciation of the domestic currency retrogresses real GDP while an appreciation has no impact.

Jin (2008) explores alternative links through which oil price shocks are transmitted to the supply-and-demand side of the domestic economy. The supply-side impact is driven by the fact that oil price serves as a vital input in the production process and a price distortion invariably affects the output level. Illustratively, a positive oil price shock reduces production cost, while a negative shock reduces the cost of production and leads to higher output. The demand-side effect is premised on the fact that oil price shocks influence investment and consumption decisions. This is particularly applicable to a *paradoxical* economy such as Nigeria where export is dominated by crude oil and refined petroleum products take a significant share of its import. An increase in the price of oil constrains the household's budget constraint and affects the prices of basic goods and services.

Another approach is the use of *atheoretical* VAR models without prior restrictions on the parameters of the model. This framework assumes that the exchange rate and oil price are interlinked but fails to account for other important control variables predicted by the growth literature. This may result in misspecification bias and misleading inferences. One example is the recent study by Wesseh and Lin (2018) who model real GDP as a function of the trade balance, consumer price index, oil price, and exchange rate shocks. Mordi and Adebisi (2010) make use of a similar approach but depart in terms of their choice of variables.

The VAR approach has been widely used to analyze different measures of macroeconomic expectations in different contexts, but the shocks are not decomposed and thus the impact is discerned from the impact from a variable of interest. The finding by Byrne, Lorusso, and Xu (2018) that expectations can be a key driver of oil prices suggests that modeling oil prices in a symmetric model may not be appropriate, prompting the use of a non-linear framework. This is premised on the fact that information friction may force a wedge between oil prices and supply and/or demand shocks, especially during periods of elevated risk aversion and uncertainty (*ibid.*).

Mordi and Adebisi (2010) develop an SVAR model for Nigeria that accounts for the impact of oil shocks on output and domestic prices. The results reveal that the effect of oil price shocks on output is asymmetric and the impact of a negative shock is significantly more pronounced relative to a positive shock. We draw inspiration from this important empirical outcome for Nigeria by considering a nonlinear framework that decomposes negative and positive oil price shocks, and exchange rate volatility transmission to output performance. Similarly, Economou (2016) uses an SVAR model that augments endogenous oil supply shocks to price changes during crisis periods to analyze the role of capacity shifts in oil production relative to demand.

Lorusso and Pieroni (2018) rely on a VAR framework that decomposes oil price variations from the underlying source of the shock. The study shows that the consequences of oil price changes on UK macroeconomic aggregates depend on different sources of shocks, while shortfalls in crude oil supply negatively affect output performance in the short run. Notably, these approaches may not be appropriate because, as pointed out by Hamilton (2003, p. 364), as long as there is a change in the underlying data generating process of oil price *and/or production*, a linear approximation of the relationship between oil prices and economic activity may appear unstable over time, even if the underlying nonlinear relation is stable. This makes the use of the nonlinear ARDL framework more appropriate. Pesaran, Shin, and Smith (2001) and more recently Shin et al. (2014) provide an extensive discussion on the application and advantages of this approach.

A dominant strand of the empirical literature has assumed a linear symmetric relationship between oil price shocks and exchange rate volatility on output performance. Extant works that lend support to the asymmetric responses of oil price shocks and volatility of currency price do not directly test the hypothesis of asymmetric transmission of standard innovation from these variables to the economy, but rather impose it on the estimators (Kilian, 2014). Kilian further argues that a plausible explanation for the lack of explanatory power of oil price shocks in linear models may be traced to time variation in the relationship between oil prices and the macroeconomics. The instability in the empirical link between oil price and output has been traced to misspecification of functional forms, and this issue

has been well documented in Davis and Haltiwanger (2001), Hamilton (2003). Aghion, Bacchetta, Ranciere, and Rogoff (2009) provide evidence showing that exchange rate volatility significantly influences economic growth.

Further attempts to examine this nexus by Aliyu (2009) and Osigwe (2015), who document the positive effect of an oil price shock and exchange rate appreciation on growth in Nigeria, have been marred by several empirical issues. For instance, they fail to account for asymmetric shocks, ignore potential endogeneity bias, inappropriate variable measurement as well as the inherent asymmetry that characterizes this important nexus (Kilian, 2014; Hamilton, 2003; Davis & Haltiwanger, 2001). We overcome this deficiency by using the non-linear ARDL model proposed by Shin et. al. (2014). This is because endogeneity is less of a problem in this framework and the model is free of residual correlation, since the lagged levels (or first difference regressors) are serially uncorrelated, thus shielding the model from omitted lag bias (Arize et. al., 2017).

3. Analytical Considerations and The Model: Non-linearity and Asymmetric Responses

The link between exchange rate volatility, oil price shocks, and output performance has been commonly modeled within the framework of growth theory. This approach is predicated on the notion that energy consumption serves as a valuable input in the production process and this has gained empirical support from the energy-growth literature (Hamilton, 2003; Kilian, 2014; Lorusso & Pieroni, 2018; Prest, 2018). Energy inputs enter the production function as intermediate inputs or to augment capital equipment and machinery. Therefore, a negative or positive oil price shock will exert a significant impact on economic growth. However, the impact of the shocks will depend on whether the country is a net exporter or importer of oil. For instance, in an oil exporting country, a negative oil price shock retrogresses output performance while a positive shock spurs growth. However, for a net oil importing country, the negative shock will reduce its cost of production, and in turn boost productivity, whereas a positive oil shock will reduce productivity. Theoretically, the immediate effect of a positive

oil price shock is to increase the cost of production for oil-importing countries (Mordi & Adebiji, 2010) and this, in turn, distorts aggregate demand.

