# Oil Price Shocks and Income Inequality in Nigeria: Evidence from Nonlinear ARDL Approach

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**Abstract**
This study examines the impact of decrease/increase oil prices on income inequality in Nigeria based on annual data covering the period from 1981 to 2018. To achieve this objective, a nonlinear autoregressive distributed lag approach (NARDL) and vector error correction modeling approaches are employed. The outcomes show that changes in oil price have an asymmetric effect on income inequality only in the short run. Negative shocks in oil prices reduce income inequality significantly, while positive shocks increase it though not significant. The income inequality's response to negative shocks in oil prices is stronger. Moreover, GDP per capita moderates income inequality in both the short and long run. Openness reduces income inequality in the long run but hurts it in the short run. Corruption hurts income inequality in the short-run, while the misery index increases it in the long run. Hence, policies that help to reduce oil prices, promote sustainable economic growth and reduce corruption, inflation, and unemployment are needed to reduce income inequality.

**Keywords**: Oil price; income inequality; asymmetry; nonlinear ARDL; Nigeria
**JEL Classification Codes:** C59, I38, Q43

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## 1. Introduction

Recent decades have witnessed a high and rising level of income inequality, especially in Asia, Latin America, and Sub-Saharan Africa (SSA). According to Oxfam (2020), the world's richest one percent has more than twice as much wealth as 6.9 billion people. Likewise, the Credit Suisse Global Wealth Report (2020) affirms that the world's richest one percent, those with more than $1 million, owns 45.8 percent of the world's wealth. The situation is worse in sub-Sahara African countries. The region has the highest level of income inequality after Latin America. 10 of the 19 most unequal countries globally are in SSA. More than half of the countries in SSA have a Gini coefficient of 0.5 or more. In Nigeria, income inequality has increased over the last three decades. Based on Oxfam's (2020) calculations, the quantum of money earned annually by the wealthiest Nigerian from their wealth will move 2 million people out of poverty in a year. The report further states that it will cost about $24 billion to move all Nigerian people below the extreme poverty line $1.90 out of poverty in a year, while the total wealth owned by the five richest Nigerians in 2016 was $29.6 billion.

The high- and increasing-income inequality worldwide has occupied the attention of policymakers and researchers (Draghi, 2016; Bernanke, 2015; Farzanegan & Krieger, 2017). An extensive literature has identified several causes of income inequality. Among these factors are globalization (Furceri & Loungani, 2015), institutions (North, 1990; North & Thomas, 1973; Knack and Keefer, 1995; Hall and Jones, 1999; Acemoglu, Johnson, & Robinson, 2001, 2002; Acemoglu & Robinson, 2012), technological change (Bound & Johnson, 1992; Acemoglu 2002), demographics (Karahan & Ozkan, 2013), monetary policy (Acemoglu & Johnson 2012; Stiglitz, 2015), labour market structure (Jaumotte & Osorio-Buitron, 2015) and government expenditure (Abdel-Latif, Osman, & Ahmed 2018). Interestingly, however, the role of changing oil prices in affecting income inequality has not been adequately explored despite its importance in the world economy.

The price of oil is linked to the economy through various channels. Some of these channels are the sectoral adjustment channel, the supply-side channel, real-balance channel, wealth transfer channel, and uncertainty about future increases in crude oil price channels (details in Rafiu, Aminu, & Folawewo, 2020). Essentially, changes in oil price working through these channels affect the economy and income distribution. Oil price change is directly related to income. An increase in energy will increase the proportion of households' expenditure on energy with dire consequences on the welfare of the workers. The study by Brada (2013) shows that increases in the prices of energy reduces the share of labour in total income, thereby increasing the problem of income inequality.

The situation is worse in Nigeria. The country depends mainly on oil. Nigeria exports crude oil and imports refined oil because domestic refineries are unable to meet domestic consumption. Moreover, production in Nigeria depends on petroleum due to low electricity generation and supply. The electricity generation and supply have been deficient and acute over the years. Therefore, many of the firms in the country rely on petroleum products, namely PMS and diesel, to generate electricity for production. When the prices of petroleum products increase, cost of production increases with dire consequences on output, unit price, sales, and profit. Most firms react by either reducing wages or workforce to maintain their profit margin with adverse effect on income inequality.

Empirically, few known works have explored the income distribution effect of oil price changes and are focused on Europe and Asian countries. For example, empirical studies by Saari, Dietzenbacher, & Los (2016) and Sheng & Gupta (2021) find that oil price increase aggravated the problem of income inequality in Malaysia and the United States, respectively. No known study has examined the issue in the case of Nigeria. Besides, a common feature of few known empirical studies on the subject matter is the assumption of symmetric relationship between income inequality and oil price changes. However, as argued in the literature, oil price changes could be asymmetrically related to income inequality. Indeed, Saari, Dietzenbacher, & Los (2016) confirm that the distributional impact of increased petroleum prices is retrogressive, while decreased oil prices is progressive. There is a need to explore the possibility of asymmetric effects of shocks in oil prices on income inequality in Nigeria.

The remaining part of the paper is organized as follows: Section 2 discusses the theoretical and empirical literature. Section 3 provides the data and methodology. Section 4 presents the results and discussion. Section 5 contains the conclusions.

## 2. Literature review

There are several studies on income inequality; some have examined the determinants of income inequality (Bahmani-Oskooee, Scott & Harvey, 2008; Crespo, Simoes, & Diogo, 2012; Deyshappriya, 2017; Munir & Sultan, 2017). The identified determinants of income inequality include education, globalization, inflation, population, monetary policy, fiscal policy, governance, technological development, and labour market institutions. Few studies have examined the linear and nonlinear effects of some of the factors mentioned above on inequality of income. Acemoglu & Johnson (2012); Stiglitz (2015) and Guerello (2016), and O'Farrell et al., (2016) examined the effect of monetary policy on income inequality. Others focused on the roles of financial development (Bolarinwa & Akinlo 2021; Naceur & Zhang, 2016; Jung & Vijverberg 2019; Thorton & Tommaso 2019), oil rent/resource boom (Carmignari, 2013; Bhattacharya & Williamson 2015; Howie & Atakhanova 2014; Goderis & Malone 2011) and institutions (Acemoglu et al., 2005; Mehlum et al., 2006; Krieger & Meierrieks 2016; Acemoglu & Robinson 2006). So far, not much is known about the way income inequality responds to oil price shocks. The empirical literature on this topic is relatively thin.

### *Theoretical Issues*

There are two theoretical perspectives on the oil price-income inequality nexus. The first argues that an increase in oil price will lead to a rise in income inequality working through changes in relative prices, employment, and changes in government expenditures. The second aspect of the theoretical literature argues that oil price shocks (i.e., reducing oil prices) could narrow the income inequality gap by working through various channels.

Theoretically, the income widening hypothesis argues that an upward movement in oil price will lead to an economic slowdown and higher unemployment. This arises because oil is an essential factor of production alongside labour and capital. As oil prices of oil move up, the cost of production increases leading to output decline and rising unemployment. In most cases, the vulnerable people in the society, namely the poor and low-income earners, often bear the brunt of workers' retrenchment and wage cuts. Besides, a significant share of households' budgets is on commodity items that use a lot of energy to produce. Consequently, a rising oil price will affect the low-income earners more than the rich, thereby widening the income inequality gap, particularly in the developing oil-dependent economies.

The oil price-income inequality narrowing hypothesis argues that a fall in the price of oil could beneficial to income inequality working through the increased output channel. It is argued that a reduction in oil prices could result in an economic boom, which may lead to higher investment and employment. This is relevant in an economy where the cost of oil constitutes a significant share of aggregate production costs. Thus, as oil price falls, the cost of production declines, causing investment, output, and employment to increase. However, the extent to which oil price affects income inequality depends on such factors as the degree of mobility of labour and capital across sectors and the share of oil in the aggregate production cost.

However, a fall in oil price could adversely affect government spending, especially in oil-exporting countries. Generally, earnings from oil accrue directly to the national government, and where reduction in oil prices adversely affects government spending, labour demand, relative prices, direct transfer to households, and the provision of public goods and services will be adversely affected. In this way, the welfare of the poor and low-income earners will be adversely affected, thereby compounding the problem of income inequality.

***Empirical Review***
Several empirical works have investigated the effects of oil price shocks on different economic variables such as unemployment (Akinlo 2021, Ordonez, Momfort & Cuestas 2019, Cuestas and Ordonez 2018, Nusair 2020); inflation (Nusair 2019, Lorusso & Pieroni 2018); the exchange rate (Nusair & Oslo 2019); stock market returns (Wei & Guo 2017, Nusair & Al-Khasawneh 2017, Conti & Manera 2016); economic growth (Nusair 2016); industrial output (Farzunegan & Markwardt, 2009); remittances (Akinlo & Ojo 2021, Akcay & Karasoy 2019, Abbas, 2020, Samir & Zahran 2019, Akcay, 2019).

