Oil Price Shock and Trade Balance in Nigeria

Johnbosco Chukwuma Ozigbu
Department of Economics, Rivers State University, Port Harcourt – Nigeria
E-mail: johnbosco2008@yahoo.com

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Abstract

This study used the Brent crude oil price to examine whether the variability in the trade balance of Nigeria is linked to the fluctuation in oil price.To achieve this, the study used annual frequency data from 1981 to 2021 sourced from the United Nations Conference on Trade and Development (UNCTAD), the World Bank's World Development Indicator (WDI), and the Central Bank of Nigeria (CBN) Statistical Bulletin. The bound test procedure to cointegration was adopted and the nexus between oil shock and trade balance was examined within the autoregressive distributed lag (ARDL) framework. Additionally, the augmented Dickey-Fuller approach to unit root was used in determining the degree of integration of the series. Certain findings were made from the analyses. First, the study confirmed that there is long-run relationship among the variables. Second, oil price hikes lead to a surplus trade balance in the long run, but only insignificantly. Contrariwise, the positive impact of oil price hikes on the trade balance in the short run was significant. Third, the study found that inflation had an insignificant positive effect on the trade balance. Fourth, the estimation revealed that an increase in real effective exchange rate and trade openness is insignificant and lead to a deficit trade balance in the long run. The study recommends that domestic oil shocks in the form of low oil production should be mitigated by addressing the security challenges in the country.

Keywords: *Oil Shock, Trade Balance, Brent crude, Trade deficit and Trade Surplus*

1. Introduction

For decades, international trade has provided the impetus for economic growth and sustainable development for countries increasingly open and conduct exchanges with the global economy. International trade serves as a channel for receipt of new technology through imports especially for developing countries, creates incentives that promote domestic productivity by reducing the misallocation of resources, and increases market size which allows countries to enjoy economies of scale and reap the benefit from specialization (Zahonogo, 2016).While countries have embarked on a plethora of trade reforms to integrate their economy with the global economy, the desire to harness the gains from globalization could have implications for the balance of trade position.

The traditional neoclassical growth theory attributed a minor role to energy or oil in the production process. This position was challenged by ecological economists such as Ayres and Warr (2010), Stern (2011) and Kümmel, Ayres and Lindenberger (2010), following the energy crisis of the 1970s. According to Stern (2011), the economic recessions that emerged from the oil crisis of the 1970s suffice for oil/energy to be considered a primary factor of production. They argued that energy activates capital and its use raises both capital and labour productivity (Foster, 2015). As globalization has become widespread, there is increasing recognition that fluctuation in international crude oil prices could affect a country's trade balance (Baek, Ikponmwosa and Choi, 2019;Arouri, Tiwari andTeulon, 2014; Le and Chang, 2013;Jibril, Chaudhuri andMohaddes,2020;Açikalin andUğurlu,2014).

Oil is a critical source of energy and an important factor input in production as production equipment run on oil-related energy sources, but its importance differs and varies across space and time. The impact of fluctuating oil prices on a country's trade balance depends on whether the country is a net-oil exporting country or net-oil importing country (Faheem, Azali, Chin andMazlan, 2020; Gershon, Ezenwa andOsabohien,2019).

Oil price surge could have adverse consequences for net oil-importing economies and may benefit net oil-exporting economies. High oil prices could lead to depreciation of the exchange rate, fuel inflation and expand trade deficits for oil-importing economies through depreciation of the local currency. Two effects are likely to result from currency depreciation. On the one hand, high oil prices increase the import bills due to the high cost of oil imports, which results in a deficit trade balance for oil-importing countries. This negative trade imbalance will lead to a contraction in the gross domestic product, further reducing the standard of living (Ahad andAnwer, 2020). On the flip side of the coin, currency depreciation will increase the external debt stock, weakening the economic prospects of the country. The rising external debt level is likely to aggravate the fiscal deficit position and increase taxes, further crowding out investment, reducing production and export, and worsening the negative trade imbalance. Oil price hikes improve the terms of trade of oil-exporting countries as it raises real income. In response to the oil price hike, firms and households will increase investment and consumption spending, resulting in an appreciation of the local currency and a surplus trade balance. High oil prices will also increase the export bill of net oil-exporting countries (Le and Chang, 2013).

