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Oil Revenue Shocks and the Current Account Balance Dynamics in Nigeria: New evidence from Asymmetry and Structural Breaks

Ismail O. Fasanya[a], Abiodun Adetokunbo[b], Felix O. Ajayi[c]

[a]Department of Economics, Augustine University, Epe, Lagos, and Center for Econometric and Allied Research, University of Ibadan, Ibadan, Nigeria. Email:fascojnr@yahoo.com
[b]Department of Economics, Augustine University, Epe, Lagos
[c]Department of Economics, Olabisi Onabanjo University, Ago-iwoye, Ogun State, Nigeria

Abstract

In this paper, we model the relationship between oil revenue and current account balance dynamics in Nigeria using quarterly data from 1987Q1 to 2015Q4. We employ both the Linear ARDL and Nonlinear ARDL models and we also account for multiple structural breaks using a test that allows for multiple structural changes in regression models. The following were noticed from our analyses. First, we observe the existence of an asymmetric effect on the current account balance both in the short and long run. Second, accounting for structural breaks play an important role when modelling the relationship between oil revenue and current account balance. Third, the paper finds that oil revenue has a significant positive effect on current account balance, however, puzzling that both positive and negative shocks affect the current account balance in the same manner. Overall, the positive changes in oil revenue have considerably larger impact than negative changes. The implications for policy are designed based on gathered findings.

Keywords: Oil revenue, Current account balance, Price asymmetry, Nigeria.
JEL Classifications: C51; F32; Q43

1. Introduction

Oil is arguably a prominent source of energy because of the important role it plays as an energy input in the production process across the globe. Given the importance of oil as a globally traded commodity and the unpredictability of its price, oil price shocks could explain the emergence of large external imbalances across the globe. Since the seminal work of Hamilton (1983), several studies have focused on the relationships between oil price change and macroeconomic fundamentals[1]. More recently, the emphasis has shifted to the linkages between oil prices and external imbalances (see inter alia, Bollino 2007; Kilian et al. 2009; Ozlale and Pekkurnaz 2010; Le and Chang, 2013; Chuku et al., 2011; Allegret et al., 2014; Aregbeyen and Fasanya, 2017; Gnimassoun et al., 2017). These studies have produced mixed

[1] Macroeconomic fundamentals have a wide coverage and it is difficult to pinpoint a particular proxy that would be all-encompassing. Based on survey of the literature on oil price, variables that have been captured under macroeconomic fundamentals include exchange rate, inflation, real interest rate, stock price, industrial production and economic growth.

conclusions. Hence, there is need to consider further evidence on the link between oil and current account balance.

Despite the rapidly increasing literature on the relationship between oil and external balance, few studies have been considered in developing countries (see for example, Ozlale and Pekkurnaz 2010; Chuku et al., 2011). In addition, little attention has been devoted to the role of oil revenue in the external adjustment of a country's trade. Unlike most existing studies, this paper intends to examine the relationship between shocks in oil revenue and current account balance in Nigeria.

Since the discovery of oil in commercial quantity in Nigeria and the oil boom of 1970s, oil has dominated the economy of the country. Oil accounts for more than 80 percent of government total revenue and about 65% of budgetary revenue. As a result, the economy of the country has been substantially unstable, a consequence of the heavy dependence on oil revenue, and the volatility in prices (Fasanya and Onakoya, 2013; Aregbeyen and Fasanya, 2017; Fasanya and Ogundare, 2018). The oil boom of the 1970s led to the neglect of agriculture and other non-oil tax revenue sector, expansion of the public sector, and deterioration in fiscal discipline and accountability (Fasanya et al., 2013). In turn, oil-dependence exposed Nigeria to the vagaries associated with oil price volatility which threw the country's public finance into disarray (Aliyu, 2009).

The inefficiency of the oil sector, theft, corruption, sabotage majorly by the Niger-Delta militant, lack of political transparency, mismanagement of funds and political unrest are the major internal factors which are endogenous to the Nigeria economy and affecting the quantity supply of oil. While oil price fluctuations, international wars and conflicts (such as the Yom-Kippur or the Arab-Israel Conflict of 1973, Gulf War of 1991, etc.), consensus of the Organization of Petroleum Exporting Countries (OPEC), global depressions (such as the global financial crisis of 2008) are some of the external factors affecting the Nigeria oil revenue and are exogenous to her economy. Although the effect of other factors affecting oil revenue cannot be relegated, oil revenue in Nigeria is majorly influenced by oil price whose fluctuations are highly volatile and are exogenously determined. Hence, it cannot be underrated that oil revenue shock is a problem to the current account balance of Nigeria since oil exports constitute the bulk of her foreign earnings.

The motivation of this study, relative to existing studies is in two-fold. First, we account for asymmetries in the model using the nonlinear autoregressive distributed lags (NARDL) approach proposed by Shin et al (2014). The main advantage of this model lies in its ability to simultaneously capture the short- and long-run asymmetries through positive and negative partial sum decompositions of changes in the independent variable(s) [see Qin, 2016; Nusair, 2016; Van Hoang et al., 2016]. In addition, the approach is easy to compute and also has computational advantages over other models[2] particularly in terms of dealing with time series of different orders of integration. Nonetheless, we also consider the symmetric version of the Shin et al (2014) developed by Pesaran et al (2001) in order to validate if asymmetry matters for modelling the relationship between oil revenue and current account balance. Second, we modify the Shin et al. (2014) to account for structural breaks in the model as there appears to be evidence of some notable shifts in the series [see Figure 1]. Not paying attention to these breaks may generate spurious results [see, inter alia, Salisu and Fasanya 2013; Salisu and Oloko, 2015]. To account for this, Bai-Perron (2003) structural break test is applied which allows for up to five breaks that are determined endogenously. These breaks are included in the estimation procedure to account for possible shifts that may produce bias result. Overall,

[2] Such as the Bayesian VECM or various other specifications of the error-correction models and smooth transition autoregressive models

the regression model is presented in four different sections: (i) Symmetric (Linear) ARDL without structural breaks; (ii) Symmetric ARDL with structural breaks; (iii) Asymmetric (Nonlinear) ARDL without structural breaks; and (iv) Asymmetric ARDL with structural breaks. To the best of our knowledge, there is not a single literature that investigates the oil revenue–current account relation for an oil-exporting developing economy like Nigeria. And if at all they exist, no study we are aware of has simultaneously captured both the asymmetry effect and structural break in modelling this nexus.