In terms of income inequality, only a few existing empirical studies explicitly focused on the income distribution effects of oil price shocks. These studies include Saari, Dietzenbcher, & Los (2016), Sheng & Gupta (2021), and Farzanegard & Krieger (2017). Saari, Dietzenbchar, & Los (2016) examine how the movement in domestic prices of petroleum products affects the income of Malaysian’s ethnic groups. The outcomes from the extended social accounting matrix (SAM) model employed reveals the regressive distributional impacts of rising petroleum prices in the Malaysian economy. This indicates that the lowest income groups bear the highest-burden while the upper groups suffer the least. The reverse is however the case with declining petroleum prices. All the household groups experience a reduction in real income, but the least income groups are less affected compared to the highest income class.

The study by Farzanegard & Frieger (2017) investigates how income inequality respond to positive oil rents shocks in Iran using VAR-based impulse response functions. The outcomes show a significant positive response of income inequality to the oil rents boom. The results reveal that a 10 percent upward movement in oil and gas rents causes income inequality to increase by 1.1 percent in the long run.

Finally, Sheng & Gupta (2021) examine the oil price shocks' income inequality impact in the United States. The outcomes reveal that oil supply shocks precipitate higher income inequality in the short run. It, however, reduces income inequality in the medium- and long-term. The nonlinear impulse response results provide evidence of heterogeneous income inequality responses to shocks in the price of oil between low- and high-oil dependence US states.

## 3. Model

To determine whether income inequality asymmetrically responds to changes in oil price in Nigeria, we utilize time-series data for 1981-2018. Consistent with the literature, a model of income inequality that incorporates oil prices, corruption, gross domestic product per capita, the misery index, and openness as explanatory variables is formulated as:

$$gin_t = \alpha_0 + \alpha_1 oip_t + \alpha_2 gdp_t + \alpha_3 mis_t + \alpha_4 corp_t + \alpha_5 ope_t + \varepsilon_t \qquad (1)$$

where *gin* is income inequality, *gdp* represents the real gross domestic product per capita (constant 2010 US$), *mis* is misery index, *oip* is the oil price, *corp* represents the corruption index, *ope* denotes trade openness, and ε is the error term.

Following Pesaran, Shin & Smith (2001), model 1 specified in an unrestricted error correction version is given as:

$$\begin{aligned}\Delta gin = {} & \delta_0 + \delta_1 gin_{t-1} + \delta_2 oip_{t-1} + \delta_3 gdp_{t-1} + \delta_4 mis_{t-1} + \delta_5 corp_{t-1} + \delta_6 ope_{t-1} \\ & + \sum_{i=1}^{n} \beta_1\, gin_{t-i} + \sum_{i=0}^{p} \beta_2\, oip_{t-i} + \sum_{i=0}^{q} \beta_3\, gdp_{t-i} + \sum_{i=0}^{r} \beta_4 mis_{t-i} \\ & + \sum_{i=0}^{s} \beta_5\, corp_{t-i} + \sum_{i=0}^{r} \beta_6 ope_{t-i} + \varepsilon_t \qquad (2)\end{aligned}$$

To incorporate asymmetries, we divided oil price innovations as: ($oip_t^+, oip_t^-$). While $oip_t^+$ represents the positive oil price innovation, $oip_t^-$ denotes the negative innovation. The two partial sums (innovations) are generated as shown in equation 3:

$$oip_t^+ = \sum_{j=1}^{m} \Delta oip_j^+ = \sum_{j=1}^{m} \max(\Delta oip_j, 0)$$

$$oip_t^- = \sum_{j=1}^{m} \Delta oip_j^- = \sum_{j=1}^{m} \max(\Delta oip_j, 0) \qquad (3)$$

Taking a cue from Shin, Yu, & Greenwood-Nimmo (2014), we substitute equation (3) into equation (2), to obtain a nonlinear ARDL (NARDL) given as:

$$\Delta gin_t = \delta_0 + \delta_1 gin_{t-1} + \delta_2^+ oip_{t-1}^+ + \delta_3^- oip_{t-1}^- + \delta_4 gdp_{t-1} + \delta_5 mis_{t-1} + \delta_6 corp_{t-1} + \delta_7 ope_{t-1} + \sum_{i=1}^{z} \beta_1 \Delta gin_{t-i} + \sum_{i=0}^{w} \beta_2 gdp_{t-i} + \sum_{i=0}^{x} \beta_3 mis_{t-i} + \sum_{i=0}^{r} \beta_4 \Delta corp_{t-i} + \sum_{i=0}^{n} \beta_5 \Delta ope_{t-i} + \sum_{i=0}^{s} (\beta_6^+ oip_{t-i}^+ + \beta_6^- oip_{t-i}^-) + \mu_t \quad (4)$$

where *z*, *w*, *x*, *r*, *n*, and s denote the lag orders. $oip^+$ and $oip^-$ represent the decomposed positive and negative oil price innovations, respectively. The two innovations incorporated into equation (4), are useful in verifying short- and long-run asymmetric responses of income inequality to oil price shocks.

To verify the long-run asymmetric effect of oil price changes in equation 4, the study employ the Wald test with the null hypothesis ($\delta_2^+ = \delta_3^-$). The long-run impacts of respectively of oil price increase ($oip^+$) and oil price reduction ($oip^-$) on income inequality are obtained as $B^+ = -(\delta_2^+/\delta_1)$, $B^- = -(\delta_3^-/\delta_1)$, respectively. However, to validate short run asymmetric effect of the oil prices, the Wald test with the null hypothesis ($\beta_6^+ = \beta_6^-$) is employed.

Next, the study investigates the unit root properties of the variables to avoid the inclusion of I(2) variable. Following this is the conduct of linear and nonlinear bounds test that involves testing the null hypothesis of no cointegration ($H_0$: $\delta_1 = \delta_2 = \ldots = \delta_7 = 0$) against an alternative hypothesis ($H_1$: $\delta_1 \neq \delta_2 \neq \ldots \neq \delta_7 \neq 0$) using the F-test. When the computed value of the F-statistic lies above the upper critical value of the two sets of critical values provided by Pesaran, Shin, & Smith (2001), cointegration is established.

### 3.1 Data

The study uses annual data series covering the period 1981 to 2018 for Nigeria. Data on imports, exports and gross domestic product per capita are obtained from the World Bank, World Development Indicators. The Inflation rate is sourced from the Central Bank of Nigeria Statistical Bulletin 2019 edition. The data on unemployment rate is sourced from the Nigerian National Bureau of Statistics database. Oil prices are obtained from the BP Statistical Review of World Energy. Gini-coefficient and Atkinson's index are sourced from the Standardized World Income Inequality Database. The natural logarithmic of the all the variables are employed form except the index variables. Table 1 shows the definitions of variables and data sources.

**Table 1: Description of variables and data sources**

| Variables | Symbol, Definition and data sources |
|---|---|
| *gdp* | GDP per capita denotes real gross domestic product divided by midyear population. Source: WDI (2019) |
| *gin* | Gini coefficient. Source: Standardized World Income Inequality Database (SWIID) |
| *oip* | oil prices (US dollar per barrel). Source: BP Statistical Review of World Energy (2019) |
| *ain* | Atkinson's index. Source: Standardized World Income Inequality Database (2019) |
| *mis* | sum of the unemployment rate and inflation rate. Unemployment rate. Source: National Bureau of Statistics (2019); Inflation rate. Source: Central Bank of Nigeria Statistical Bulletin (2019). |
| *ope* | openness calculated as exports plus imports divided by gross domestic product (GDP) |
| *corp* | corruption index. The value ranges from 0 for a country with the highest degree of corruption to 6 for less corruption. In this study, we re-define the index by deducting each year's figure from 6. Consequently, 6 indicates the highest level of corruption and 0 lowest. It simply means that an increase in the corruption index indicates a worsening level of corruption (Bahmami-Oskooee and Goswami 2005). Source: International Country Risk Guide (ICRG). |

## 4. Empirical Results

Tables 2 and 3 show the descriptive statistics and the pair-wise correlation matrix of the variables, respectively. As revealed in Table 2 all the variables used in the model are platykurtic as their kurtosis values are less than 3 except for the Gini coefficient index and openness. The implication of this finding is that the series have lighter tails than a normal distribution. Except for the Gini coefficient index and openness, the Jacque-Bera statistic accepts the normal distribution hypothesis at 5 percent. The pair-wise correlation results reveal that the Gini coefficient index negatively correlates with an oil price increase, misery index, GDP per capita, and openness. In contrast, increase oil price and openness are positively correlated with the Gini coefficient index.