The empirical and theoretical evidence points to some form of relationship between oil price and trade balance. This study tries to examine the trade balance effect of oil prices in the context of an oil-exporting country, Nigeria. The focus on Nigeria is due to several reasons. First, Nigeria is considered the largest economy in Africa and is the second-largest producer of crude oil in Africa. Second, the bulk of her exports are oil-related and is a heavy importer of petroleum products. Hence, crude oil price shocks could have important implications for her trade balance. Third, the bulk of her food needs are met through imports and the Central Bank of Nigeria (CBN) has, over the years, managed the exchange rate to reduce the exchange rate pass-through to inflation.

The rest of this paper follows this sequence: The study reviewed relevant literature in Section 2. The methodology is reported in Section 3. Section 4 comprises of results and discussion and Section 5 concludes the study.

2. Literature Review

2.1 Empirical Literature

Ahad andAnwer (2020) examined if the trade balance of Pakistan adjusts to shocks in oil price. Using the nonlinear autoregressive distributed lag (NARDL) method on quarterly frequency data from 1990Q1 to 2016Q4, they decomposed oil price into positive and negative partial sums in order to investigated the response of trade deficit to increase and decrease in crude oil price. The researchers showed evidence of asymmetric relationship between oil price variations and trade deficits, noting that the trade deficit of Pakistan deteriorates with rising price of crude oil. They showed that decrease in oil price improves the trade deficit position of Pakistan.

Gershon, Ezenwa andOsabohien (2019) specified an unrestricted vector autoregression model to analysed the relationship between oil price, economic growth and energy consumption of four (4) oil-importing countries in West Africa. Using data from 1980 to 2015, they discovered mixed results across the four oil importing countries. The causality result showed unidirectional causality running from oil prices to economic growth (proxy with gross domestic product per capita) in Sierra Leone and Liberia. From the impulse response function, oil price was found to temporarily stimulate economic growth in the short run and this result was observed across the four countries studied.

Data from 1980 to 2017 for Saudi Arabia, United Arab Emirates and Kuwait was used by Faheem, Azali, Chin andMazlan (2020) in investigating the effect of oil price changes on trade balance. Apart from x-raying the asymmetric trade balance effect of oil prices changes, they further examined if real effective exchange rate moderates the effect of oil price changes on trade balance in the three countries.Analysing this relationship using the nonlinear autoregressive distributed lag (NARDL) method, it was revealed that positive shock to oil price had significant positive effect on trade balance in Kuwait and United Arab Emirates. The NARDL result revealed that declining oil price had significant positive impact on trade balance in Kuwait.

Baek (2020) using panel dataset of four member countries of the Association of Southeast Asian Nations (ASEAN) investigated the effect of oil price on trade balance. The ASEAN countries studied were Singapore, Indonesia, Thailand and Malaysia. The work which focused on examining the symmetric and asymmetric relationship between oil price and trade balance used the autoregressive distributed lag (ARDL) and nonlinear autoregressive distributed lag (NARDL) methods. The ARDL result revealed that oil price played significant role in affecting trade balances in the ASEAN countries, with the significant impact observed in the long- and short-run. In addition, trade balances respond differently to oil price hikes and fall.

Baek and Kwon (2019) examined the nexus between oil price and trade balance at the bilateral level, examining the bilateral trade balance effect of oil price fluctuations between Korea and fourteen of her trading partners. Adopting the nonlinear autoregressive distributed lag (NARDL) approach, they concluded that oil price swings in the form of hikes and plummeting oil prices affect the trade balance of Korea, with the impact varying among countries. They noted that hike in oil price appears to create trade surplus position with United States and Japan. For China,

declining oil price improve the trade balance of Korea.They reported that Korea's trade balance with Singapore, Malaysia, Hong Kong and Indonesia respond more to oil price hike, than declining oil price.Baek, Ikponmwosa and Choi (2019) followed nonlinear approach to the relationship between oil price and trade balance of six African countries, using data from 1980 to 2015. With the nonlinear autoregressive distributed lag (NARDL) method, they discovered that declining oil price is detrimental to the non-oil and oil trade balances of the African countries. Though oil price hikes improve the oil and non-oil trade balances, the effect was insignificant.