Presaging the main finding from this study, there exists a positive relationship between current account balance and each of positive and negative changes in oil revenue. The short-run relationships are maintained even in the long-run although with increased magnitude of effects.

The remainder of this paper is organised as follows. Section two reviews related papers to the topic. In section three, the theoretical framework is pursued while section four considers the methodology and data. The empirical results are covered in section five and section six concludes the paper.

2. Review of relevant studies

There is huge number of studies that examines the effects of oil price shocks on current account balances for both developed and developing countries. However, the results overtime have been mixed. While studies like Khan and Knight (1983), Zaouali (2007), Narayan and Wong (2009), Morsy (2009), Beidas-Strom and Cashin (2011), Kilian and Vigfusson (2009) affirm that there is positive relationship between oil price and current account balance, studies like Kilian et al., (2007), Ozlale and Pekkurnaz (2010), Schubert (2009) provide evidence that there is negative relationship between oil price and current account balance. This section thereby provides a synopsis of these empirical studies into the relationship between oil revenue and current account balance.

Examining the Turkish economy, Ozlale and Pekkurnaz (2010) analysed the impact of oil prices on the current account balances using a structural vector auto regression model. The result showed that the response of current account ratio to oil price shock increases gradually up to the first three months and then starts to decrease, which indicated a significant effect of oil price shocks in the short-run. Moreover, when the obtained structural shocks were employed in a simple regression analysis, the parameter regarding the oil price shocks was found to be negative and statistically significant.

In a study for the middle income countries including Latin America and emerging Asia, Kilian et al., (2007) estimated net foreign asset position. They discovered that the current account deteriorates significantly in response to oil supply shocks. Contrary to their earlier study, Kilian and Vigfusson (2009) examine the dynamic effects of oil demand and oil supply shocks on external balances of developing oil-exporting and oil-importing economies during 1975–2006 and observed the current account balance depends on the source of the shock, and the response of the non-oil trade balance.

An influential study by Narayan and Wong (2009) investigated the determinants of oil consumption for Australian states and territories over the period 1985 to 2006. Investigating the long-run relationship among oil consumption, oil prices and state income, the study found that with the variables panel co-integration, oil prices have had a statistically insignificant impact on oil consumption, but income has had a positive and statistically significant effect on oil consumption in the long run. This has also earlier been confirmed by Zaouali (2007) focusing on the Chinese economy, concluded that positive oil price shocks have modest effects on the current account because the Chinese economy could attract foreign capital and investment.

In a study of 32 non-oil developing countries between 1973 and 1980, Khan and Knight (1983) examined the effects of external and domestic factors on the current account. The study points out that oil price increases in 1979 to 1980 appears to have a much smaller impact on the current account of non-oil developing countries than did the earlier increase. They concluded that external factors as well as domestic factors were statistically significant and relevant factors in explaining the current account imbalances. Morsy (2009) investigated the effects of fiscal balance, demographic factors, net foreign assets, oil balance, oil wealth, economic growth and degree of maturity in oil production on the current account balance for 28 oil exporting developing countries using dynamic panel estimation techniques. The empirical results showed that fiscal balance, oil balance, oil wealth, age dependency ratio and the degree of maturity in oil production have statistical and economical significant effect on the current account balance for the selected developing countries.

Beidas-Strom and Cashin (2011) estimated the medium-term current account position for emerging markets, low-income and fragile economies, and oil exporting countries. The study found that fiscal balance is an important current account fundamental and the current account balance responds positively to the oil balance in all group of countries selected. However, Schubert (2009) investigated the effects of oil price shocks on internal and external economic performance of a small open economy with particular focus on permanent increases in oil price. The findings were that after an oil price increase, the current account exhibited the J-curve property by first deteriorating for a while and then improving. Some studies have investigated the oil price–current account dynamics with a focus on emerging market economies.

For a study on Nigeria, Chuku et al (2011) points out that oil price shocks have a significant short run effect on current account balances. The study posits that there is an incomplete pass through from oil prices to current account balances, which can be explained by the offsetting variations in non -oil trade balances as a result of improvement in terms of trade (a consequence of the Dutch diseases). Similarly, Uneze and Ekor (2012) discovered that oil wealth has a significant negative effect on the current account balance in the long-run. Also, that oil price has significantly positive effect on the current account balance in the short run. In another study, Yusuf (2015) affirmed that with the use of Structural vector auto-regression, using the impulse response functions (IRFs) and Variance decompositions (VDCs) indicates that the response of oil price shocks and unrest to current account balance depicts both negative and positive impacts, which means that long run impact on Current account balance exists. The study also finds that oil price, exchange rates, agricultural outputs and social unrests, contain some useful information in predicting the future path of economic growth in Nigeria.

The previous studies were of great good, however, most of the studies done in Nigeria have not empirically examine the effect of oil revenue shocks on the current account balance considering the role of structural breaks and asymmetry, which is a major thrust of this study. Hence, this study is an unassuming attempt in this regard to fill the gap.

3. Theoretical Foundation

The theory underpinning the analysis of current account dynamics is well developed using the Keynesian theory of income (see inter alia, Trehan and Walsh, 1991; Appleyard and Field, 2001; Chuku et al., 2011 and Taylor, 2002) which this paper also employs. However, a brief survey of some basic theoretical definitions and notations will prove useful for this study. If we define gross domestic product (GDP), Q as the sum of goods produced, which, with imports M, may be allocated to private consumption C, government spending G, investments I or exports X, then

$$Q + M = C + I + G + X \tag{1}$$

Rearranging, GDP is given as

$$\text{GDP} \equiv Q = C + I + G + (X - M) \tag{2}$$

Where: (X - M) is net exports.