Oil price shocks could impact real economic activity through the demand side due to actual or perceived changes in the purchasing power of disposable income, increased uncertainty about future economic conditions, or a reduction in consumer and investor sentiment. This induces households and firms to cut back on their consumption and investment expenditures (Guntner & Linsbauer, 2018). In addition to the shock prompting a fall in current disposable income, gloomy expectations about future economic conditions due to oil price fluctuations might depress consumer spending further. This implies that modeling asymmetries will matter in the information set explaining growth, as the economic agent's expectation about growth could affect medium-to-long-term growth.

The neoclassical growth model assumes a constant growth rate of labor and productivity while an exogenously determined share of output is saved up and used for investment in capital. The model posits the existence of steady-state growth where the capital-labor ratio is on a balanced growth path. In other words, capital and output grow at a constant rate that mirrors the growth of labor and its productivity. In this model, savings are used up to add new and maintain old capital stock to sustain a constant capital-labor ratio per worker. This means that the growth rate per worker is affected by population growth and technical progress. Idrisov et al. (2015) extensively appraise the theoretical issues with respect to the growth elasticity of oil price in Russia using a DSGE model. The paper concludes that a constant increase in oil price cannot influence long-run growth, but rather predetermines short-term transitional trends over time. This may not be the case, particularly in a monoculture economy like Nigeria's, where short-term innovations instantaneously spill over to the domestic economy through the exchange rate channel. Additionally, the impact may arise through increased oil revenue inflows which in turn increases investment and consumption. The effect on investment can be traced to capital accumulation, which in turn increases productivity.

3.1. The Model

The specified model is based on Wesseh and Lin (2018), who expressed real GDP as a function of oil price, exchange rate, composite price index, and trade balance. The model is modified to reflect the basic control variables in line with the growth literature. In addition to these key variables, the asymmetric effect of exchange rate and oil price shocks on growth are considered as well as other variables that have been validated in the empirical literature for Nigeria (Aliyu, 2009; Osigwe, 2015). The model is presented as follows.

$$\ln gdp_{pc_t} = \alpha_0 + \alpha_1 ops_t + \alpha_2 exr_t + \alpha_3 X + \alpha_4 Z + \varepsilon_t \quad (1)$$

where gdp_{pc} denotes gross domestic product per capita, ops is oil price shock, exr is exchange rate volatility, X is a vector of traditional growth determinants (labor- lab and gross fixed capital formation- $gfcf$) and Z is a vector of other control variables considered as important drivers of Nigeria's growth. The variables considered are government expenditure ($gexp$), trade openness ($open$), and infrastructural development ($infra$). α_0 is a constant while α_1 - α_4 are parameters of the model. ε_t is the error term assumed to be normally distributed with zero mean and has constant variance.

The effect of an oil price shock on gdp_{pc} will either be positive or negative depending on the direction of the shock. A positive oil price shock exerts a positive influence on growth while a negative shock inhibits growth. This conforms to the predictions of extant literature such as Aliyu (2009) and Osigwe (2015). Likewise, the coefficient of exchange rate volatility will depend on whether the domestic currency is appreciating or depreciating. In the case of the former, a positive impact on growth is expected while in the latter case, an inverse effect is predicted. Nevertheless, we focus on testing the hypothesis, proposed by Aghion et al. (2009), that exchange rate volatility has a positive impact on productivity growth. The key variables-labor and capital- as predicted by the growth model are expected to be positive. The coefficients of infrastructure development, government spending, and the degree of trade openness are also expected to be positive (Aliyu, 2009; Mordi & Adebisi, 2010; Osigwe, 2015).

4. The Nonlinear ARDL Approach

In this section, we focus on decomposing oil price (*ops*) and exchange rate (*exr*) as positive and negative shocks in the NARDL framework *ala* Shin et al. (2014), to ascertain whether the series are non-linearly cointegrated. An important advantage over other symmetric cointegration approaches is that regressors can be decomposed using partial sums of positive and negative changes (*ibid.*). Furthermore, NARDL is preferred for three reasons. First, it provides more robust results that are sensitive to small sample size properties and therefore can reject a false null hypothesis. Second, it is applicable irrespective of the order of integration of the variables; and third, it yields both short and long-run coefficients as well as the covariance matrix simultaneously, making it possible to draw inferences on long-run estimates, which is not always the case based on other cointegration tests (Arize et al., 2017).

The use of this technique makes it possible for an underlying association to independently exhibit long-run asymmetry, short-run asymmetry, or both (Bahmani-Oskoe & Bahmani, 2015; Bahmani-Oskoe & Fariditavana, 2014). In addition to the possibility of simultaneously testing the long and short-run nonlinearities through the positive and negative partial sum decompositions of regressors, it also offers the possibility of quantifying the respective responses of the dependent variable to positive and negative shocks of the regressors from the asymmetric dynamic multipliers (Arize et al., 2017).

In line with Shin et al. (2014), we proceed with the decomposition of partial sums of negative and positive shocks of oil prices and exchange rate volatility in an asymmetric long-run equation as follows:

$$x_t = \gamma^+ ops_t^+ + \gamma^- ops_t^- + \mu_t \quad (2)$$

$$y_t = \gamma^+ exr_t^+ + \gamma^- exr_t^- + \mu_t \quad (3)$$

where x_t and y_t are scalar $I(1)$ variables and the variables *exr* and *ops* are as earlier defined are decomposed as follows; $ops_t = \alpha + ops_t^+ + ops_t^-$ and

$exr_t = \alpha + exr_t^+ + exr_t^-$. α is a constant while $ops_t^+, ops_t^-, exr_t^+, exr_t^-$ are partial sum processes of negative and positive oil price shocks and exchange rate volatility.