Ahad andAnwer (2021) in their study focused on the relationship between oil prices and trade balance in the BRICS region using quarterly frequency data covering the period from 1992Q1 to 2015Q4. The work which followed a nonlinear approach, decomposing oil price changes to positive and negative shocks, and adopting the nonlinear autoregressive distributed lag (NARDL) estimator confirmed asymmetric relationship between oil price, wholesale price, economic growth and trade balance in the BRICS region. They showed that both increase and decrease in oil price increase the trade deficit position of India, South Africa and China.

Balli, Çatık and Nugent (2021) employed a four variables vector autoregression (VAR) model in analysing the effect of oil price shocks, in the form of oil demand shock and oil supply shock, on the trade balances of Russia and China. The dataset used were in quarterly frequency, spanning from 1993Q1 to 2018Q3. The found using the time-varying VAR method that the impact of oil demand shocks was bigger than those of oil supply shocks. It was reported that, oil demand shocks had positive effect on Russia's trade balance than that of China. China's trade balances was found to be adversely affected by oil demand shocks.

Bala, Chin and Mustafa (2022) used panel fully modified ordinary least square, panel dynamic ordinary least square and panel threshold method to analyse data of four Oil Exporting Countries (OPEC) members in Africa. Examined by them was the tripartite relationship between oil price, oil export and trade balance. The result obtained revealed that increased oil price and oil export significantly encouraged import. They also found that depreciation of exchange rate discouraged import in the OPEC countries. From their estimation, a threshold level of oil export and oil price was discovered, with the impact of oil export on trade balance found to be higher above the threshold.

Bala and Chin (2023) usedthe spot oil prices of the countries studied, OPEC reference basket oil price and average of the Dubai, Brent and WTI oil prices to determine the impact of oil price on trade balance of Algeria, Angola, Nigeria and Libya from 1980 to 2016. The result of the fully modified ordinary least square showed that hike in oil price improves the trade balance of the countries studied. Result showed that exchange rate had insignificant positive impact on export, but its effect on imports was negative and significant.

Onakoya, Johnson andAjibola (2019) tested the validity of the J-curve effect by examining the nexus between real effective exchange rate and trade balance in Nigeria using data from 1981 to 2016. For the study, they deployed the impulse response function and Granger causality methods. The vector error correction result indicated that relationship between real effective exchange rate and trade balance was positive and significant, suggesting the presence of an inverted J-curve and invalidating the J-curve hypothesis that a depreciated currency worsen trade balance.

3. Data and Methodology

3.1 Data

In examining the relationship between oil price shocks and trade balance, the study employed annual data on trade balance as a percentage of gross domestic product, oil price, real effective exchange rate, inflation and trade openness, covering from 1981 to 2021. The current account balance as percentage of gross domestic product was used to measure trade balance. The study employed Brent crude oil price as proxy of oil price. The data for the series were sourced from the Central Bank of Nigeria (CBN) official website and Statistical bulletin, the United Nations Conference on Trade and Development (UNCTAD), and the World Development Indicator.

3.2 Model Specification

In analyzing the effect of oil price on trade balance, the study specified the following model given below:

$$trb = f\ (olp, reer, inf, top) \qquad (1)$$

The econometric form of equation (2) is given as;

$$TRB_t = \ \delta_0 + \ \delta_1 OLP_t + \ \delta_2 lnREER_t + \ \delta_3 INF_t + \delta_4 TOP_t + e_t \qquad (2)$$

Where;

TRB = trade balance;

$REER$ = real effective exchange rate;

INF = inflation;

OLP = oil price;

TOP = trade openness (proxy by sum of exports and imports as percentage of GDP); and

e_t = error term

Theoretically, it is expected that: $\delta_1 < 0$, $\delta_2 > 0$, $\delta_3 < 0$ and $\delta_4 > 0$.

The effect of oil price on trade balance was examined using several techniques. The analytical procedure for this study started off by determining the integrated properties of the series. This was done to avoid estimating a spurious regression which would otherwise lead to misleading statistical inference. The study test for stationarity of the series using the augmented Dickey-Fuller (ADF) (1979) test.