In reality, X consists of all the credit items in the current account, while M consists of all the debit items in the current account. To obtain the current account balance, we rearrange Equation (2) with (X - M) on the right-hand side; thus,

$$Q - (C + I + G) = (X - M) \tag{3}$$

This rearrangement indicates that the current account balance is simply the difference between the GDP of a country (Q) and the gross expenditure by the country's residence (C + I + G) during the same time period. If a country has a current account deficit (i.e. $X - M < 0$), then it means that a country is spending more than its income and is living above its means, that is, $C + I + G > Q$. This was the case in Nigeria during the 1980s and early 1990s. On the other hand, if a country has a current account surplus, (i.e. $X - M > 0$), then the country is spending less than its income, and $Q > C + I + G$. This has been the case with Japan since 1981 (Appleyard and Field, 2001). Alternatively, distortions in the current account dynamics can better be appreciated if we express the national income identity using the savings–investment approach. Hence, GDP can be expressed as

$$\text{GDP} \equiv Q = C + S + T \tag{4}$$

Where: S is savings and T is taxes.

Substituting equation (2) into equation (4), equation (5) results and it implies that income from output can be used for consumption (including imports), savings and paying taxes.

$$C + I + G + (X - M) = C + S + T \tag{5}$$

Rearranging further and collecting like terms,

$$(X - M) = S + (T - G) - I \tag{6}$$

If (T - G) is government savings, then the current account balance (X - M) is the difference between a country's savings and the country's investments. Thus, a current account deficit implies that a country is saving less than it invests.

Thus, equation (6) is the model derived from the Keynesian theory of income. Following the above analysis, the following model is generated in general form:

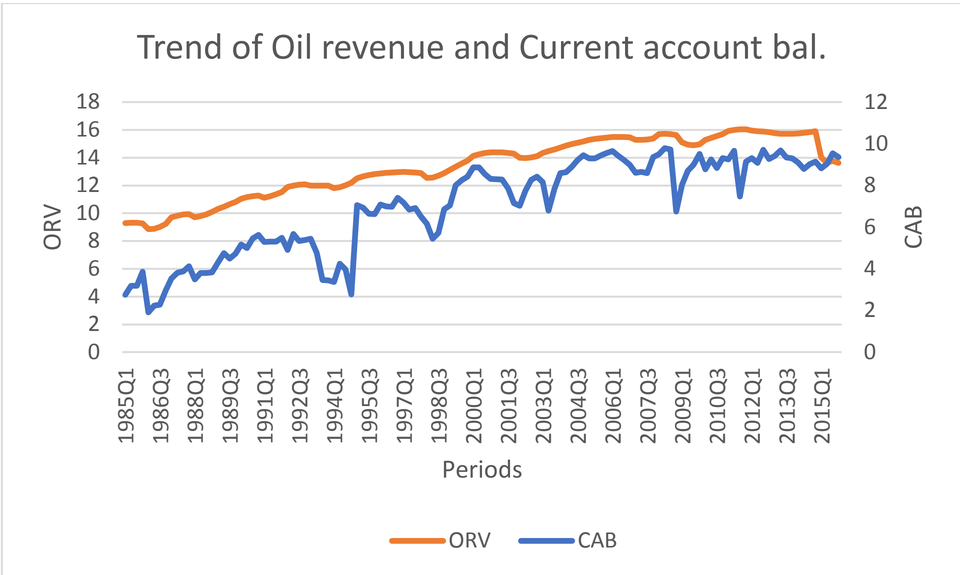
$$CAB_t = \beta_0 + \beta_1 ORV_t + \mu_t \tag{7}$$

4. Data and Methodology

4.1 Data Sources and Description

This study covers the oil revenue and current account balance (CAB). The sample period runs from 1987Q1 to 2015Q4. Oil revenue is deflated by the domestic consumer price index (CPI) while CAB is a percentage of index of industrial production (IIP). IIP is used to capture economic activity (GDP) due to inability to get high frequency data for GDP. Data on the quarterly oil revenue, index of industrial production and current account balance (CAB) come from Central Bank of Nigeria (CBN) Statistical bulletin, CPI were obtained from IMF Database respectively. A plot of the oil revenue and current account balance as a percentage of IIP is shown in fig. 1. It shows an upward trend in the value of oil revenue in Nigeria from 2000 to 2014 except for the downward fall in 2015. However, for the periods between 1979 and 1981 Nigeria experienced surplus in its current account balance majorly as a result of substantial rises in crude oil prices. Outside these years, the country's current account showed a deficit pattern over the period 1982-1983. The following three years marked current account surpluses to the magnitude of 10.6%, partly reflecting the tightening of trade controls during 1983-1986 periods when the government introduced the Economic Stabilization Act of 1982 and the National Economic Emergency Act of 1985. These austerity measures emphasized reduction in aggregate absorption, without much focus on structural issues. Between 1987 and 1988, the country experienced deficit followed by current account surplus for the period 1989-1992. However, the following three years recorded deficits, followed by current account surplus up to 1997. Except for 1998, the country has been recording a current account surplus up to 2011 with a peak of 32.5% in 2005. Hence, a fall in the world oil price account for the drop in current account experienced by Nigeria in the late 1980s and early 1990s.

Figure 1. Oil revenue and Current account balance



4.2 Methodology

The methodological innovation of this study is that we employ the recently developed NARDL model of Shin et al. (2014) to examine the short run and long-run asymmetrical effects of oil revenue shocks on the current account balance of Nigeria. The NARDL model is an asymmetric expansion of the linear ARDL model of Pesaran et al. (2001), which is a single cointegration and error correction approach. The advantages of using the NARDL approach are well documented in the works of Van Hoang et al. (2016) and Nusair (2016). First, it allows modelling the long run relation that could exist between the endogenous and exogenous variables. Second, non-linear relationship can be determined. Third, it differentiates between the short- and long-run effects from the exogenous variable to the endogenous variable. Although, these three advantages may also be valid for non-linear threshold Vector Error Correction Models (VECM) or smooth transition models, but these models may suffer from the convergence problem due to the escalation of the number of parameters. This is not the case with the NARDL model. Fourth, unlike other error correction models (such as the VECM) where the order of integration of the considered time series should be the same, the NARDL model relaxes this restriction and allows series with fractional integration orders, i.e. I(0) and I(1).