**Table 2: Descriptive statistics**

| | *gin* | $oip^{+}$ | $oip^{-}$ | *gdp* | *mis* | *corp* | *ope* |
|---|---|---|---|---|---|---|---|
| Mean | 0.5582 | 1.8415 | -1.8808 | 26.0564 | 3.4762 | 0.4398 | 1.9357 |
| Median | 0.5836 | 1.7943 | -2.0028 | 25.8299 | 3.5889 | 0.4055 | 1.7824 |
| Maximum | 0.6007 | 4.2519 | -0.0488 | 26.8747 | 5.5727 | 0.6931 | 4.5711 |
| Minimum | 0.3988 | 0.000 | -3.6055 | 25.4041 | 1.7627 | 0.0000 | 0.9708 |
| Std.Dev | 0.0503 | 1.4408 | 0.9466 | 0.5041 | 1.3181 | 0.2353 | 0.8700 |
| Skewness | -1.3677 | 0.2334 | 0.0789 | 0.4129 | -0.0083 | -0.6381 | 1.8170 |
| Kurtosis | 3.9091 | 1.5418 | 2.5885 | 1.6702 | 1.4812 | 2.5238 | 6.0685 |
| Jarque-Bera | 13.1556 | 3.6145 | 0.2995 | 3.8798 | 3.6529 | 2.9378 | 35.8181 |
| Probability | 0.0014 | 0.1641 | 0.8609 | 0.1437 | 0.1610 | 0.2302 | 0.0000 |
| Sum | 21.2104 | 68.1340 | -69.5903 | 990.1425 | 132.0963 | 16.7126 | 73.5572 |
| Sum Sq.Dev | 0.0937 | 74.7307 | 32.2592 | 9.4032 | 64.2809 | 2.0485 | 28.0055 |

**Table 3: Pairwise-Correlation matrix**

| Variable | *gin* | $oip^{+}$ | $oip^{-}$ | *gdp* | *mis* | *corp* | *ope* |
|---|---|---|---|---|---|---|---|
| *gin* | 1.0000 | | | | | | |
| $oip^{+}$ | -0.5924 | 1.0000 | | | | | |
| $oip^{-}$ | 0.5875 | -0.9842 | 1.0000 | | | | |
| *gdp* | -0.5855 | 0.9922 | -0.9860 | 1.0000 | | | |
| *mis* | -0.6910 | 0.9605 | -0.9597 | 0.9602 | 1.0000 | | |
| *corp* | 0.5204 | -0.6303 | 0.6474 | -0.6326 | -0.6566 | 1.0000 | |
| *ope* | -0.5717 | 0.9819 | -0.9736 | 0.9798 | 0.9509 | -0.5976 | 1.0000 |

The results of Augmented Dickey-Fuller (ADF intercept only) and Phillips Peron tests Unit root tests as presented in Table 4 show that all the variables are $I(1)$ except openness, which is $I(0)$ at the 10 percent level.

**Table 4: ADF and PP unit root tests**

| | ADF | | PP | |
|---|---|---|---|---|
| Variable | Level | 1st diff | Level | 1st diff |
| *gin* | 0.6112 | -4.9576*** | 0.7216 | -4.9576*** |
| *ina* | -0.1697 | -5.3622*** | -0.2018 | -5.3622*** |
| $oip^{+}$ | 0.6863 | -4.5215*** | 0.6100 | -4.4122*** |
| $oip^{-}$ | -0.7819 | -6.1409*** | -0.7037 | -6.3769*** |
| *gdp* | -0.2782 | -3.8091*** | 0.8185 | -3.8091*** |
| *mis* | -0.7506 | -4.5139*** | -0.7543 | -6.1570*** |
| *corp* | -2.0516 | -3.6149*** | -1.6797 | -3.5324*** |
| *ope* | 2.9040* | -5.6101*** | 2.9040* | -5.6101*** |

Note:***, ** and * represent 1%, 5% and 10% significant levels respectively. For ADF test, critical values are: -3.6268, -2.9458 and -2.6115 at 1%, 5% and 10% respectively. For PP test, critical values are: -3.6210, -2.9434 and -2.6103 at 1%, 5% and 10% respectively.

The linear and nonlinear cointegration test results are presented in Table 5. The results confirm lack of cointegration as $F\text{-}_{PSS}$ = 2.146 for the linear model lies beneath the lower bound. The variables are not cointegrated for the linear model. The reverse is the case for the nonlinear model with the Gini coefficient index (*gin*) and Atkinson

**Table 5: Results of bounds test for the linear and nonlinear specifications**

| Dependent Variable: $\Delta gin$ | F-PSS | 95% Lower bound | 95% Upper bound | Result |
|---|---|---|---|---|
| Linear ARDL | 2.146 | 2.39 | 3.38 | No Cointegration |
| Non-Linear ARDL[a] | 4.659*** | 2.27 | 3.28 | Cointegration |
| Non-linear ARDL with $\Delta \boldsymbol{ina}$ as a dependent variable | 3.290*** | 2.27 | 3.28 | Cointegration |

Bounds test at 5%.

[a]The exact specification of the asymmetric ARDL model is presented in Tables 6 and 7

*F-PSS* indicates the *PSS F*-statistic testing the model hypothesis of no cointegration.

index (*ina*) as measures of income inequality. The $F$-pss statistic of the nonlinear model (NARDL) model lies above the upper bound of the critical value. For the two measures of income inequality, the NARDL cointegration test confirms cointegration.

The results of the linear ARDL model presented in table 6 reveal that the coefficient of one-year Gini coefficient index is negative and significant ($\delta_1$ = -0.407; ρ-value = 0.008). Oil price lagged one year reduces income inequality especially in the long run. Also, oil price reduces income inequality in the short run. However, a one-year lagged oil price increases income inequality in the short run. The results show that corruption lagged two-period increases corruption in the short run. However, since the variables are not cointegrated in the linear model, firm conclusion cannot be drawn from the results.

Next, we tested for nonlinear relationship between oil price and income inequality using the NARDL bounds test. Equation 4 is estimated using the Gini coefficient index, and Atkinson's index as measures of income inequality. The outcomes are presented in tables 7 and 8, respectively.

**Table 6: Income Inequality-Oil Price: ARDL Estimation**.

| **Dependent variable: $Gin_t$** | | | |
|---|---|---|---|
| Variable | Coefficient | t-statistics | P-value |
| Constant | 0.289 | 0.391 | 0.700 |
| $gin_{t-1}$ | -0.407*** | -2.958 | 0.008 |
| $Inoip_{t-1}$ | -0.031** | -2.142 | 0.045 |
| $Ingdp_t$ | 0.002 | 0.079 | 0.938 |
| $Inmis_t$ | 0.002 | 0.174 | 0.864 |
| $Incorp_{t-1}$ | -0.012 | -0.629 | 0.539 |
| $lope_{t-1}$ | -0.009 | -0.327 | 0.748 |
| $\Delta lnoip_t$ | -0.033** | -2.579 | 0.018 |
| $\Delta lnoip_{t-1}$ | 0.051*** | 3.615 | 0.002 |
| $\Delta lnoip_{t-2}$ | 0.022 | 1.586 | 0.129 |
| $\Delta lncorp_t$ | 0.034 | 0.818 | 0.424 |
| $\Delta lncorp_{t-1}$ | -0.066 | -1.634 | 0.119 |
| $\Delta lncorp_{t-2}$ | 0.119*** | 3.114 | 0.006 |
| $\Delta lnope_t$ | -0.001 | -0.074 | 0.942 |
| $\Delta lnope_{t-1}$ | 0.015 | 0.450 | 0.658 |
| $\Delta lnope_{t-2}$ | -0.042 | -1.254 | 0.225 |
| Statistics and diagnostic tests | | | |
| $X^2_{Norm}$ = 10.376(0.005) | | $X^2_{Het}$ = 0.0123(0.912) | |
| $X^2_{SC}$ = 2.093(0.154) | | $X^2_{FF}$ = 0.7885(0.386) | |

Note: *** and ** indicate significance levels for 1% and 5%, respectively.
$\chi^2_{SC}$, $\chi^2_{HET}$, $\chi^2_{NORM}$ and $\chi^2_{FF}$ refer to LM test for serail correlation, normality, functionality form and heteroscedasticity, respectively.

The results in tables 7 and 8 confirm the rejection of the null hypothesis in the short run. Specifically, Wald tests results are $W_{SR,Inoip}$ = 4.610***(0.046) and $W_{SR,Inoip}$= 3.224***(0.000).