$$exr_t^+ = \sum_{j=1}^l \Delta exr_j^+ = \sum_{j=1}^l (\Delta exr, 0), exr_t^- = \sum_{j=1}^l \Delta exr_j^- = \sum_{j=1}^l (\Delta exr, 0) \quad (4)$$

$$ops_t^+ = \sum_{j=1}^l \Delta ops_j^+ = \sum_{j=1}^l \max(\Delta ops, 0), ops_t^- = \sum_{j=1}^l \Delta ops_j^- = \sum_{j=1}^l \min(\Delta ops, 0) \quad (5)$$

Equation 4 and 5 provide a simple framework for modelling asymmetric cointegration based on partial sum decomposition to account for non-linearity. This sets the stage for specifying Equation 1 in a NARDL framework. This is done in two parts. The first considers asymmetric oil price shocks while the second considers asymmetric exchange rate volatility shocks and the models are presented as follows:

$$\Delta gdppc_t = \alpha + \phi_1 gdppc_{t-i} + \phi_2^+ ops_{t-i}^+ + \phi_2^- ops_{t-i}^- + \phi_3 X_{t-i} + \phi_4 Z_{t-i} + \sum_{i=1}^l \delta_i \Delta gdppc_{t-i} + \sum_{i=1}^q \epsilon_i^+ \Delta ops_{t-i}^+ + \sum_{i=1}^q \epsilon_i^- \Delta ops_{t-i}^- + \sum_{i=1}^d \varphi_i \Delta X_{t-i} + \sum_{i=1}^s \theta_i \Delta Z_{t-i} + \mu_t \quad (6)$$

$$\Delta gdppc_t = \alpha + \gamma_1 gdppc_{t-i} + \gamma_2^+ exr_{t-i}^+ + \gamma_2^- exr_{t-i}^- + \gamma_3 X_{t-i} + \gamma_4 Z_{t-i} + \sum_{i=1}^r \delta_i \Delta gdppc_{t-i} + \sum_{i=1}^q \epsilon_i^+ \Delta exr_{t-i}^+ + \sum_{i=1}^q \epsilon_i^- \Delta exr_{t-i}^- + \sum_{i=1}^d \varphi_i \Delta X_{t-i} + \sum_{i=1}^s \theta_i \Delta Z_{t-i} + \mu_t \quad (7)$$

Equations 6 and 7 provide a basis for analyzing asymmetries in the long-run, short-run or both horizons. In these models, the long-run coefficients of oil price shocks and exchange rate volatility are $\frac{\phi_2^+}{\phi_1}, \frac{\phi_2^-}{\phi_1}, \frac{\gamma_2^+}{\gamma_1}$, and $\frac{\gamma_2^-}{\gamma_1}$. Thus, the level terms in the models denote the long-run association analyzed using the bounds testing approach of Pesaran et al. (2001), while the contemporaneous dynamics are captured by the asymmetric lags of the first difference of oil price shocks and exchange rate volatility. The lags of the coefficients are represented by p, d, q , and s .

The analysis of the NARDL model is carried out in three steps. First is an estimation of Equations 6 and 7 using OLS. The second step entails testing for an asymmetric long-run non-linear association between the variables. Pesaran et al. (2001) and Shin et al. (2014) propose two operational testing procedures. The first is the t-test on the coefficient of the error correction term which tests the null hypothesis of no cointegration $H_0: \gamma_1=0$ and $H_0: \phi_1=0$ against the alternative $H_1: \gamma_1 \neq 0$ and $H_1: \phi_1 \neq 0$. If we fail to reject the null, then it implies the absence of a long-run relationship amongst the variables. The second test is the F-statistic that tests for the joint null hypothesis that the coefficients of the level variables are jointly equal to zero ($H_0: \phi_1 = \phi_2^+ = \phi_2^- = \phi_3 = \phi_4 = 0$ and $H_0: \gamma_1 = \gamma_2^+ = \gamma_2^- = \gamma_3 = \gamma_4 = 0$) against the alternative ($H_0: \phi_1 \neq \phi_2^+ \neq \phi_2^- \neq \phi_3 \neq \phi_4 \neq 0$ and $H_0: \gamma_1 \neq \gamma_2^+ \neq \gamma_2^- \neq \gamma_3 \neq \gamma_4 \neq 0$).

To test for short-run symmetry we rely on the strong or weak form of the model. In the former case, we test for $\varepsilon_i^+ = \varepsilon_i^-$ in Equations 6 and 7 while the latter, otherwise called additive short run symmetry, is given as: $\sum_{i=1}^q \varepsilon_i^+ = \sum_{i=1}^q \varepsilon_i^-$. A standard Wald test can be performed on each or the combination of the dynamic coefficients of the negative and positive shocks or their sum. Thus, it follows that the short-run adjustments to positive and negative exchange rate volatility shocks are captured by ε_i^+ and ε_i^- in both models. This implies that for a positive oil price shock to boost productivity over the long term, the estimate of ϕ_2^+ normalized on ϕ_1 should be positive and statistically significant. The reverse is applicable in the case of a negative shock.

5. Data Description and Preliminary Checks

The analysis was performed using annual data for 36 years spanning 1981 to 2016. All the data were obtained from the World Bank World Development Indicators (online) excluding the oil price series, which was sourced from the US Energy Information Administration (Table A1 in the appendix).

The summary statistics of the series to be used in estimation are reported in Table 1. Notably, while the average Naira exchange rate recorded an average value of about 76,5, the mean value of oil price stood at 43,1 USD per barrel during the review period. There was a large disparity between the minimum and maximum values, which resulted in a significantly high standard deviation. The average value

of GDP per capita in Nigeria stood at N121.849,49 (in Naira-local currency units) but reached a peak of over N500.000,00. Overall, the summary suggests the use of a log-linear functional form to normalize the series due to the disparity in the unit of measurement. This conforms to the existing growth regressions in the literature. The correlation between the variables is also conducted and the outcome is reported in Table 2. We find evidence of a high positive correlation between the dependent variable (GDP per capita) and the regressors. However, the correlation coefficients of financial development (*findev*)¹ and degree of openness (*open*) were negative and quite low, recording 28% and 38% respectively.