4.2.1 Symmetric ARDL without structural breaks

For the purpose of robustness, however, this paper considers both the linear (symmetric) ARDL and non-linear (asymmetric) ARDL (with and without breaks) in order to validate the possibility of differences in the estimates of the two models. Since the NARDL model is a non-linear expansion of the symmetric ARDL, it is useful to start by presenting the symmetric ARDL model. The Linear ARDL without structural breaks can be written as:

$$\Delta CAB_t = \vartheta_0 + \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} \beta_i \Delta ORV_{t-i} + \vartheta_1 CAB_{t-1} + \vartheta_2 ORV_{t-i} + \varepsilon_t \qquad (8)$$

where CAB_t is the percentage of current account balance to GDP; ORV_t is the logarithm of oil revenue. ε_t is white noise error term, $-\frac{\vartheta_0}{\vartheta_1}$ and $-\frac{\vartheta_2}{\vartheta_1}$ are the long-run coefficients for the intercept and the slope respectively, and α_i and β_i are the short run coefficients. p and q are the optimal lags on the first-differenced variables selected by some information criteria, such as Schwarz Information Criterion (SIC) or Akaike Information Criterion (AIC). The linear approach for the long-run relationship between CAB and ORV is based on the Wald test (F statistic) by imposing restrictions on the long-run estimated coefficients of one period lagged level of CAB and ORV to be equal to zero, that is, the null hypothesis of no cointegration states that $H_0: \vartheta_1 = \vartheta_2 = 0$, is tested against the alternative hypothesis of $H_0: \vartheta_1 \neq \vartheta_2 \neq 0$. Then the calculated F-statistic is compared to the tabulated critical value (Pesaran et al, 2001). They compute two critical values bounds for any significance level: a lower value that assumes all variables are I(0), and an upper value that assumes all variables are I(1). If the calculated F-statistic is greater than the upper bound, there is cointegration; if it is less than the lower bound, there is no cointegration and if it lies in between the two bounds, then, the test is considered inconclusive.

However, to restore equilibrium immediately may not be possible because of the speed of adjustment. This could be caused by the lags and adjustment process used to capture changes in any of the factors affecting current account balance or oil revenue overtime. Hence, the error correction model can be used to capture the speed of adjustment which defined as λ in the model (9) expressed below:

$$\Delta CAB_t = \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} \beta_i \Delta ORV_{t-i} + \lambda \, ECT_{t-1} + \nu_t \qquad (9)$$

4.2.2 Symmetric ARDL with structural breaks

We extend the model in equations (8) and (9) to include endogenous structural breaks. The model is then specified below:

$$\Delta CAB_t = \vartheta_0 + \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} \beta_i \Delta ORV_{t-i} + \vartheta_1 CAB_{t-1} + \vartheta_2 ORV_{t-i} + \sum_{r=1}^{s} D_r B_{rt} + \varepsilon_t \tag{10}$$

As shown in equation (10), the breaks are captured with the inclusion of $\sum_{r=1}^{s} D_r B_{rt}$ where B_{rt} is a dummy variable for each of the breaks defined as $B_{rt} = 1$ for $t > T_B$, otherwise B_{rt} =0. The time period is represented by t; T_B are the structural break dates where r =1, 2, 3,….., k and D_r is the coefficient of the break dummy. All the other parameters have been previously defined. As earlier noted, the Bai-Perron (2003) test which determines breaks endogenously is used. This test is relevant when dealing with models with probable multiple structural changes over time. Apart from computational simplicity, the test allows for up to five (5) breaks in the regression model and is therefore considered a more general framework for detecting multiple structural changes in linear models. We also test for the existence of long run relationship in the presence of structural breaks using the ARDL test. In essence, we are also able to determine long run and short estimates for the real oil revenue – current account balance dynamics in the presence of structural breaks. In addition, the results obtained are compared with those from equation (8) to see if accounting for breaks in the regression is necessary. Subsequently, the Wald test is used to test for the joint significance of structural breaks in equation (10). That is, we test $\sum_{r=1}^{s} D_r = 0$ against $\sum_{r=1}^{s} D_r \neq 0$. The rejection of the null hypothesis implies that the breaks are important and should be included in the model, hence, suggesting the adoption of equation 3 while the non-rejection implies that structural breaks do not matter in the symmetric case.

4.2.3 Asymmetric ARDL without structural breaks

To examine the role of asymmetries in the model, cointegrating NARDL model of Shin et al. (2014) that accommodates the potential short- and long-run asymmetries would be of great interest. In actual fact, this model uses the decomposition of the independent variable orv_t into its positive oil revenue changes and negative oil revenue changes. This is premised on the fact that economic agents may respond differently to positive and negative changes in oil revenue. The decomposed oil revenue (orv) Δorv_t+ and negative Δorv_t- partial sums for increases and decreases such as:

$$ORV_t^{+} = \sum_{j=1}^{t} \Delta ORV_j^{+} = \sum_{j=1}^{t} \max(\Delta ORV_j, 0) \tag{11}$$

$$ORV_t^{-} = \sum_{j=1}^{t} \Delta ORV_j^{-} = \sum_{j=1}^{t} \min(\Delta ORV_j, 0) \tag{12}$$