The result confirms that income inequality reacts differently to an increase and a decrease in oil price in the short run. In the long run, however, the results reject the alternate hypothesis ($W_{LR,Inoip}$ = 2.136(0.180) and $W_{LR,Inoip}$ = 0.490(0.626)). This simply means that an upward or downward oil price movement does not have a different impact on income inequality. This suggests lack of long-run asymmetric effect of oil price change. The main inference from these results is that the asymmetry in the effects of oil price shocks on income inequality is a short-term rather than long-run phenomenon in Nigeria. It means that nonlinearity and asymmetry should be considered when analyzing the energy-income inequality relationship for Nigeria in the short run period.

With evidence of asymmetry, especially in the short-run, we focus on the long-run and short-run estimates. In tables 7 and 8, the coefficients of positive ($oip_t^+$) and negative ($oip_t^-$) oil price change are positive and negative, respectively. The results reveal that a positive oil price change has an insignificant positive effect, while a negative oil price change has a significant negative impact. This finding suggests that a reduction in oil prices will cause income inequality to reduce in the long run. As shown in table 7, the four critical variables that explain the long-run equilibrium of income inequality in Nigeria are the negative partial sums decomposition, GDP per capita, misery index, and openness, all lagged one-period. In the short run, income inequality is explained by negative and positive partial sums decompositions, GDP per capita, one- and two-periods lagged misery index, two-period lagged corruption index, and openness index lagged one period. The misery index reduces inequality of income in the short run but increases it in the long run. An increase in GDP per capita reduces income inequality in the short and long run. Openness is harmful to inequality of income in the short run but produces a beneficial effect on reducing income inequality in the long run. In the short run, corruption increases income inequality. The long-run coefficients of negative and positive changes in the oil price are -0.398 and 0.337, respectively. This finding shows that a 1 percent decrease in oil price precipitates an approximately 0.398 percent reduction in income inequality. However, a 1 percent increase in the price of oil leads to a 0.337 percent increase in income inequality but is significant only at 10 percent. The results indicate a greater effect from oil price reduction than oil price increase. The results obtained when income inequality is measured as Atkinson's index (see table 8) follow the same pattern as in table 7 except for the magnitude and significance of a few variables.

**Table 7: Results of NARDL estimation**

Dependent variable: $Gin_t$

| Variable | Coefficient | t-statistics | P-value |
|---|---|---|---|
| Constant | 16.039** | 2.261 | 0.054 |
| $gin_{t-1}$ | -0.332* | -1.829 | 0.104 |
| $Inoip^{+}_{t-1}$ | 0.112 | 1.411 | 0.196 |
| $Inoip^{-}_{t-1}$ | -0.132** | -2.812 | 0.023 |
| $Ingdp_{t-1}$ | -0.629** | -2.238 | 0.056 |
| $Inmis_{t-1}$ | 0.072* | 2.138 | 0.065 |
| $Incorp_{t-1}$ | 0.112 | 1.725 | 0.123 |
| $Inope_{t-1}$ | -0.071** | -2.913 | 0.020 |
| $\Delta gini_{t-1}$ | -0.298 | -1.249 | 0.247 |
| $\Delta oip^{+}_{t}$ | -0.065 | -1.633 | 0.141 |
| $\Delta oip^{+}_{t-1}$ | -0.083 | -1.147 | 0.285 |
| $\Delta oip^{+}_{t-2}$ | -0.089* | -1.868 | 0.099 |
| $\Delta oip^{-}_{t}$ | -0.038 | -1.318 | 0.224 |
| $\Delta oip^{-}_{t-1}$ | 0.099*** | 3.398 | 0.009 |
| $\Delta oip^{-}_{t-2}$ | 0.074** | 2.515 | 0.037 |
| $\Delta gdp_{t}$ | -0.558** | -2.288 | 0.051 |
| $\Delta gdp_{t-1}$ | -0.126 | -0.893 | 0.398 |
| $\Delta gdp_{t-2}$ | 0.128 | 0.909 | 0.390 |
| $\Delta mis_{t}$ | -0.069 | -1.540 | 0.162 |
| $\Delta mis_{t-1}$ | -0.118** | -2.512 | 0.036 |
| $\Delta mis_{t-2}$ | -0.139* | -2.092 | 0.069 |
| $\Delta corp_{t}$ | 0.240** | 2.343 | 0.047 |
| $\Delta corp_{t-1}$ | -0.085 | -1.557 | 0.158 |
| $\Delta corp_{t-2}$ | 0.120** | 2.626 | 0.030 |
| $\Delta ope_{t}$ | -0.025 | -1.338 | 0.218 |
| $\Delta ope_{t-1}$ | 0.058*** | 3.049 | 0.016 |

| Asymmetric coefficient (Long-Run) | | Long and Short run asymmetric tests | |
|---|---|---|---|
| $LR^{+}_{Inoip}$ | = 0.337 (0.299) | $W_{LR,Inoip}$ | = 2.136 (0.180) |
| $LR^{-}_{Inoip}$ | = -0.398* (0.100) | $W_{SR,Inoip}$ | = 4.610** (0.046) |
| Diagnostic tests | | | |
| $X^2_{Norm}$ = | 0.487 (0.783) | $X^2_{Het}$ = | 0.581 (0.451) |
| $X^2_{SC}$ = | 3.616 (0.100) | $X^2_{FF}$ = | 6.097 (0.042) |

*, **, and ***, denote significance level for 10%, 5%, and 1%, respectively.
$W_{LR}$, $W_{SR}$ and wald test for the null of long and short-run symmetry, respectively
$\chi^2_{SC}$, $\chi^2_{NORM}$, $\chi^2_{HET}$ and $\chi^2_{FF}$ symbolize LM test for serial correlation, normality, functional form and heteroscedasticity, respectively.

The diagnostic tests of the estimated models are reported in the lower part of Tables 7 and 8. The serial correlation LM ($X^2_{SC}$) and ARCH ($X^2_{Het}$) for heteroscedasticity confirm that the model well specified. Moreover, the plots of the CUSUMQ and CUSUM statistics for nonlinear models confirm model stability (see Figs. 2, 3, 4, and 5 in Appendix A). Hence, the estimated models are suitable for policy formulation and implementation.

The study further uses the dynamic multiplier by Shin, Yu, & Greenwood-Nimmo (2014) in examining the pattern of the asymmetric adjustment of income inequality from its initial equilibrium to the new steady-state in the long-run shocks, albeit from its initial equilibrium. Figs 6 and 7 show the effects of an increases and decrease in oil price on income inequality measured as Gini coefficient index and Atkinson's index, respectively. The solid black line in Figs 6 and 7 depicts the shocks in income inequality after a positive change in oil price. In contrast, the black short-dotted line represents the shocks in income inequality following a negative change in oil price. The red short-dotted line represents the asymmetry curve which captures the difference between the negative and positive changes in oil prices, with its corresponding 95% confidence interval for statistical inferences. The zero line lies between the upper and lower band of the 95% confidence interval (see figs. 6 and 7); hence, the asymmetric effect of oil price is statistically insignificant at the 5% level.

**Table 8: Results of NARDL estimation**

| Dependent variable: $\Delta ina_t$ | | | |
|---|---|---|---|
| Variable | coefficient | t-statistics | P-value |
| Constant | 25.438* | 1.837 | 0.096 |
| $ina_{t-1}$ | -0.485** | -2.805 | 0.019 |
| $oip_{t-1}^{+}$ | 0.189 | 1.229 | 0.247 |
| $oip_{t-1}^{-}$ | -0.267** | -2.516 | 0.031 |
| $gdp_{t-1}$ | -0.991* | -1.808 | 0.100 |
| $mis_{t-1}$ | 0.056 | 0.796 | 0.444 |
| $corp_{t-1}$ | 0.106 | 0.773 | 0.457 |
| $ope_{t-1}$ | -0.134** | -2.763 | 0.020 |
| $\Delta oip_{t}^{+}$ | -0.012 | -0.145 | 0.888 |
| $\Delta oip_{t-1}^{+}$ | -0.095 | -0.701 | 0.499 |
| $\Delta oip_{t-2}^{+}$ | -0.162 | -1.571 | 0.147 |
| $\Delta oip_{t}^{-}$ | -0.112* | -1.814 | 0.997 |
| $\Delta oip_{t-1}^{-}$ | 0.205*** | 3.158 | 0.010 |
| $\Delta oip_{t-2}^{-}$ | 0.144** | 2.299 | 0.044 |
| $\Delta gdp_t$ | -0.758 | -1.697 | 0.121 |
| $\Delta gdp_{t-1}$ | -0.294 | -0.965 | 0.358 |
| $\Delta mis_t$ | -0.059 | -0.614 | 0.553 |
| $\Delta mis_{t-1}$ | -0.128 | -1.261 | 0.236 |
| $\Delta mis_{t-2}$ | -0.198 | -0.426 | 0.185 |
| $\Delta corp_t$ | 0.276 | 1.339 | 0.210 |
| $\Delta corp_{t-1}$ | -0.036 | -0.342 | 0.740 |
| $\Delta corp_{t-2}$ | 0.285** | 2.789 | 0.019 |
| $\Delta ope_t$ | -0.026 | -0.626 | 0.546 |
| $\Delta ope_{t-1}$ | 0.108** | 2.655 | 0.024 |
| Asymmetric coefficient (Long-Run) | | Long and Short run asymmetric tests | |
| $LR_{Inoip}^{+}$ | = 0.389 (0.290) | $W_{LR,Inoip}$ | = 0.490 (0.626) |
| $LR_{Inoip}^{-}$ | = -0.551** (0.034) | $W_{SR,Inoip}$ | = 3.224***(0.000) |
| Statistics and diagnostic tests | | | |
| $X_{Norm}^2$ = | 5.712 (0.028) | $X_{Het}^2$ = | 1.468 (0.234) |
| $X_{SC}^2$ = | 0.798 (0.670) | $X_{FF}^2$ = | 2.966 (0.119) |