Table 1: Summary Statistics

	Mean	Max	Min	Standard Deviation
exr	76,47	253,49	0,62	71,95
findev	0,24	0,43	0,13	0,07
gexp	1501,10	5953,21	7,58	2177,28
gfcf	2725,74	15696,12	8,80	4796,48
infra	31,37	154,50	0,15	50,72
lab	64,82	98,88	39,87	17,83
open	0,50	0,82	0,21	0,17
ops	43,14	117,70	13,62	31,58
gdppc	121849,49	551511,46	685,35	178577,21

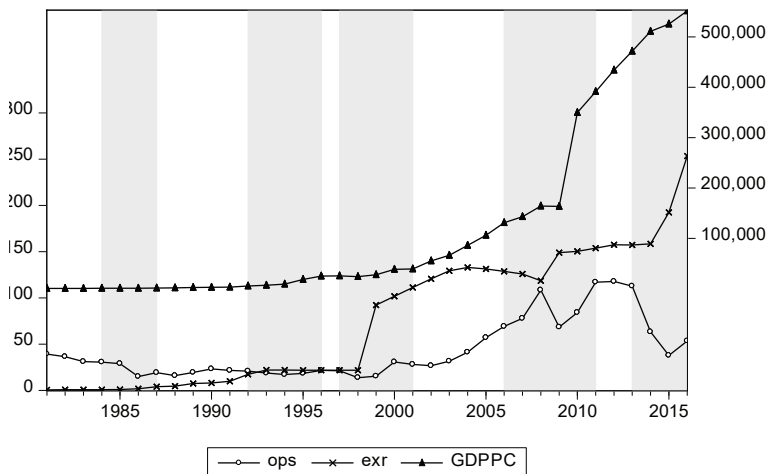
Table 2: Correlation Matrix

	exr	findev	gdppc	gexp	gfcf	infra	lab	open	ops
exr	1,00	-0,18	0,83	0,81	0,77	0,81	0,96	-0,03	0,66
findev	-0,18	1,00	-0,20	-0,10	-0,20	-0,07	-0,25	-0,21	0,11
gdppc	0,83	-0,20	1,00	0,98	0,99	0,99	0,88	-0,38	0,71
gexp	0,81	-0,10	0,98	1,00	0,96	0,98	0,88	-0,33	0,79
gfcf	0,77	-0,20	0,99	0,96	1,00	0,97	0,82	-0,45	0,62
infra	0,81	-0,07	0,99	0,98	0,97	1,00	0,87	-0,40	0,72
lab	0,96	-0,25	0,88	0,88	0,82	0,87	1,00	0,00	0,70
open	-0,03	-0,21	-0,38	-0,33	-0,45	-0,40	0,00	1,00	-0,08
ops	0,66	0,11	0,71	0,79	0,62	0,72	0,70	-0,08	1,00

¹ Ample evidence suggests that financial development promotes growth through capital accumulation and technological progress by mobilizing resources, producing information about investment, facilitating capital inflows and ensuring efficient allocation of resources. Although there are numerous indicators of financial development, across depth, access, efficiency, and stability, we focus on a common and widely used financial institutions' indicator of financial depth: M2 to GDP ratio. <https://www.worldbank.org/en/publication/gfdr/gfdr-2016/background/financial-development>.

A visual inspection of the trend of oil price, exchange rate, and GDP per capita presented in Figure 1 reveals a lopsided pattern. The movement of GDP per capita was relatively stable in earlier years but trended upwards slowly from 1992, which mirrored positive oil price developments in the international market at the time. Before this, the negative oil price shock and economic slowdown in the early 1980s prompted the need for structural adjustment in 1986, which led to a devaluation of the Naira exchange rate. However, the impact became more pronounced after 1998, when, due to improved global crude oil market conditions and growth prospects, it stabilized. Interestingly, at the inception of the 2008 financial crisis, the Nigerian economy was somewhat insulated due to the sharp increase in crude oil prices, and the consequent accumulation of foreign exchange reserves put downward pressure on the naira exchange rate. However, by 2009 the impact of the crisis was fully transmitted. This resulted in a sharp depreciation of the Naira exchange rate in 2009, perhaps due to low demand for oil, which led to a decrease in its price. The full impact on GDP was artificially buffered by the GDP rebasing exercise by the National Bureau of Statistics, which led to the significant spike in GDP per capita in 2010.

Figure 1. Trend of Key Variables



An understanding of the stationarity properties of variables has important implications for time series analysis. The Augmented Dickey-Fuller (ADF) (1981), Phillips-Perron (PP) (1988) and the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) (1992) tests were used. The results of these tests are presented in Table 3 and it shows that the null hypothesis of a unit root cannot be rejected at the 5% level for all the variables. The KPSS tests, on the other hand, show that all the variables are stationary at levels excluding degree of openness and oil price, which were I(2) and I(1), respectively. Further checks using the Perron (2006) unit root tests, that account for structural breaks in the series, were carried out for robustness. The structural break unit root test result presented in Table 4 validates the ADF, Philips-Perron and KPSS stationarity tests, thus making a case for the use of the NARDL approach.

Table 3: Unit Root Test Result

Series	Augmented Dickey-Fuller			Philip-Perron			KPSS	
	t-value	p-value	order	t-value	p-value	order	t-value	order
exr	-3,645	0,009	i(1)	-3,646	0,009	i(1)	0,688**	i(0)
findev	-5,357	0,000	i(1)	-8,199	0,000	i(1)	0,230**	i(0)
gdppc	-5,469	0,000	i(1)	-5,463	0,000	i(1)	0,698**	i(0)
gexp	-4,957	0,000	i(1)	-5,070	0,000	i(1)	0,682**	i(0)
gfcf	-4,641	0,000	i(1)	-4,639	0,000	i(1)	0,690**	i(0)
infra	-8,437	0,000	i(2)	-8,010	0,000	i(2)	0,641**	i(0)
lab	-5,013	0,000	i(1)	-3,017	0,043	i(1)	0,714**	i(0)
open	-4,720	0,000	i(2)	-8,169	0,000	i(1)	0,500**	i(2)
ops	-5,254	0,000	i(1)	-5,218	0,000	i(1)	0,445*	i(1)

Note: ** indicates significance at the 5% level while * indicates significance at 10%.