Given the definitions in (11)–(12), Shin et al. (2014) show that the linear ARDL model (8) can be modified to account for asymmetries to produce the following nonlinear ARDL model:

$$\Delta CAB_t = \vartheta_0 + \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} ({\beta_i}^{+} \Delta ORV^{+}{}_{t-i} + {\beta_i}^{-} \Delta ORV^{-}{}_{t-i}) + \vartheta_1 CAB_{t-1} + {\vartheta_2}^{+} ORV^{+}{}_{t-1} + {\vartheta_2}^{-} ORV^{-}{}_{t-1} + \epsilon_t \tag{13}$$

Equation (13) can be rewritten to include error correction term as:

$$\Delta CAB_t = \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} ({\beta_i}^{+} \Delta ORV^{+}{}_{t-i} + {\beta_i}^{-} \Delta ORV^{-}{}_{t-i}) + \delta\, ECT_{t-1} + \mu_t \tag{14}$$

where $ECT_{t-1} = CAB_{t-1} - \omega^{+} ORV^{+}{}_{t-1} - \omega^{-} ORV^{-}{}_{t-1}$ is the non-linear error correction term; the parameter δ is the speed of adjustment while the underlying long run parameters are defined as $\omega^{+} = -\frac{{\vartheta_2}^{+}}{\vartheta_1}$ *and* $\omega^{-} = -\frac{{\vartheta_2}^{-}}{\vartheta_1}$ and the associated short-run adjustment to positive and negative changes in oil price are captured by ${\beta_i}^{+}$ *and* ${\beta_i}^{-}$ respectively.

Just like the linear ARDL, the long run is estimated only if there is presence of cointegration. The NARDL also involves the Bounds testing that is *F* distributed. But in this case, the null hypothesis of no cointegration expressed as $H_0: \vartheta_1 = {\vartheta_2}^{+} = {\vartheta_2}^{-} = 0$ is tested against the alternative hypothesis of cointegration given as $H_1: \vartheta_1 = {\vartheta_2}^{+} = {\vartheta_2}^{-} = 0$. Furthermore, we test for the long run and short-run symmetry, using standard Wald test. For long run symmetry, the relevant null hypothesis of no asymmetries is defined as $H_0: {\vartheta_2}^{+} = {\vartheta_2}^{-} = 0$ tested against the alternative (presence of asymmetries) $H_1: {\vartheta_2}^{+} \neq {\vartheta_2}^{-} \neq 0$. The short-run additive symmetry can also be tested with the null hypothesis (no asymmetries) $H_0: \sum_{i=0}^{q} {\beta_i}^{+} = \sum_{i=0}^{q} {\beta_i}^{-} = 0$ which is tested against the alternative presence of asymmetries $H_1: \sum_{i=0}^{q} {\beta_i}^{+} \neq \sum_{i=0}^{q} {\beta_i}^{-} \neq 0$.

4.2.4 Asymmetric ARDL with structural breaks

Introducing structural breaks into the NARDL framework, we extend equation (13) to include the relevant break dummies.

$$\Delta CAB_t = \vartheta_0 + \sum_{i=1}^{p} \alpha_i \Delta CAB_{t-i} + \sum_{i=0}^{q} ({\beta_i}^{+} \Delta ORV^{+}{}_{t-i} + {\beta_i}^{-} \Delta ORV^{-}{}_{t-i}) + \vartheta_1 CAB_{t-1} + {\vartheta_2}^{+} ORV^{+}{}_{t-1} + {\vartheta_2}^{-} ORV^{-}{}_{t-1} + \sum_{r=1}^{s} D_r B_{rt} + \varepsilon_t \tag{15}$$

The definitions of the parameters still follow the sequence of the earlier models. We also conduct structural break test to ascertain the significance of including the breaks in the NARDL model. Besides, we also use the F- distributed Bound test to confirm the presence of long run relationship and the Wald test was equally used to verify the role of asymmetry in the presence of structural breaks.

5. Empirical Results

As this study involves time series data, the ordinary least square (OLS) method cannot be applied unless it is established that the variables concerned are stationary. For this paper, we have applied unit root test to check the stationarity of the variables under study. Specifically, the Dickey Fuller GLS, Ng Perron and the break unit root test are applied. The unit root test results reported in the tables below reveals that the series of the examined variables are stationary as the null hypothesis that the series of each of these variables has a unit root cannot be rejected at any of the chosen level of significance (1%, 5% and 10%). The table shows that the series of current account balance is stationary at level, thus CAB is said to be an I(0) series. Oil revenue is revealed to be only stationary at first difference i.e an I(1) series.

Table 1: Unit Root Tests

	Without Breaks	
Method	CAB	ORV
Dickey-Fuller GLS	-3.6681***a	-8.0356***b
Ng-Perron	-20.0561**a	-55.4311***b
	With Breaks	
Perron–Vogelsang test	-7.39***a	-9.43***b
(Break Date)	(2008Q3)	(2014Q3)

Source: Authors Computation

Note: a and b indicate stationarity at level and stationarity at first difference respectively. ** and *** represents statistical significance at 5% and 1% respectively.

However, for the purpose of clarification and more understanding of the paper, it is necessary to show how the role of the structural breaks in modelling the relationship between oil revenue on current account balance which is also an objective of this study is actually accounted for and to show when the breaks in the model estimated below actually occurred.

Table 2: Bai-Perron (2003) structural break dates

SYMMETRY BREAKS	PERIOD OF BREAK	EVENTS DURING THIS PERIOD
D1	1989Q4	Saudi Arabia abandons swing role leaving oil prices low at around $30 per barrel mark until another event in the gulf changed the prices.
D2	1995Q1	OPEC increase of members export quota by 10% across board.
ASYMMETRY BREAKS		
D1	1989Q4	Saudi Arabia abandons swing role leaving oil prices low at around $30 per barrel mark until another event in the gulf changed the prices.
D2	1995Q1	OPEC increase of members export quota by 10% across board.
D3	2009Q3	OPEC spare capacity fell and created panic within the market, pushing prices up to above U$100 in 2008 and beyond till when the global financial crisis began to set in and began to put downward pressure on prices again.