*, ** and ***, denote significance level for 10%, 5%, and 1%, respectively.
$W_{LR}$, $W_{SR}$ and wald test for the null of long and short-run symmetry, respectively
$\chi^2_{SC}$, $\chi^2_{NORM}$, $\chi^2_{HET}$ and $\chi^2_{FF}$ symbolize LM test for serial correlation, normality, functional form and heteroscedasticity, respectively.

To further assess the relationship between income inequality and changes in oil prices a vector error correction model (VECM) was estimated using a variant of model 1 that incorporates both negative and positive oil changes. VECM is appropriate since the variables of the model are stationary at first difference (i.e. $I(1)$), and they are cointegrated using the NARDL bounds test. In view of the fact that individual coefficient from the vector error correction model (VECM) is somewhat difficult to interpret (Sunce & Akanbi 2016; Akinlo & Akinlo 2007), we focus on the

Impulse Response Functions (IRFs) and Variance Decompositions (VDCs) from the estimated VECM.

The plots of the IRFs at 5% error bounds, generated by Monte Carlo simulation, for the 6-variable model are plotted in fig. 1. As shown in the figure, a one standard deviation shock applied to the positive oil price change ($oip_t^+$) produces a strong negative impact on the income inequality in the first period but turns positive from the third. It reaches its peak in the sixth period. However, it falls slightly from the sixth period but increases steadily over the long-run period. A one standard deviation shock to the negative oil price change($oip_t^-$) increases income inequality in the first two periods but drops in the third. It, however, assumes a relatively upward movement from the third to the tenth period.

The GDP per capita reduces income inequality slightly in the first to the third period. The impact increases further in the medium and long run. This shows that income inequality decreases as income increases. In the same way, the misery index rate reduces income inequality sharply in the first period and remains relatively stable till the third period. The magnitude of the impact decreases in the fourth period and maintains a relatively constant level from the fifth to the tenth period. Corruption produces a strong positive impact on income inequality in the first period but drops sharply in the second period. The effect remains relatively stable from the fourth period to the tenth period. Finally, openness reduces income inequality moderately in the first period. The magnitude increases sharply in the third period and remains relatively constant afterwards.

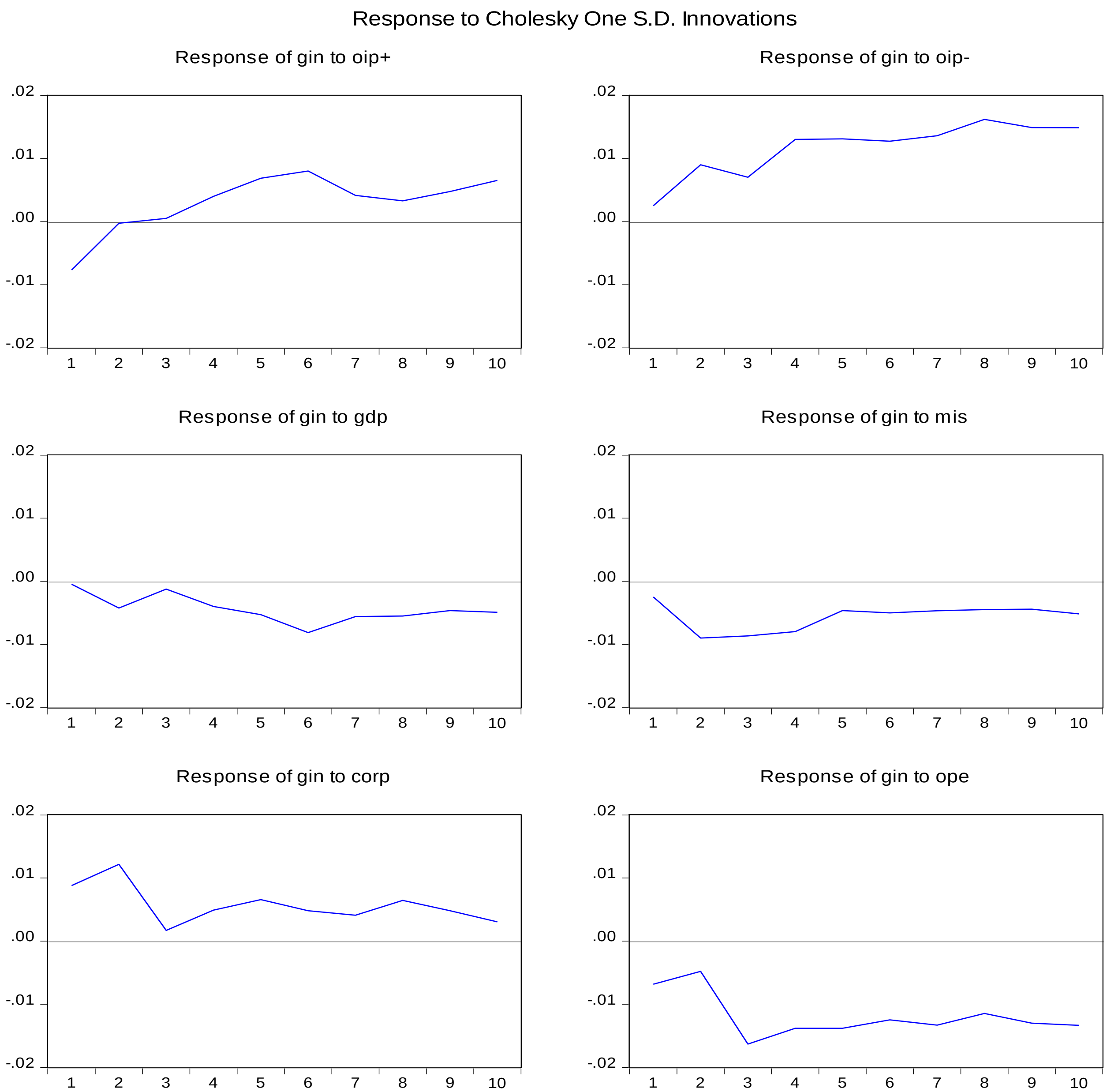


**Fig. 1: Impulse Response Functions**

Next, we analyze the variance decompositions to determine the magnitude of the effect. The results of the VDCs are shown in table 9. As shown in the table 9, increase in oil price had a considerable impact in the first period. The effect decreases sharply from the second period, while it remains relatively constant at around 5 percent after the fourth period. It accounts for six percent on average of the variation in income inequality. However, the downward movement in oil price has a relatively significant impact on income inequality starting from the third period. It accounts for approximately twenty percent of the variation in income inequality. Also, from table 9, the magnitude of the effect of gross domestic product per capita is low in the short-run period. It, however, increases marginally in the medium and the long-run horizon. GDP per capita growth accounts for approximately 3 percent of the variation in income inequality over the 10-periods horizon.

The proportion of variance explained by the misery index is low in the first period but increases from the second to the third period. It, however, drops to a single-digit value from the fifth period. Corruption shows up significantly only in the short-run period. However, the proportion of variance explained by corruption falls precipitously from approximately 28 percent in the second period to 18 percent in the third period and becomes single-digit from the seventh period. It accounts for approximately 14 percent of the variation in income inequality. Openness has a relatively high (generally double-digit) impact on income inequality except in the first two periods. Considering the fact that the estimated results can be sensitive to the ordering of the variables in the model, we changed the order by placing the first variable last and the last first to ascertain the robustness of our model. The outcomes are not significantly different from the one reported in the paper.