The augmented Dickey-Fuller test involves estimating the model expressed below:

$$\Delta Y_t = c + \ \varphi t + (\beta - 1) Y_{t-1} + \sum_{i=1}^{m} \beta_i \ \Delta Y_{t-i} + \ \mu_t \qquad (3)$$

Where;

Y = variable series

Succeeding the test of stationarity, co-integration test was carried out to determine if there is cointegrating relationship between the variables captured in the model specified for this study. The Pesaran, et al., (2001) bound test was adopted over the Engle and Granger (1987) and Johansen and Juselius (1990) following result of the unit root test which report that the series are fractionally integrated. In estimating equation (2), the study used the autoregressive distributed lag (ARDL) method in order to estimate the long run and short run model. The method was chosen due to the degree of integration of the variables, as the result of the unit root revealed that the variables included in the model are mixed order of I(0) and I(1) series.

4. Results and Discussion

4.1 Descriptive Statistics

Table 1: Descriptive Statistics

	TRB	OLP	INF	REER	TOP
Mean	5.4644	44.1811	18.9250	147.3663	31.6743
Median	5.4851	29.8291	12.8800	100.5755	33.7197
Maximum	19.4262	111.9656	72.8400	536.8850	53.2779
Minimum	-5.1899	12.7165	5.3800	49.7445	9.1358
Std. Dev.	5.8316	30.0067	16.6702	115.7697	12.4293
Skewness	0.5070	0.9624	1.8544	1.9419	-0.2602
Kurtosis	2.7550	2.7537	5.3051	6.0140	2.1284
Jarque-Bera	1.8591	6.4338	32.5778	41.2893	1.7603
Probability	0.3947	0.0400	0.0000	0.0000	0.4147
Observations	41	41	41	41	41

Source: Author's computation (2023)

The descriptive statistics of Table 1 revealed the first and second moments (mean and standard deviation) of trade balance to be 5.4644% of gross domestic product and 5.8316% of GDP. The trade balance of Nigeria showed strong variability, ranging from deficit position of -5.1899% of GDP to a peaked surplus of 19.4262% of GDP. Oil price sold for an average of US$44.18 per barrel, fluctuating strongly between US$12.71 per barrel to US$111.96 per barrel. Inflation in Nigeria is expected to be in double digit, averaging 18.9250% every year. There was strong fluctuation in price of commodities, with the price level peaking at 72.84% and falling to a low of 5.38%. The study observed strong fluctuation in real effective exchange rate, with an average of 147.3663 and a range between 49.7445 and 536.8850. The degree of openness of the Nigerian economy averaged 31.67% of gross domestic product, fluctuating between 9.1358% and 53.2779% of GDP. The study observed that trade balance, oil price, real effective exchange rate and inflation are skewed to the right, as there is evidence showing that trade openness is skewed

to the left. It was noticed that most of the variables, particularly oil price, inflation and real effective exchange rate are not normally distributed.

4.2 Unit Root

The motivation for conducting unit root testing on the interest variables is to understand the effect of shocks on each variable. With unit root testing, it is possible to determine if shocks to the series are permanent or transitory. The test also aids in the selection of an estimation framework that best accommodates the integration properties of the series. In line with conventional estimation trajectory, the study followed the augmented Dickey-Fuller (ADF) procedure in testing for unit root. The results are summarized in Table 2.

Table 2: Unit Root Test Result

Variables	ADF			Decision I(d)
	Level	1st_diff.	Critical Value at 5%	
TRB_t	-1.7770	-8.3952***	-2.9411	I(1)
$lnOLP_t$	-1.0953	-5.1180***	-2.9369	I(1)
INF_t	-3.0074**	-	-2.9369	I(0)
$lnREER_t$	-2.9637**	-	-2.9389	I(0)
TOP_t	-2.3783	-7.7599***	-2.9369	I(1)

Note: Test statistics values are reported. *, ** and *** denote rejection of the null hypothesis at Significant of 10%, 5% and 1% level.
Source: Author's Computation (2023)

From the test, trade balance as percentage of gross domestic product (TRB), oil price (OLP) and trade openness (TOP) are non-stationary in their observed form. The study observed that the ADF statistics for these variables, in their level form, is higher than their respective 5% critical values. With first differencing of the three series, stationary was confirmed as their ADF test statistics were lower than the critical values at 5%. Inflation and real effective exchange rate were not subjected to first differencing as they were found not to have unit root in their level form. Summarily, the variables considered in analysing the trade balance effect of oil price shocks are fractionally integrated, composed of I(0) and I(1) integration properties. These statistical features of the variables gave the impetus for the use of bound test and the autoregressive distributed lag (ARDL) framework to achieve the objective of this paper.