Source: Authors Computation

The period of break above is discovered with the use of Bai-Perron (2003) technique. D1 and D2 are the only breaks that occurred in the linear ARDL, i.e. without the decomposition of the oil revenue, but the other group D1, D2 and D3 are breaks in the Nonlinear ARDL i.e. after the decomposition of the oil revenue. Interpreting from the break periods, the period of break in the linear ARDL is same as break in the non-linear ARDL except for an additional break of D3 to the Nonlinear ARDL breaks.

In order to ensure robustness in the analysis of this study and to determine precisely the impact of oil revenue on the current account balance of Nigeria and also to account for structural breaks in the model, four equations are estimated as follows, the symmetric ARDL (linear ARDL), symmetric ARDL with structural breaks, asymmetric ARDL (non-linear) and lastly the asymmetric ARDL with structural breaks. Following the result of the unit root test and the Bounds co-integration test (included in the regression table), both long run (static) model and short run (dynamic) model are estimated for the all the equations. The results are presented thus:

Table 3: Regression Results

Variable	Symmetry without Breaks	Symmetry with Breaks	Asymmetry without Breaks	Asymmetry with Breaks
Long-run Results				
C	-5.7156***(0.4552)	-4.2491***(0.7037)	-8.0313***(1.2390)	-4.5336***(0.8505)
ORV^+	-------------	-------------	1.2155***(0.1268)	0.8414***(0.0860)
ORV^-	-------------	-------------	1.1944 (0.1294)	0.8147***(0.0863)
ORV	0.9550***(0.0331)	0.7943***(0.7057)	-------------	-------------
@TREND	-------------	-------------	-0.0167**(0.0008)	-------------
D1	-------------	0.1220(0.2912)	-------------	0.0754(0.3078)
D2	-------------	0.9424**(0.3971)	-------------	0.7612**(0.4388)
D3	-------------	-------------	-------------	0.6435(0.5645)
Wald (Asymmetries)	-------------	-------------	3.5578(0.0621)	-2.8786***(0.0049)
Wald (Joint F-test)	-------------	3.7793**(0.0261)	-------------	2.0710(0.1088)
Short-run Results				
C				
ΔORV^+	-------------	-------------	0.9338***(0.1418)	0.6378***(0.1000)
ΔORV^-	-------------	-------------	0.9175***(0.1436)	0.6176***(0.1010)
ΔORV	1.7939***(0.3670)	1.7655***(0.3596)	-------------	-------------
Δ@TREND	-------------	-------------	-0.0128**(0.0064)	
D1	-------------	0.0913 (0.2175)	-------------	0.0571(0.2330)
D2	-------------	0.7050**(0.2945)	-------------	0.5769**(0.3291)
D3	-------------	-------------	-------------	0.4877(0.4237)
ECM_{t-1}	-0.7224***(0.0794)	-0.7481***(0.0779)	-0.7682***(0.0818)	-0.7579***(0.0806)
F-Stat	544.51***	345.85***	407.22***	272.41***

Bound F-Stat	41.589***	47.550***	25.354***	28.958***
Adj. R^2	0.9389	0.9420	0.9388	0.9389
DIAGNOSTICS				
LM(1)	0.9284[0.3985]	0.6012[0.5501]	1.5443 [0.2185]	2.0502[0.1342]
ARCH(1)	0.1743[0.6772]	0.0298[0.8632]	0.1945[0.6602]	0.0687[0.7968]
Ramsey test	3.8330[0.0530]	1.1394[0.2884]	0.9760[0.3255]	1.3961[0.2402]
Lag Selection (SIC)	(1,1)	(1,1)	(1,1,1)	(1,1,1)
Wald (Asymmetries)	-------------	-------------	3.5570***(0.0621)	2.4206**(0.0173)
Wald (Joint F-test)	-------------	3.5346**(0.0328)	-------------	1.9408(0.1279)

Source: Authors Computation

Note: Standard errors are presented in parenthesis and probability values are presented in square brackets. Trend is included only if significant at 10%. The critical values for the Lower and Upper Bounds respectively are 6.84 and 7.84 at 1% significance level. D1-D3 represents dummies for corresponding break dates as identified in the Bai-Perron test. ORV^+ and ORV^- respectively capture positive and negative changes in oil revenue ***, **, and * indicate statistical significance at 1%, 5% and 10% respectively.

The bounds test result shows that there exists cointegration because the bounds F-statistics value is greater than the I(0) and I(1) series, the study then proceeds to presenting both the short run and long run result for all the models.

For the case of the symmetric model, oil revenue affects current account balance positively both in the short run and long run. As oil revenue increases, current account balance increases as well. The results further indicate that for every 1% positive change in the revenue generated from oil, current account balance improves by about 0.95% and 1.79% in short run and long run respectively. When structural breaks are considered, the results are not too different from when breaks are not considered. In both short run and long run, positive relationship still results between oil price and current account balance in Nigeria. The only difference relates to the magnitude of effects, thus confirming the need to regard the role of structural breaks in the model. Current account balance increases by about 0.79% and 1.77% in long run and short run respectively for every 1% increase in oil price wealth. These results corroborate the findings of Yusuf (2015) and Uneze and Ekor (2012) only in the short run, however differ in a longer period. This could be as a result of not accounting for the role of structural breaks in modelling this relationship. More so, the study by Yusuf (2015) acknowledges the fact that the nexus between oil wealth and economic growth is through a productive and healthy current account balance but couldn't identify the link between oil wealth and current account balance in Nigeria. Interestingly, we show that while oil revenue have an impact on current account balance in the short-run, their impact is stronger in the long-run, hence, we can easily prove that this relation changes as time passes. Meanwhile, the positive relationship found between the current account balance and the structural break of 1995Q1 (D2) can be explained with an effect from the increase of export quota for OPEC members by 10% during this period. This allowed higher exports of crude oil by Nigeria, thus increasing her export revenue from oil and subsequent increase in the balance of the current account.