**Table 9: Decomposition of Variance Error of gin from VECM[a]**

| Period | SE | Explained by Innovation | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | $oip^+$ | $oip^-$ | *gdp* | mis | corp | ope | gin |
| 1 | 0.01783 | 18.575 | 2.013 | 0.068 | 1.900 | 24.341 | 14.676 | 38.427 |
| 2 | 0.02816 | 7.459 | 11.048 | 2.302 | 10.968 | 28.481 | 8.786 | 30.956 |
| 3 | 0.03599 | 4.587 | 10.566 | 1.527 | 12.496 | 17.661 | 25.884 | 27.280 |
| 4 | 0.04341 | 3.999 | 16.278 | 1.887 | 11.961 | 13.416 | 27.880 | 24.579 |
| 5 | 0.05049 | 4.817 | 18.798 | 2.494 | 9.683 | 11.620 | 28.111 | 24.476 |
| 6 | 0.05633 | 5.900 | 20.223 | 4.081 | 8.564 | 10.068 | 27.485 | 23.677 |
| 7 | 0.06127 | 5.449 | 22.044 | 4.280 | 7.818 | 8.962 | 27.961 | 23.486 |
| 8 | 0.06619 | 4.918 | 24.901 | 4.355 | 7.158 | 8.629 | 26.952 | 23.088 |
| 9 | 0.00623 | 4.776 | 26.322 | 4.255 | 6.677 | 8.044 | 27.069 | 22.858 |
| 10 | 0.07486 | 5.018 | 27.384 | 4.217 | 6.420 | 7.327 | 27.269 | 22.364 |

Ordering: $oip^+$, $oip^-$ *gdp, mis, corp, ope, gin*

Finally, the study performs diagnostic tests to verify the stability of the established relationships over the sample period. The results confirm the absence of conditional heteroscedasticity ($\chi 2 = 569.721$, probability value = 0.2334) and serial correlation. All the roots of AR characteristics polynomial in Fig. 8 have an absolute value of less than one and fall inside the unit circle (see Fig. 8 in Appendix A). This is a confirmation that the VECM employed in our analysis satisfies the basic econometric assumptions.

## 5. Conclusion

Despite the numerous existing studies on the impact of changes in oil prices on macroeconomic fundamentals, little attention has been devoted to investigating how oil price shocks affect income inequality, especially in Nigeria-a highly oil-dependent economy. Hence, the focus of this study is examining the effect of oil price shocks on income inequality in Nigeria. Specifically, the paper employs linear and nonlinear ARDL models and VECM model with emphasis on variance decompositions, and impulse response functions (IRFs) techniques.

The results of the linear ARDL estimation show that income inequality, oil prices, corruption, openness, misery index, and GDP per capita are not cointegrated. However, using the Shin, Yu, & Greenwood-Mimmo's (2014) asymmetric nonlinear ARDL approach, the results confirm cointegration and asymmetry in the short run. Moreover, the outcomes reveal that income inequality responds more to a fall in oil price than an increase. The study reveals that, in the short run, the most effective and efficient model for analyzing income inequality and changes in oil prices should incorporate asymmetric effect.

What policy inferences can we draw from the findings of this study, especially for the Nigerian economy? The results suggest that increased oil price increases income inequality. In contrast, decreased oil price reduces income inequality. This finding suggests that the policy makers must introduce measures to domestic oil price. However, this may be costly in terms of revenue loss since oil constitutes a major source of income for the government in Nigeria. Hence, there is a need for economic diversification in the country. Efforts should be geared toward promoting agriculture, technology, and manufacturing in the economy.

The result shows that GDP per capita benefits income inequality in Nigeria. This suggests that the government needs to grow the economy. Government must provide the enabling environment for the private sector to thrive. The basic social amenities such as good roads and electricity must be provided. Policy makers must improve on the ease-of-doing business in Nigeria. In addition to growing the economy, the government must ensure that economic growth trickles down to the poor in the country.

Moreover, the government needs to tackle decisively the high and increasing level of corruption in the country. This will require building of strong institutions and structures to address the problem of corruption in the country. Government needs to show a high level of commitment to transparency, accountability, and good governance. Policymakers must introduce measures to address the increasing rates of inflation and unemployment to reduce income inequality. The problem of inflation can be addressed through the institution of appropriate monetary and fiscal policies by the policymakers. Monetary policies such as reduction in interest and exchange rates can assist in boosting investment and output, which may help in reducing the level of inflation and unemployment in the long run.

Generally, the outcomes of this study reemphasize the need to adequately understand the role of asymmetry in oil price effects to better address their problem on income inequality using Nigeria as a case study. It drives home the need to carefully explore the sources of oil perturbations to enhance formulation of appropriate policies that will address the problem of income inequality.

## References

Abbas S (2020) Impact of oil prices on remittances to Pakistan from GCC countries: evidence from panel asymmetric analysis. *OPEC Energy Review*, 44(2): 205-223.

Abdel-Latif H, Osman RA, Ahmed H (2018) Asymmetric impacts of oil price shocks on government expenditures: evidence from Saudi Arabia. *Cogent Economics and Finance,* 6(1):1-14.

Acemoglu, D., & Johnson, S. (2005). Unbundling institutions. *Journal of Political Economy*, 3, 949-995.

Acemoglu, D., & Johnson, S. (2012). Who captured the Fed? *New York Times*, 29.

Acemoglu, D., & Robinson, J. (2012). Why nations fail: The origins of power, prosperity, and poverty. Crown Business, New York.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2001). The colonial origins of comparative development: an empirical investigation. *American Economic Review,* 91, 1369-1401.

Acemoglu, D., Johnson, S., & Robinson, J. A. (2002). Reversal of fortune: Geography and institutions in the making of the modern world income distribution. *The Quarterly Journal of Economics,* 117, 1231-1294.

Akcay A, Karasoy A (2019) Asymmetric impact of oil prices on remittances: evidence from India. *OPEC Energy Review*, 43(3): 362-382.

Akcay S (2019) Does oil price asymmetrically impact remittance outflows? The case of Oman. *Review of Middle East Economics and Finance*, 15(2): 1-9.

Akcay S (2021) Are oil prices and remittance outflows asymmetric? Evidence from Saudi Arabia. *Energy RESEARCH LETTERS*, 2(1): 1-5.

Akcay S, Karasoy A (2019) Determinants of remittances in Egypt: do macroeconomic instability and oil price matter? *International Migration*, 57(5): 142-160.

Akinlo, A. E., & Akinlo, O. O. (2007). Financial development, money, public expenditure and national income in Nigeria, *Journal of Social and Economic Development,* 9(1): 1-24.

Akinlo, A. E., & Ojo, M. S. (2021). Examining the asymmetric effects of oil price shocks on remittances inflows: evidence from Nigeria. *SN Business and Economics*, 1:137, https://doi.org/10.1007/s43546-021-00140-y.

Akinlo, AE (2020) Asymmetric impacts of oil price shocks on unemployment: evidence from Nigeria. *The Review of Finance and Banking*, 12(1): 63-78.

Bahmani-Oskooee, M., & Goswami, G. G. (2005). Impact of corruption on the black market premium, *Southern Economic Journal,* 71(3), 483-493.

Bahmani-Oskooee, M., Scott, W. H., & Harvey, M. (2008). Short-run and long-run determinants of income inequality: evidence from 16 countries. *Journal of Post Keynesian Economics,* 30(3), 463-484.

Bastianin, A.,Conti, F., & Manera, M. (2016). The impacts of oil price shocks on stock market volatility: Evidence from the G7 countries. *Energy Policy*, 98, 160-168.

Bernanke, B. S. (2015). Monetary policy and inequality. http/www.brookings.edu/blogs/ben-bernanke/posts/2015/06/01-monetary-policy-and-inequality.

Bhattacharyya, S, & Williamson, J. G. (2015). Distributional consequences of commodity price shocks: Australia over a century. *Review of Income and Wealth*, 10.1111/roiw.12167.

Bolarinwa, T. S., & Akinlo, A. E. (2021). Is there a nonlinear relationship between financial development and income inequality in Africa? Evidence from dynamic panel threshold. *The Journal of Economic Asymmetries*, 24, e0026, 1-9.

Bound, J., & Johnson, G. (1992). Changes in the structure of wages in the 1980s: an evaluation of alternative evidence. *American Economic Review*, 82(3), 371-392.

Brada, J. C. (2013). The distribution of income between labour and capital is not stable: but why is that so and why does it matter? *Economic System*, 37, 333-344.

Carmignani, F. (2013). Development outcomes, resource abundance, and the transmission through inequality. *Resource and Energy Economics,* 35, 412-428.