4.3 Cointegration

The need to conduct a cointegration test is borne out of modelling at least one non-stationary variable in this study. With the inherent feature of a non-stationary variable, the test of

cointegration and validation is necessary to authenticate any long run response of trade balance to changes in oil price and other control variables. The bound test procedure was followed dutifully in testing for long run relationship and the result reported in Table 3.

Table 3: Bound Test Result

Model	Optimal Lag Length	F-Statistics	Cointegration
$trb = f(olp, inf, reer, top)$	(1, 2, 1, 1, 0)	3.989428***	
Significant Level	I(0)	I(1)	Null hypothesis: No levels relationship
10%	2.2	3.09	
5%	2.56	3.49	
2.5%	2.88	3.87	
1%	3.29	4.37	

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

The study did not bother with restating the decision guiding the validity of cointegrating relationship among level variables, using the bound test, as this has been painstakingly outlined in Pesaran, et al., (2001). The study observed that the calculated F-statistics value of 3.989428 is higher than 3.49, which is 5% critical value for an I(1) series. As noted by Pesaran, et al., (2001), were this applies, then the null hypothesis must be rejected. The study rejects the null hypothesis of no level relationship, confirming that oil price, inflation, real effective exchange rate, trade openness and trade balance have common long run trend, an indication of long run relationship among the variables.

4.3 ARDL Model Estimation

Table 4: Long Run and Short Run ECM Results

Dependent Variable: TRB_t				
Part A: Long Run Results				
Variable	***Coefficient***	***Std. Error***	***t – Stats***	***Prob.***
$lnOLP_t$	0.5085	2.7069	0.1878	0.8523
INF_t	0.2330	0.1625	1.4335	0.1624
$lnREER_t$	-0.5020	3.1275	-0.1605	0.8736
TOP_t	-0.1359	0.1817	-0.7479	0.4605
C	5.5990	23.7949	0.2353	0.8156
Part B: Short Run Results				
Variable	***Coefficient***	***Std. Error***	***t – Stats***	***Prob.***
$D(lnOLP_t)$	11.3146***	1.7266	6.5528	0.0000
$D(lnOLP_{t-1})$	4.7572*	2.5047	1.8992	0.0675

$D(INF_t)$	-0.0129	0.0331	-0.3894	0.6998
$D(lnREER_t)$	-3.9046**	1.5463	-2.5250	0.0173
ECM_{t-1}	-0.4130***	0.0779	-5.2975	0.0000
$R^2 = 0.7138$		Adjusted $R^2 = 0.6801$		

Note: *, ** and *** denote significance at 10%, 5% and 1% level.
Source: Author's computation

The variables that improve the balance of trade position of Nigeria or cause unfavourable balance of trade in the long run are summarized in Part A of Table 4. The factors responsible for trade surplus or trade deficit position of Nigeria in the short run are reported in Part B of Table 4.

The study observed that Brent oil price insignificantly impact on the trade balance of Nigeria. The estimate for oil price which is 0.5085 is not consistent with economic theory, as the result indicates that an increase in oil price by 1 percent leads to an increase in exports over import, causing about 0.5085% trade surplus. The theoretical inconsistency with the relationship between oil price and trade balance could be due to the cheap petrol purchased by productive firms in Nigeria due to how heavily subsidized petroleum products are. This result failed to corroborate the findings of Faheem, Azali, Chin andMazlan (2020), Ahad andAnwer (2020) and Baek (2020).

The estimated coefficient on inflation is statistically insignificant and failed to appear with the correct sign. The result indicates that an increase in inflation by 1% improves the trade balance by 0.2330 percent, ceteris paribus. This implies that rising inflation level is not sufficient to make Nigerian export unattractive and worsen her balance of trade position. One possibility why the effect of inflation on trade balance is insignificant is that, Nigerians export is mainly composed of crude oil export which response essentially to oil demand shocks and oil supply shocks. The dependence on imports by Nigerian could explain why trade balance is not significantly responsive to changes in domestic inflation level.