The asymmetric models are also presented to determine if positive and negative oil price changes matter. Without accounting for structural breaks, positive oil price change drive current account balance in both short run and long run, while negative oil revenue change matters only in the short run. As evidently seen, a 1% positive change in oil revenue raises current account balance by 0.93% in the short run and 1.22% in the long run, while the short value of the current account balance improves by 0.92% given a 1% negative change in oil revenue. Although positive relationship is also found between the series when asymmetric effects are considered just as the case of the symmetric effect, asymmetry proves important as can be seen that negative oil revenue change does not matter in the long run. The result further proves the validity of the structural breaks by indicating that the elasticity of current account balance to positive oil revenue change is higher in the long run compared to what is suggested by the symmetric model where current account balance is more responsive to oil revenue in the short run. Meanwhile, the asymmetric model shows that the decomposed oil revenue (both positive and negative changes in oil revenue) affects current account balance positively in the two periods. In the short run, a 1% increase in each of positive and negative oil revenue changes will cause current account balance to rise by 0.64% and 0.62% respectively, and 0.84% and 0.81% respectively in the long run. The estimates are lower for both short run and long run in this case, but with lower response of current account balance in the short run also, thus proving the importance of structural breaks in the asymmetry model. Also, except for the 1995Q1 break (D2), all the structural breaks play no significant role in affecting the balance of the current account.

Considering the Wald tests, the null hypothesis of a symmetric effect of oil revenue is rejected and we conclude that the asymmetric effect of oil revenue growth on current account balance exists when the role of structural breaks that exist within this period of study is accounted for. This result is valid both at the short run and long run of the NARDL with breaks but we do not reject the null of symmetry in the short run and long run of NARDL without breaks. Having conducted the Wald test to examine the validity of structural breaks effect on current account balance, and it is revealed that the effect of structural break is not statistically different from zero for non-linear analysis, while structural breaks in symmetry analysis is significantly different from zero. Since only the structural break of 1995Q1 is significant, this can be as a result of the policies implemented for foreign exchange and the Foreign Exchange Act of 1995 which led the Nigerian economy into recession. Even though exchange rate is not explicitly considered in this study, it further explains that the economic melt-down of that period is a result of the diversion of the foreign exchange needed to settle import bills (felt by the current account balance) to the augmentation of the Nigerian domiciliary accounts.

Sequel to the adoption of the technique, for any estimated model to be valid, there are certain assumptions that are needed to be fulfilled. Table 3 also includes the result of the tests on these assumptions after estimating the short-run and long-run models. The Jarque-Bera test suggests that the residuals are normally distributed since the probability value is greater than the 5% significance level. Hence, the hypothesis of normal distribution for the residuals cannot be rejected. Confirming the absence of serial correlation among the residuals, the Breusch-Pagan serial correlation (LM) test result suggests the non-rejection of the null hypothesis at the 5% level of significance. Also, The ARCH and Ramsey-Reset results whose probability values are greater than 5% indicate that there is neither heteroscedasticity nor functional misspecification in the estimated model. Thus, the hypotheses of constant variance and linear relationship cannot be rejected. Since these assumptions have not been violated, it therefore follows that the results of the models presented in Table 3 are consistent, efficient and feasible for forecast and policy making.

6. Concluding Remarks

Nigeria is one country, among several others, whose current account position is usually under severe threat, especially by factors that cannot be wholly influenced by the government. One of such factors is revenue from the sale of crude oil which although, depends on her willingness to export and certain other internal factors like crises, oil theft, etc., but is still largely exogenously determined by factors including oil price shocks (since oil revenue is a price-quantity relation), export quota by OPEC, among others. This concern has led to the motivation of this work to broadly analyse the extent to which the current account balance of Nigeria is affected by oil revenue shock using quarterly data from 1987Q1 to 2015Q4 obtained from the CBN Statistical Bulletin.

As informed by the formal test that the series were fractionally integrated of different orders, the linear (symmetric) ARDL by Pesaran et al. (2001) and the non-linear (asymmetric) ARDL by Shin et al. (2014) were more appropriate. Justification for the simultaneous use of both models is placed on the ground of validating the consideration of asymmetric effects in the relationship between oil revenue shock and current account balance. Also, for the sake of robustness, this study considers structural breaks within the context of both symmetric and asymmetric relationships between the variables, thus leading to the use of the Wald test to show the significance of the breaks. Meanwhile, this study had earlier adopted the ARDL and NARDL bounds cointegration test which shows that there is a long run relationship between current account balance and oil revenue in both symmetric and asymmetric models with and without breaks.

Expectedly, any change in the revenue of oil export causes an immediate and direct impact on the balance of the current account of Nigeria since any increased revenue from oil implies that more oil export has been made while the converse is true for oil import. Likewise, there exists a positive relationship between current account balance and each of positive and negative changes in oil revenue. Meanwhile, the short-run relationships are maintained even in the long-run although with increased magnitude of effects. The high sensitivity of the current account balance over time is a clear indication to the government and other policy makers to pay close attention to controllable factors that directly affect the revenue from oil, as a slight alteration in oil import or export (leading to oil revenue fluctuation) has major impact on the current account. By extension, since the factors affecting oil revenue are not all endogenously determined or influenced by the government and other policy makers, they should look into other sources of exports that can augment receipts from oil export such that any undue fluctuation in it will not necessarily drag the current account into deficit. Thus, encouragement for local manufacturing of exportable goods, incentives for mechanised and commercial agricultural practices, export incentives for local producers, etc. are suggested for implementation. This study further recommends that given the exogenous nature of oil revenue, the excess crude oil account should be treated with sacred discipline in order to save for the raining day and to cushion the effect of negative oil revenue growth. An example is the building of refineries from the excess crude oil account as this will further have effect on the current account balance because the quantity of petroleum product imported will positively fall.

References

Allegret, J.P., Couharde, C., Coulibaly, D. (2014). Current accounts and oil price fluctuations in oil-exporting countries: the role financial development. *J. Int. Money Finance*. 47, 185-201.