Credit Sussie (2020) Global Wealth Report. Canada

Crespo, N., Simeos, N., & Diogo, A. (2012). Determinant factors of income inequality- Evidence from a Portuguese region. *Economic Bulletin*, 32(3), 2056-2064.

Cuesta, J., & Ordonez, J. (2018). Oil prices and unemployment in the UK before and after crisis: A Bayesian VAR approach. A note. *Physica* A, 510, 200-207.

Deyshappriya, N. P. R. (2017). Impact of macroeconomic factors on income inequality and income distribution in Asian countries. ADBI Working Paper 696.

Draghi, M. (2016). Stability, equity and monetary policy, 2nd DIW Europe Lecture, http://www.ecb.europa.eu/press/key/date/2016/html/sp161025.en,html.

Farzanegan, M. R., & Krieger, T. (2017). The response of income inequality to positive oil rents shocks in Iran: Implications for post-sanction period. Diskussionsbeitrage, No. 2017-04.

Farzanegan, M., & Markwardt, G. (2009). The effects of oil price shocks on the Iranian economy. *Energy Economics*, 31, 134-151.

Furceri, D., Loungani, P., & Zdzienicka, A. (2016). The effects of monetary policy shocks on inequality. IMF Working Paper WP/16/245.

Goderis, B., & Malone, S. W. (2011). Natural resource booms and inequality: theory and evidence. *Scandinavian Journal of Economics*, 113, 388-417.

Guerello, C. (2016). Conventional and unconventional monetary policy vs. household income distribution: an empirical analysis for the Euro Area. (mimeo).

Hall, R. F., & Jones, C. I. (1999). Why do some countries produce so much more output per worker than others? *The Quarterly Journal of Economics*, 114, 83-116.

Howie, P. & Atakhanova, Z. (2014). Resource boom and inequality: Kazakhstan as a case study. *Resource Policy,* 39, 71-79.

Hussey, A. J., Jetter, M., & McWilliam, D. (2020). The fundamental determinants of economic inequality in average income across countries: The declining role of political institutions. *The Review of Income and Wealth,* series 0 no 0, 1-30.

Jaumotte, F., & Buitron, C. O. (2015). Inequality and labour market institutions. IMF Staff Discussion Note, No. 15/14.

Jung, S. M., & Vijverberg, C. C. (2019). Financial development and income in China- a spatial data analysis. *The North American Journal of Economics and Finance*, 48(3), 295-320.

Karahan, F., & Ozkan, S. (2013). On the persistence of income shocks over the life cycle: evidence, theory, and implications. *Review of Economic Dynamics*, 16(3), 452-476.

Knack, S. & Keefer, P. (1995). Institutions and economic performance: Cross-country tests using alternative institutional measures. *Economics & Politics,* 7, 207-227.

Krieger, T., & Meirrieks, D. (2016). Political capitalism: The interaction between income inequality, economic freedom and democracy. *European Journal of Political Economy*, 45, 115-132.

Lorusso, M., & Pieroni, L. (2018). Causes and consequences of oil price shocks on the UK economy. *Economic Modelling*, 72(C), 223-236.

Mehlum, H., Moene, K., & Torvik, R. (2006). Institutions and the resource curse. *The Economic Journal*, 116, 1-20.

Munir, K., & Sultan, M. (2017). Macroeconomic determinants of income inequality in India and Pakistan. *Theoretical and Applied Economics*, 24(3), 109-120.

Naceur, S. P., & Zhang, R. (2016). Financial development, inequality and poverty: Some international evidence. *IMF Working Paper*16/32.

North, D. C. (1990). Institutions, Institutional Change and Economic Performance. Cambridge University Press, Cambridge.

North, D. C., & Thomas, R. P. (1973). The Rise of the Western World: A New Economic History. Cambridge University Press, Cambridge.

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

Nusair, S. A. (2020). The asymmetric effects of oil price changes on unemployment: Evidence from Canada and the U. S. *The Journal of Economic Asymmetries*, 21, 200153.1-13.

Nusair, S.(2029). Oil prices and inflation dynamics in the Gulf Cooperation council countries. *Energy*, 181, 997-1011.

Nusair, S., & Al-Khawneh, J. (2017). Oil price shocks and stock market returns of the GCC countries: Empirical evidence from quantile regression analysis. *Economic Change and Restructuring*, 51, 339-372.

Nusair, S., & Olson, D. (2019). The effects of oil price shocks on Asian exchange rates: Evidence from quantile regression analysis. *Energy Economics*, 78, 44-63.

O' Farrell, R., Radwdanowicz, L., & Inaba, K. (2016). Monetary policy and inequality. OECD Economics Department Working Papers, No. 1281, OECD Publishing, Paris.

Ordonez, J., Monfort, M., & Cuestas, J. (2019). Oil prices, unemployment and the financial crisis in oil-importing countries: The case of Spain. *Energy*, 181-634.

Oxfam (2017). Extreme Inequality and Essential Services, Full Report, Oxfam.

Pesaran MH, Shin Y, Smith RJ (2001) Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics* 16(3): 289-326.

Rafiu, I. A., Aminu, A., & Folawewo, A. O. (2020). Investigating the relationship between changes in oil prices and unemployment rate in Nigeria: linear and nonlinear autoregressive distributed lag approaches. *Future Business Journal*, 6(1), 1-18.

Saari, M. Y., Dietzenbacher, E., & Los, B. (2016). The impacts of petroleum price fluctuations on income distribution across ethnic groups in Malaysia. *Ecological Economics*, 130, 25-36.

Saiki, A., & Frost, J. (2014). Does unconventional monetary policy affect inequality? Evidence from Japan. *Applied Economics*, 46(36), 4445-4454.

Samir M, Zahran A (2019) The response of remittances inflows to asymmetric oil price shocks in Egypt. *Review of Economics and Political Science*, 3(2): 1-20.

Sheng X., & Gupta, R. (2021). The impact of oil price shocks on income inequality: evidence from state-level data of the United States. University of Pretoria Working Paper No. 202128.

Shin Y., Yu B., & Greenwood-Nimmo, M. (2014). Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework. In W. Horrace, R Sickles (ed.) Festschrift in Honour of Peter Schmidt, Vol 44. Springer New York, New York, NY, pp. 281-314.

Stiglitz, J. (2015). New theoretical perspectives on the distribution of income and wealth among individuals: part iv: land and credit. NBER Working Paper 21192.

Sunce, T., & Akanbi, O. A. (2016). The dynamic effects of monetary policy on real variables in Namibia, *Africa Journal of Economic Review*, 4(1): 1-37.

Thornton, J., & Tommaso, C. I. (2019). The long-run relationship between finance and income inequality: Evidence from panel data. *Finance Research Letters*, 32, 1-6.

Wei, Y., & Guo, X. (2017). Oil price shocks and China's stock market. *Energy*, 140(1), 185-197.