The estimated elasticity of real effective exchange rate increase is -0.5020, indicating that 1% increase in real effective exchange rate is expected to lead to a 0.5020 percent deterioration in trade balance in the long run. The result revealed that the negative relationship is inelastic and insignificant. When the considered the effect of trade openness, the study estimated a coefficient of -0.1359, indicating that increased openness of the Nigerian economy is detrimental to her balance of trade position as 1% increase in trade openness is associated with a decline in trade balance (trade deficit) of 0.1359%. The implication of this is that, when trade activities increase, trade deficit expands. This result is not unconnected with increased propensity of Nigerians to import, causing imports to outstrip exports. Though the trade balance deteriorates with increased openness of the economy, the result showed that the negative relationship is insignificant.

In the short run, changes in oil price significantly improves the trade balance of Nigeria. An increase in oil price improves trade balance by 11.3146% contemporaneously. The increase could result from increased export of crude oil, Nigeria's main commodity export, as price of Brent crude oil continues climbing upward. Considering the trade balance in the short run, the coefficient of real effective exchange rate is negative and significant, implying that a 1% increase in real effective exchange rate leads to worsening trade balance by -3.9046% contemporaneously. The error correction coefficient is negative and statistically significant, further validating the existence of

long run relationship among the variables. The coefficient of -0.4130 suggest that, 41% of short run deviation from long run equilibrium level is correctly every year, confirming the ability of the model to convergence to equilibrium level.

The study subjected the estimated model to diagnostic test to ensure the model does not suffer from the classical regression problems of normality, model misspecification, structural stability, serial correlation and heteroscedasticity. The diagnostic results are shown in Table 5.

The result of the post-estimation test revealed that the assumption of serial independence of the error is satisfied as the probability value of the Breusch-Godfrey chi-square statistics is greater than 0.05. The study found no evidence of heteroscedasticity and model misspecification as the study failed to reject the null hypothesis of these tests. Also, the residuals are normally distributed around a zero mean and constant variance. The cumulative sum (CUSUM) and cumulative sum of squares used to determine the structural stability of the model, depicted using Figure 1 and 2, indicate that the coefficients estimated using the ARDL method are stable over the period of the study.

Table 5: Diagnostic Test Results

Tests	CLRM Problem	χ^2 Value	χ^2 Prob.	Decision
Breusch-Godfrey LM	Serial Correlation	1.6467	0.4390	Serial independence
ARCH	Heteroscedasticity	0.9027	0.3420	Constant Variance
Ramsey RESET	Specification error	1.9100	0.1779	Correctly specified
Jarque-Bera	Normality	1.9648	0.3743	Normal residuals
CUSUM	Stability	-	-	Stable Model
CUSUM of Squares	Stability	-	-	Stable Model

Note: CLRM stands for classical linear regression model
Source: Authors' compilation (2023)