Table 4: Perron (2006) Unit Root Test with Structural Breaks Result

Series	Perron (2006)			
	t-value	p-value	order	break date
exr	-5,387	0,000	i(1)	2015
findev	-5,913	0,000	i(1)	2010
gdppc	-6,306	0,000	i(1)	1995
gexp	-5,495	0,000	i(1)	1999
gfcf	-5,729	0,000	i(1)	1985
infra	-8,590	0,000	i(0)	2001
lab	-5,229	0,000	i(1)	1993
open	-8,281	0,000	i(1)	1987
ops	-5,044	0,000	i(0)	1992

6. Empirical Analysis and Discussion of Findings

The discussion of the findings is carried out in two sections. The first focuses on presenting and discussing the findings from the NARDL model with nonlinear exchange rate shocks, followed by the model normalized with oil price asymmetries. Although not presented here due to space, the symmetric version (linear ARDL) was also carried out and the findings validate extant literature on the existence of a long-run relationship between oil price shocks, exchange rate fluctuations, and economic growth. Nevertheless, the findings remain inconclusive and mixed, due to the failure of these models to account for idiosyncratic shocks that emanate from the foreign exchange and international crude oil markets.

6.1. Non-linear ARDL Model with Asymmetric Exchange Rate Shock

The result of the bounds testing approach for testing long-run relationships is presented in Table 5. The outcome shows that there is a long-run asymmetric relationship between growth, oil price shocks, exchange rate fluctuations, and other variables considered. The computed F-statistic is 14,611 and it exceeds the upper critical bound at the 5% significance level. The long-run estimated coefficient of the model is presented in Table 6 and it reveals that an appreciation of the domestic currency *vis-à-vis* the US dollar leads to an improvement in economic growth over the long term. For instance, the appreciation of the Naira exchange rate in the aftermath of the 2016 recession did not instantaneously affect growth; rather, a modest recovery was recorded in the aftermath of the crisis. This transmission delay has been reported in previous studies of Nigeria, such as Aliyu (2009) and Mordi and Adebisi (2010). The coefficients of capital, labor and the degree of economic openness were, as expected, positive and statistically significant, suggesting their crucial role for long-run growth in Nigeria.

Table 5: Bound Test Result with Asymmetric Exchange Rate Shock

Computed F-Statistic	14,611	lower bound	upper bound
Critical Bounds	1%	2,54	3,97
	5%	2,04	3,33
	10%	1,80	2,99

Note: k=9; Case 3 (unrestricted constant and no trend); critical values are from (Narayan, 2005)

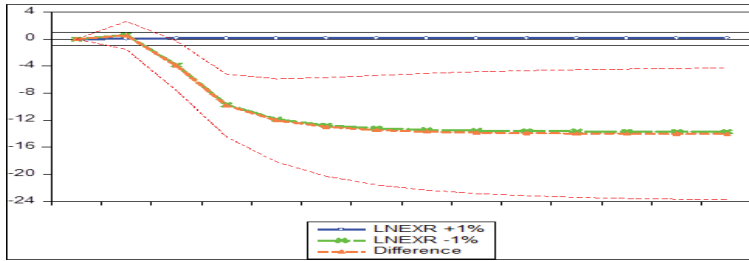
Table 6: Long-Run Estimates of NARDL with Exchange Rate Shocks

Variable	Coefficient	Standard Error	t-statistics	p-value
lnexr_pos	0,130	0,109	1,198	0,265
lnexr_neg	12,788	4,613	2,772	0,024
lnops	0,029	0,076	0,382	0,713
lnfindev	0,012	0,200	0,063	0,952
lngexp	0,047	0,071	0,660	0,528
lngfcf	0,440	0,150	2,943	0,019
lninfra	0,139	0,084	1,655	0,137
lnlab	3,985	1,246	3,199	0,013
lnopen	0,613	0,175	3,506	0,008

Note: The computed error correction term: $ECT = LNGDPPC - (0,1304 * LNEXR_POS + 12,7884 * LNEXR_NEG + 0,0290 * LNOPS + 0,0125 * LNFINDEV + 0,0471 * LNGEXP + 0,4403 * LNGFCF + 0,1391 * LNINFRA + 3,9847 * LNLAB + 0,6129 * LNOPEN)$

The long-run multiplier is presented in Figure 2 and the blue line shows the response of growth to a positive exchange rate shock, while the green line plots the corresponding effect of a negative exchange rate shock on the Nigerian economy. The brown line that falls within the 95% confidence bounds is the difference between the negative and positive exchange rate shocks on growth. The chart clearly shows that the impact of a positive exchange rate shock is more pronounced on growth performance, and thus drives the asymmetry relating to growth. In other words, the responsiveness of Nigeria's growth is higher during positive exchange rate spells relative to negative innovations that affect the economy.

Figure 2. Long-Run Multiplier of Exchange Rate Shock



The contemporaneous error correction model that accounts for the asymmetric exchange rate shocks is presented in Table 7. The model performs well in terms of the diagnostic tests carried out. For instance, the LM test shows no evidence of serially correlated errors, while the Ramsey RESET test shows no evidence of functional misspecification. The residuals are normally distributed as indicated by the Jarque-Bera statistic. The model performs satisfactorily in terms of the heteroscedasticity tests (ARCH and White). The coefficient of the error correction term is negative and statistically significant, suggesting that the speed at which the Nigerian economy reverts to equilibrium in the event of a contemporaneous innovation is about 65,5%, which is quite fast.