Aliyu, S.U.R., (2009). Oil Price volatility and the Macroeconomy of Nigeria: A Non-linear Approach. *Munich Personal RePEc Archive,* Paper No. 187

Appleyard, D.R. & Field, A.J. (2001). International Economics. Irwin McGraw-Hill, New York. 98-161

Aregbeyen, O., and Fasanya, I.O. (2017). Oil Price Volatility and Fiscal Behaviour of Government in Nigeria. *Asian Journal of Economic Modelling*, 5(2), 118-134

Bai, J. and Perron, P. (2003), "Computation and analysis of multiple structural change models (J.W. Sons, Ed.)", *Journal of Applied Econometrics*, Vol. 18 No. 1, pp. 1-22.

Beidas-Strom, S., and Cashin, P. (2011). Are Middle Eastern Current Account Imbalances Excessive? IMF Working Papers 11/195, International Monetary Fund.

Bollino, C. A., (2007). Oil prices and the U.S. trade deficit. *Journal of Policy Modeling*, *29*, 729-738.

Central Bank of Nigeria, CBN, (2015). Statistical Bulletin (Special Edition); Central Bank of Nigeria, Abuja

Chuku A., Usenobong F. Akpan, N.R. & Ekpeno L. E. (2011). Oil price shocks and the dynamics of current account balances in Nigeria. OPEC_186 119. 139.

Fasanya, I.O. and Ogundare, A.E. (2018). Trivariate Analysis of Oil Revenue, Government Spending and Economic Growth in Nigeria. *OPEC Energy Review*, Vol. 42 Issue 2, pp. 107-122

Fasanya, I.O., Onakoya, A.B., and Adabanija, M.A. (2013). Oil discovery and sectorial performance in Nigeria: Application of the Dutch disease. *IUP Journal of Applied Economics*, 12(2): 25-40.

Fasanya, I.O. and Onakoya, A.B. (2013). Oil price fluctuations and output performance in Nigeria: A VAR approach. *The Romanian Economic Journal*, 16, 49, 47–72.

Gnimassoun B., Joëts, M., and Razafindrabe T. (2017). On the link between current account and oil price fluctuations in diversified economies: The case of Canada. *International Economics,* http://dx.doi.org/10.1016/j.inteco.2017.07.001

Hamilton J. (1983). Oil and the Macroeconomy since World War II. *Journal of Political Economy 91*(2), 228-248.

Khan, M.S., & Knight, M.D. (1983). "Determinants of Current Account Balances of Non-Oil Developing Countries in the 1970s: An Empirical Analysis", International Monetary Fund, 30(4), 819-842.

Kilian L., Rebucci A., & Spatafora, N. (2007). Oil Shocks and External Balances. Department of Economics, University of Michigan

Kilian, L. & R. Vigfusson (2009). Pitfalls in Estimating Asymmetric Effects of Energy Price Shocks. Manuscript, University of Michigan. 74-118

Kilian, L., Rebucci, A., Spatafora, N., (2009). Oil shocks and external balances. *Journal of international Economics 77*, 181-194.

Le, T. H. and Chang, Y., (2013). Oil price shocks and trade imbalances. *Energy Economics 36*, 78-96.

Lee, K., Ni, S., & Ratti, R. (1995). Oil shocks and the macro economy: the role of price variability. *Energy Journal*, 16 (4), 39–56.

Morsy, H. (2009). Current Account Determinants for Oil-Exporting Countries. IMF Working Paper, WP/09/28. 85-102

Narayan, P.K. & Wong, P. (2009). A Panel data analysis of the determinants of oil consumption: The case of Australia, *Applied Energy*, 86, 2771–2775.

Nusair, S. A. (2016). The effects of oil price shocks on the economies of the Gulf Co-operation Council countries: Nonlinear analysis. *Energy Policy*, *91*, 256–267

Ozlale, U., Pekkurnaz, D. (2010). Oil prices and current account: A structural analysis for the Turkish economy. *Energy Policy 38*, 4489-4496.

Pesaran, M., Shin, Y., & Smith, R. (2001). Bound testing approaches to the analysis of level relationship. *J. Appl. Econ*. 16, 289–326.

Qin, X., Zhou, C., and Wu, C. (2016). Revisiting asymmetric price transmission in the U.S. oil-gasoline markets: A multiple threshold error-correction analysis. *Economic Modelling*, 52, 583–591.

Salisu, A. A., & Fasanya. I.O. (2013). Modelling oil price volatility with structural breaks. *Energy Policy*. 52, 554-562.

Salisu, A.A. & Oloko, T.F., (2015). Modeling oil price–US stock nexus: A VARMA–BEKK–AGARCH approach. *Energy Economics*, 50(1), 1-12.

Schubert, S.F., (2009). Dynamic effects of oil price shocks and their impact on the current account. MPRA Paper No. 16738. Available at http://mpra.ub.uni-muenchen.de/16738

Shin, Y., Yu, B., and Greenwood-Nimmo, M.J., (2014). Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework. New York: Springer Science and Business Media, 2014, 281 – 314.

Taylor, A., (2002). A century of current account dynamics. *Journal of International Money and Finance* 21, 725–748.

Trehan, B. and Walsh, C.E., (1991). Testing intertemporal budget constraints: theory and applications to U.S. federal budget and current account deficits. *Journal of Money, Credit and Banking* 23, 2, 206–223.

Uneze, E. & Ekor. M. (2012). Re-Examining the Determinants of Current Account Balance in an Oil-Rich Exporting Country: A Case of Nigeria. CSEA Working Paper, WPS/12/01: 1-33.

Van Hoang, T.H., Lahiani, A. and Heller, D. (2016). Is gold a hedge against inflation? New evidence from a nonlinear ARDL approach. Economic Modelling, 54, 54–66.

Yusuf, M. (2015). An Analysis of the Impact of Oil Price Shocks on the Growth of the Nigerian Economy. *African journal of business management*, 9(3), 103-115

Zaouali, S. (2007). Impact of higher oil prices on the Chinese economy, OPEC Review, 31 (3), 191-214.