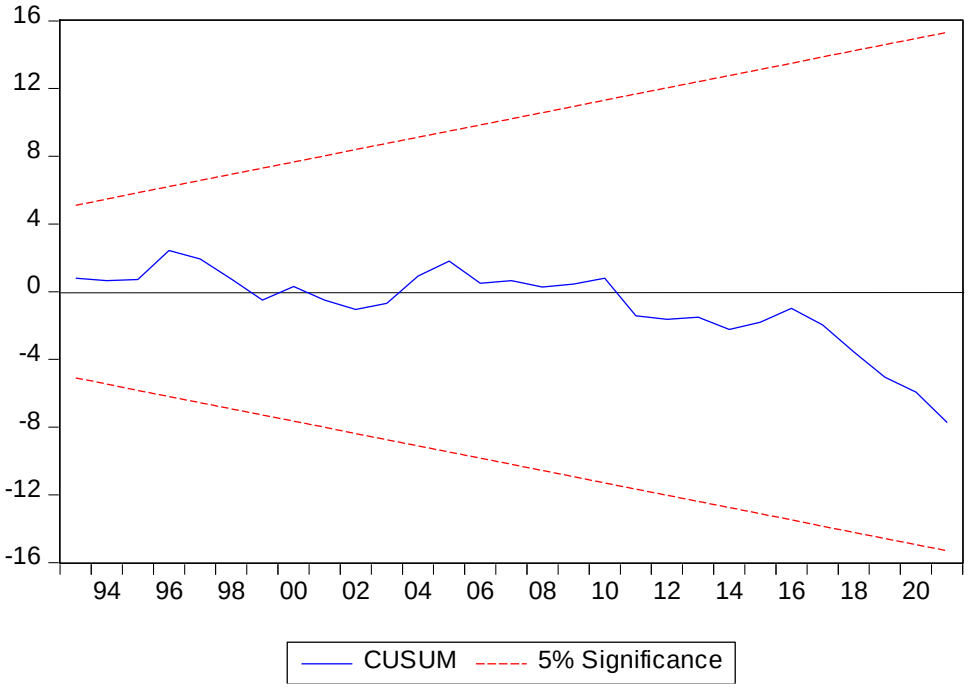

Figure 1: CUSUM Plot

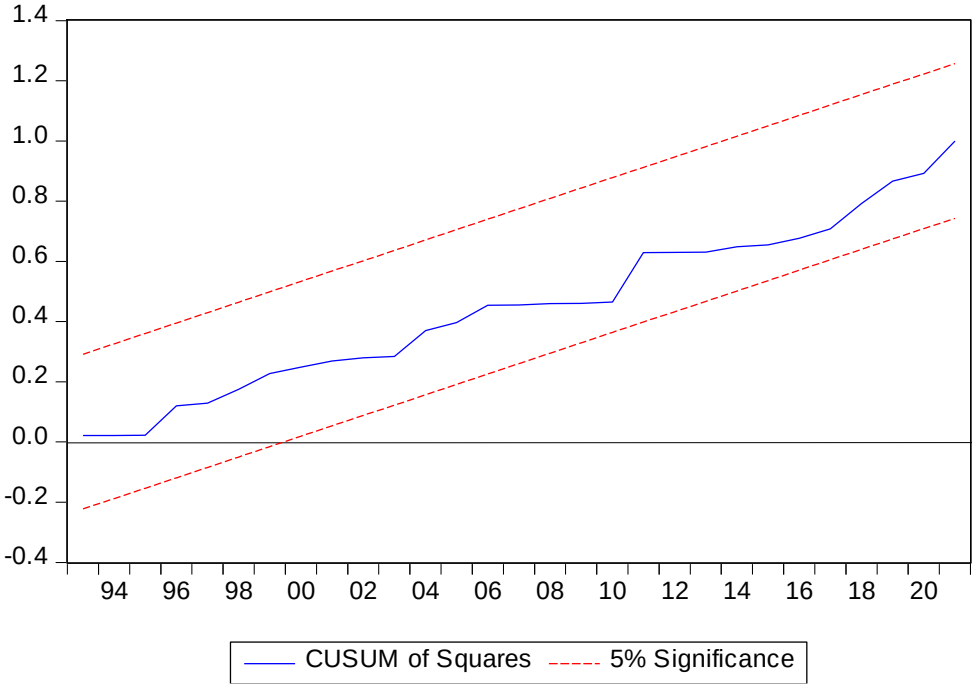

Figure 2: CUSUM of Squares Plot

5. Conclusion and Recommendations

This paper revisited the trade balance issue in Nigeria by posing the question of whether or not oil price shocks affect the balance of trade position. To assess this and provide answer to the question put forward, the study used changes in Brent crude oil price to measure oil price shocks, and examine its impact on long- and short-run trade balance, proxy by balance of trade as percentage of gross domestic product, using annual frequency data from 1981 to 2021 and the autoregressive distributed lag (ARDL) method. After employing the ARDL method, the study discovered that oil price changes had insignificant positive impact on trade balance in the long run, but rising oil price in the short run is expected to improve trade balance, significantly. Regarding inflation, the study found no evidence that inflation had significant effect on trade balance in the long- and short-run. Moreso, the survey indicates that, greater degree of openness and increase in real effective exchange rate insignificantly leads to expansion in trade deficit. The conclusion of this study is that, oil prices play significant role in influencing the balance of trade position of Nigeria and the study recommend that, factors that caused disruption to domestic crude oil production, like the insecurity challenges, should be addressed with great speed, in order to boost oil production, increase exports and ensure a trade surplus is achieved.

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