Further inspection of the result suggests that exchange rate shocks are asymmetric. For instance, a depreciation of the Naira exchange rate by 1% leads to an increase in Nigeria's growth by 5,2% while an appreciation of the domestic currency against the US dollar is insignificant. However, the first lag of a negative exchange rate shock (appreciation) exerts a negative impact on growth. A plausible explanation for this puzzling outcome is that Nigeria is an import-dependent economy and its narrow export base makes it difficult for the economy to maximize the gains from a relatively cheaper domestic currency. This may also be explained by the positive and significant coefficient of the degree of openness which is an indicator of the extent of the country's liberal trade regime and high import elasticity.

Interestingly, we find that the level of financial development negatively affects growth with statistically significant coefficients. This is unexpected because

enhancing financial depth should increase aggregate growth. This outcome may be traced to the weak capacity of the financial system to efficiently intermediate in terms of providing the much-needed funds to support infrastructure and real sector development in Nigeria. These are crucial if steady-state growth is to be attained. In line with the long-run estimates, the coefficient of capital ($\ln g_{fcf}$) is positive and statistically significant, but its first lag turns out to be negative. This may be partly explained using capital as a substitute for labor and this tends to reduce household income and aggregate demand.

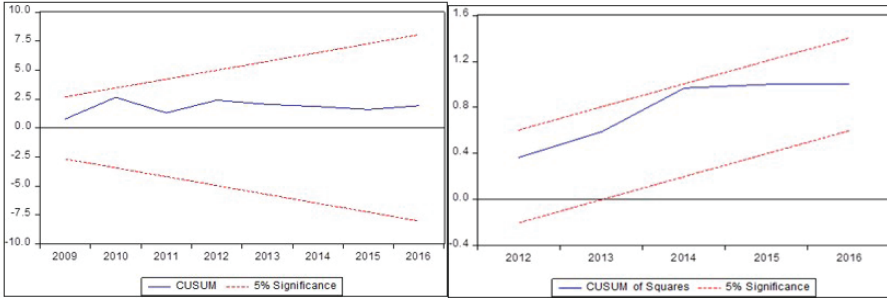
Another puzzling observation from Table 7 is the negative but statistically significant coefficient of infrastructure. Again, we trace this to the fact that the gestation period for infrastructure investment is usually quite long and thus the response of growth may not be instantaneous. This is particularly the case in a developing economy like Nigeria where budget delays, revenue shortages, misappropriation of funds, and policy inconsistency retrogress infrastructure investment and development. The CUSUM and CUSUM of squares stability tests developed by Brown, Durbin, and Evans (1975) are used to check if the long and short-run parameter estimates of the model are stable. Overall, the result in Figure 3 indicates that the parameters of the model are stable and do not suggest the presence of regime shifts.

Table 7: Non-Linear Error Correction Model with Exchange Rate Shocks

Variable	Coefficient	Standard Error	t-statistics	p-value
constant	-48,769	2,751	-17,727	0,000
d(lnexr_pos)	0,052	0,014	3,606	0,007
d(lnexr_pos(-1))	0,048	0,016	3,017	0,017
d(lnexr_neg)	-0,565	0,481	-1,174	0,274
d(lnexr_neg(-1))	-4,282	0,572	-7,482	0,000
d(lnfindev)	-0,807	0,031	-26,297	0,000
d(lnfindev(-1))	-0,341	0,045	-7,579	0,000
d(lngfcf)	0,061	0,025	2,397	0,043
d(lngfcf(-1))	-0,214	0,027	-7,808	0,000
d(lninfra)	-0,332	0,034	-9,894	0,000
d(lninfra(-1))	-0,421	0,047	-8,918	0,000
d(lnlab)	-7,419	3,791	-1,957	0,086
d(lnlab(-1))	-22,393	3,633	-6,164	0,000
d(lnopen)	0,069	0,019	3,603	0,007
d(lnopen(-1))	-0,104	0,027	-3,872	0,005
ect	-0,655	0,037	-17,621	0,000

Note: Dependent Variable is D(LNGDPPC). Sample:1981 to 2016. Included observations: 36. R-squared: 0,847; DW: 2,230. LM= 2,405[0,171]. Normality: 0,4033[0,817]. RESET: 2,017[0,198]. ARCH: 3,646[0,187]. White: 1,004[0,536].

Figure 3. Parameter Stability of NARDL Model (Exchange Rate Shocks)



6.2. Non-linear ARDL Model with the Asymmetric Oil Price Shock

The next empirical exercise is an analysis of the nonlinear ARDL model that accounts for asymmetric oil price shocks. Given the stationarity tests that suggest the variables used in estimation are a mixture of $I(0)$ and $I(1)$ series, we apply the NARDL bounds tests. We present evidence of a long-run non-linear cointegrating relationship between exchange rate, oil price, and economic growth in Nigeria in Table 8. This conclusion is drawn because the computed F-statistic of 7,249 exceeds the lower and upper critical bounds. Table 9 shows the estimated long-run coefficients. In the long-run, we find that a positive oil price shock negatively affects economic growth in Nigeria. This conforms to extant evidence on the existence of the Dutch Disease syndrome where oil revenue has been more of a *curse than a blessing* for Nigeria. The exchange rate is positively related to growth, implying that a 1% depreciation (increase) of the domestic currency leads to an increase in growth by 33,6%. This may be explained as follows; the depreciation of the domestic currency makes the country's exports cheaper in the international markets. However, this may not be the case in an import-dependent economy where the export basket is not well diversified and primarily dominated by crude oil (over 95%).

The results reported in Table 9 also suggest that higher capital investment could boost growth in Nigeria. The coefficient of financial development is negative and statistically significant, suggesting that the extent of financial development has not exerted the expected positive effect on growth, perhaps due to binding constraints that have hindered availability to the real sector. The

results also show a positive and statistically significant relationship between infrastructure development and economic growth in the long-run model that accounts for oil price asymmetries. This is because oil revenue earnings largely determine the extent of public investment in infrastructure since Nigeria's revenue profile is primarily dependent on oil revenue earnings. While labor was found to increase aggregate economic performance, more liberal trade regimes were also found to exert a similar effect. The long-run dynamic multiplier of an oil price shock on the economy is shown in Figure 4. The result shows that the effect of a negative oil price innovation on growth is higher than the positive oil price shock. Next, the short-run dynamic relationship will be analyzed.

Table 8: Bound Test Result

Computed F-Statistic:	7,249	lower bound	upper bound
Critical Bounds	1%	2,54	3,97
	5%	2,04	3,33
	10%	1,80	2,99

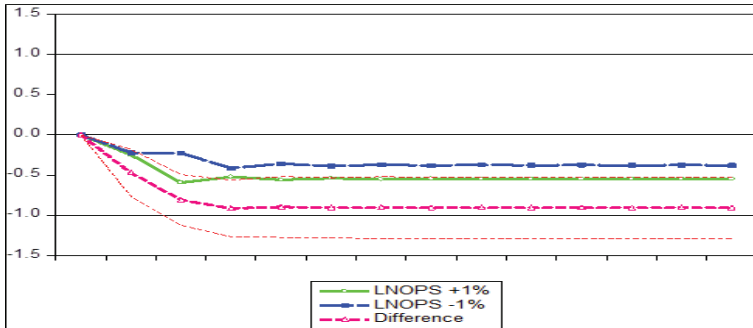
Note: k=9; Case 3 (unrestricted constant and no trend); critical values are from (Narayan, 2005).

Table 9: Long-Run Estimates of NARDL Model with Oil Price Shocks

Variable	Coefficient	Standard Error	t-statistics	p-value
lnops_pos	-0,522	0,154	-3,380	0,020
lnops_neg	0,368	0,091	4,045	0,010
lnexr	0,366	0,092	3,955	0,011
lnfindev	-0,309	0,053	-5,820	0,002
lngexp	0,061	0,067	0,915	0,402
lngfcf	0,132	0,060	2,221	0,077
lninfra	0,157	0,048	3,260	0,022
lnlab	6,515	1,460	4,462	0,007
lnopen	0,250	0,097	2,576	0,050

Note: The computed error correction term: $ECT = LNGDPPC - (-0,5218*LNOPS_POS + 0,3684*LNOPS_NEG + 0,3657*LNEXR - 0,3087*LNFINDEV + 0,0612*LNEXP + 0,1323*LNFCF + 0,1569*LNINFRA + 6,5146*LNLAB + 0,2504*LNOPEN$

Figure 4. Dynamic Multiplier of Oil Price Shock



The general-to-specific approach is used to estimate and arrive at the parsimonious error correction model. The result is presented in Table 10 and shows that capturing oil price asymmetries is important, as the nature and impact of shocks hitting the economy differ significantly. We find evidence of a positive oil price shock translating to a negative and significant effect on growth, whereas the negative shock is positive and statistically significant. This conforms to the long-run estimates presented earlier. However, the first lag of a negative shock is negative and statistically significant. A plausible explanation for this is that the government may draw down on its savings when the shock initially hits the economy. Afterward, the full impact begins to materialize as savings are depleted. Again, the short-run impact of financial development is negative and statistically significant. The first lag in government spending is positive and statistically significant, exerting a 4,2% effect on growth.

The impact of capital investment on growth is negative in the short run with only its first lag being statistically significant. This may be explained by the huge outlay involved and this takes time for its full effect to manifest on growth. The effect of trade openness is also mixed; recording a positive coefficient whereas the value of its first lag is negative. An important condition for the long-run equilibrium association to hold is dynamic stability and this requires that the coefficient of the error correction be negative and not lower than -2; that is, it falls within the unit circle (Loayza and Ranciere, 2005, p.12). As pointed out by Narayan and Smyth (2006) if the value of the lagged error correction term lies

between -1 and -2, then the lagged error correction term produces dampened fluctuations in growth around its steady state path. In this paper, the lagged error correction coefficient of -1,28 implies that instead of monotonically converging to the equilibrium path directly, the error correction process fluctuates around the long-run value in a dampening manner. However, once this process is complete, the convergence to the equilibrium path is rapid (ibid.)

Table 10: Error Correction Model with Asymmetric Oil Price Shocks

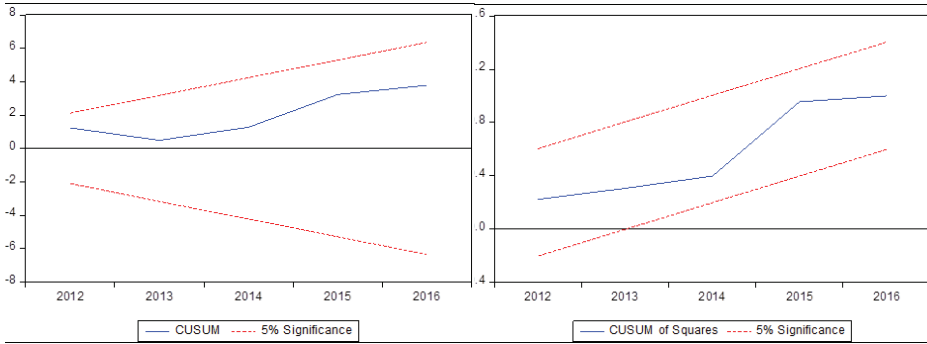
Variable	Coefficient	Standard Error	t-statistics	p-value
constant	-144,540	10,149	-14,241	0,000
d(lnops_pos)	-0,249	0,040	-6,223	0,002
d(lnops_neg)	0,222	0,020	10,879	0,000
d(lnops_neg(-1))	-0,181	0,032	-5,720	0,002
d(lnexr)	0,031	0,015	2,050	0,096
d(lnexr(-1))	-0,108	0,022	-4,907	0,004
d(lnfindev)	-0,569	0,029	-19,372	0,000
d(lnfindev(-1))	-0,453	0,051	-8,886	0,000
d(lngexp)	0,017	0,017	1,003	0,362
d(lngexp(-1))	0,042	0,016	2,597	0,048
d(lngfcf)	-0,040	0,023	-1,757	0,139
d(lngfcf(-1))	-0,319	0,031	-10,237	0,000
d(lninfra)	-0,256	0,031	-8,310	0,000
d(lninfra(-1))	-0,543	0,049	-11,089	0,000
d(lnlab)	-25,512	3,831	-6,660	0,001
d(lnlab(-1))	-31,092	3,430	-9,064	0,000
d(lnopen)	0,051	0,019	2,769	0,039
d(lnopen(-1))	-0,099	0,025	-4,007	0,010
ect	-1,281	0,090	-14,247	0,000

Note: The dependent variable is D(LNRGDP). Sample: 1981 to 2016. Included observations: 36. R-squared: 0.925; DW: 2.038. LM= 1,245[0,404]. RESET: 0,803[0,421]. Normality: 1,363[0,506]. ARCH: 1,47[0,259]. White: 0,781[0,699].

The potency of the estimated model is validated by the satisfactory performance of the diagnostic tests. The high R-square value of about 0,92 shows the high power of the independent variables in explaining growth. The autocorrelation LM tests reveal the absence of serially correlated residuals. The ARCH and White tests for heteroscedasticity reveal that the innovations have constant variance over time. While the Jarque-Bera tests show that the residuals are normally distributed, the Ramsey RESET test shows that the model is well specified. Finally, the CUSUM and CUSM of squares tests reveal that the models'

coefficients are dynamically stable as they fall within the 5% critical bounds. These imply that our results are valid for drawing policy inferences.

Figure 5. Parameter Stability of NARDL Model (Oil Price Shocks)



7. Concluding Summary and Policy Implications

Several studies have documented the vulnerability of the Nigerian economy to global oil market volatilities and exchange rate shocks. These issues affect long term growth and constrain macroeconomic policy space. Therefore, this paper examined the asymmetric impact of oil price and exchange rate on economic growth using annual data between 1981-2016. The study established that accounting for asymmetries matter. The empirical analysis reveals that there exists a long-run association between exchange rate, oil price and growth in Nigeria. The results also suggest that an exchange rate depreciation exerts a significant positive long-run effect on growth. Contrary to expectation, a fall in the price of oil had a positive impact on growth while higher oil prices slowed down growth. This result does not only suggest that the Dutch disease syndrome holds, but also reflects the inability of the government to build up fiscal buffers and savings during the review period. The positive and significant impact of capital and labor on long term growth makes a case for sustained capital investment and scaling up human capital development to sustain productivity growth. In the short run, fluctuations in oil price affect growth distinctly as positive shocks boost short-term growth while negative shocks produce the reverse effect. The results also show that positive exchange rate shocks (depreciation) exert a positive impact

while an appreciation of the domestic currency has a negative impact on short-run growth in Nigeria. The findings make a case for more coordinated policy responses to the vagaries of global crude oil prices and foreign exchange rate market. The government could consider ramping up efforts towards building fiscal buffers by diversifying the sources of domestic revenue. Further, exchange rate adjustments could be reconsidered to stimulate export competitiveness, spur long term growth, promote diversification efforts, and minimize pressure on the foreign exchange market and external reserves. Furthermore, the intermediation role of the financial system needs to be strengthened to help support long-run growth and absorb shocks. The link between shocks and expectation is an important issue, given the finding that asymmetries matter, and thus remain an important agenda for future research.

Peer-review: Externally peer-reviewed.

Conflict of Interest: The author has no conflict of interest to declare.

Grant Support: The author declared that this study has received no financial support.

Hakem Değerlendirmesi: Dış bağımsız.

Çıkar Çatışması: Yazar çıkar çatışması bildirmemiştir.

Finansal Destek: Yazar bu çalışma için finansal destek almadığını beyan etmiştir.

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APPENDIX

Table A1: The Data

sn	Variable	Description	Source
1	GDP per capita	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. Data are in current local currency.	World development indicators (WDI), world bank.
2	Oil price (ops)	Landed Costs of Nigerian Bonny Light Crude Oil. The price of crude oil stated in US dollars sold per barrel in the international market.	US Energy Information Administration.
3	Exchange rate (exr)	It is the price of a currency expressed in terms of one unit of another country's currency. It is measured as the exchange rate of the naira to the US dollar	World development indicators (WDI), world bank.
4	Gross fixed capital formation (gfcf)	This includes land improvements, plants, machinery and equipment.	World development indicators (WDI), world bank.
5	Labour force (lab)	This is the total number of the working population within the age range 15-64.	World development indicators (WDI), world bank.
6	Infrastructure (infra)	The sum of mobile cellular telephone subscriptions and fixed telephone subscriptions.	Compiled using data from World development indicators (WDI), world bank.
7	Openness (open)	This is the level of trade openness measured as the ratio of the summation of import and export to the gross domestic product.	Compiled using data from World development indicators (WDI), world bank.
8	Government Expenditure (gexp)	General government final consumption expenditure on goods and services (including compensation of employees). Data are in current local currency.	World development indicators (WDI), world bank.
9	Financial development (findev)	This variable is computed as the ratio of broad money (M2) to GDP.	Compiled using data from World development indicators (WDI), world bank.