Appendix A

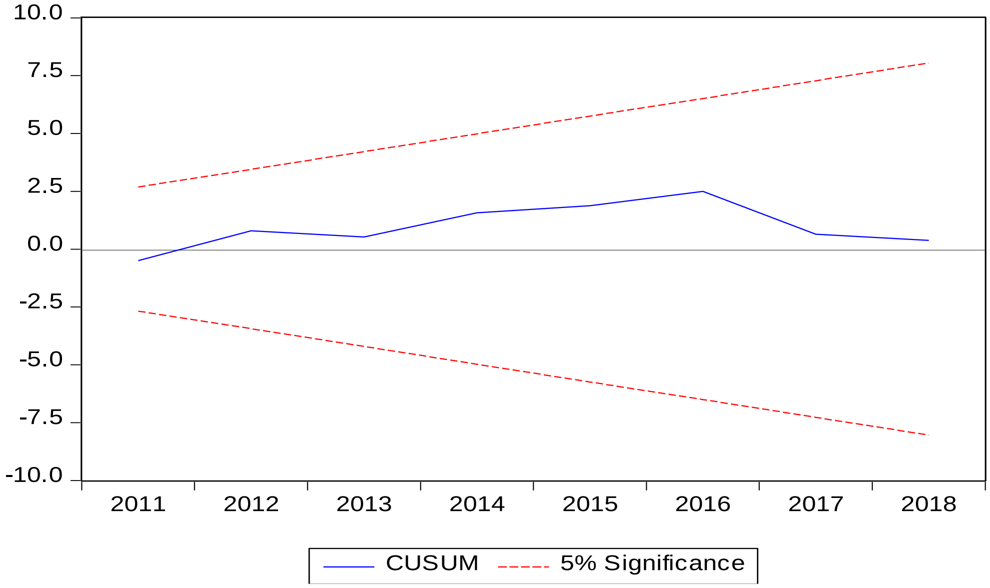


**Fig. 2: Plot of CUSUM test for the nonlinear ARDL model (Gini coefficient index)**

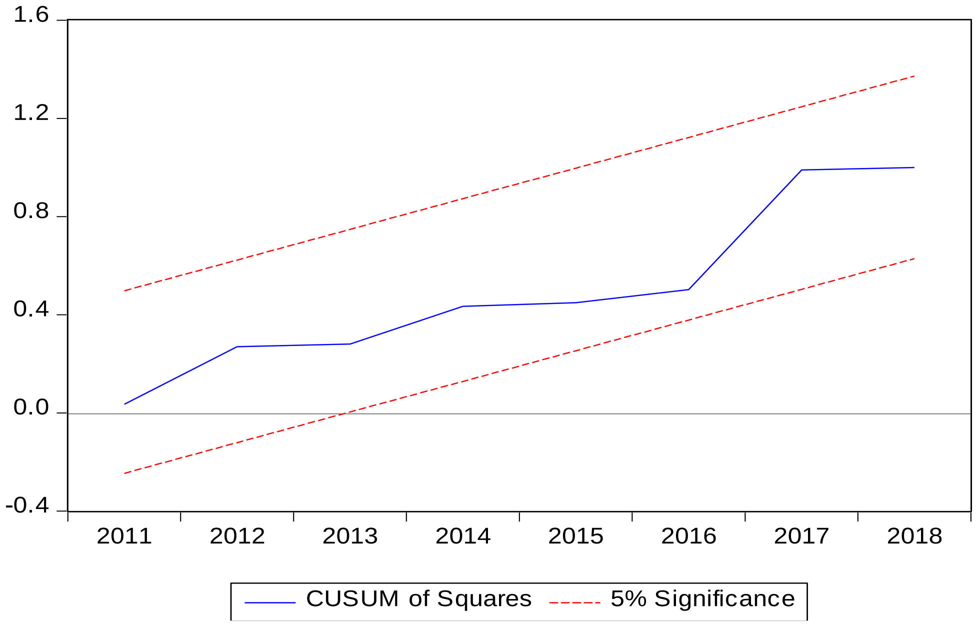


**Fig. 3: Plot of CUSUMQ test for nonlinear ARDL model (Gini coefficient index)**

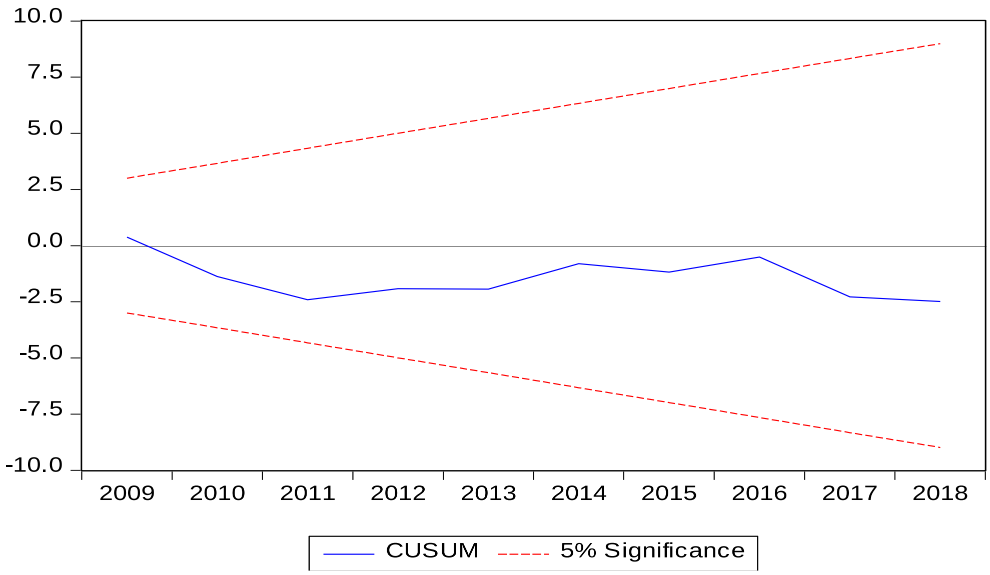


**Fig. 4: Plot of CUSUM test for the nonlinear ARDL model (Atkinson's Index)**

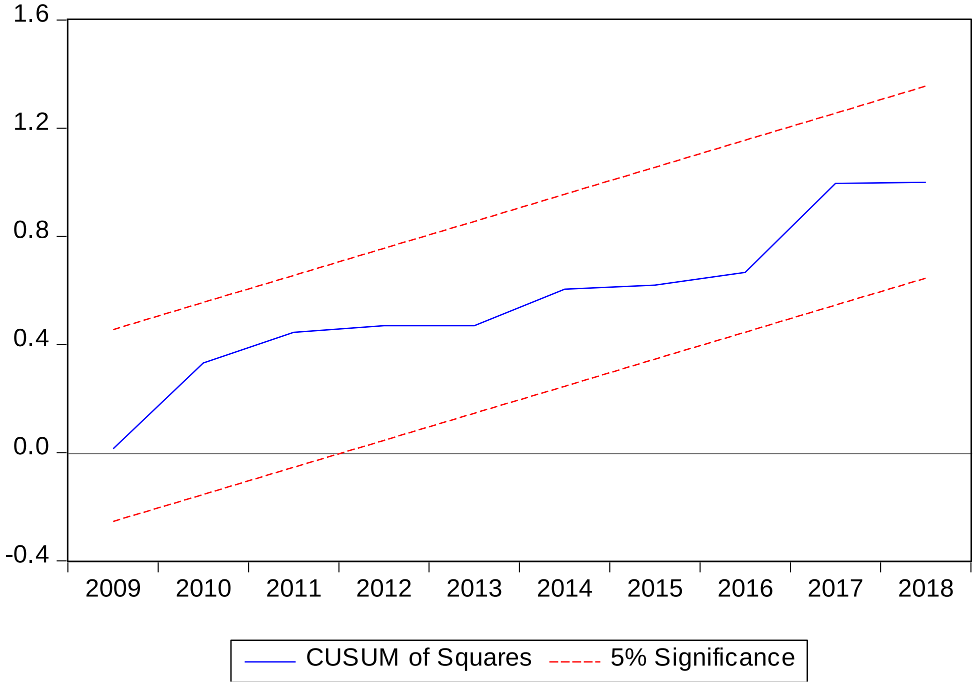


**Fig. 5: Plot of CUSUMQ test for the nonlinear ARDL model (Atkinson's index)**

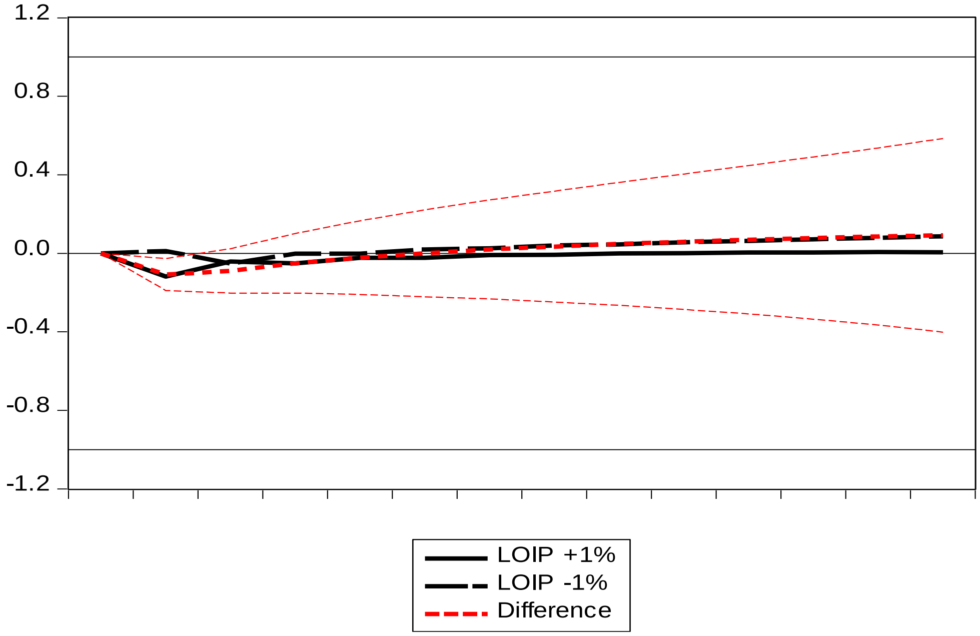


**Fig. 6: Dynamic multiplier for oil price – income inequality (*gin*) link**

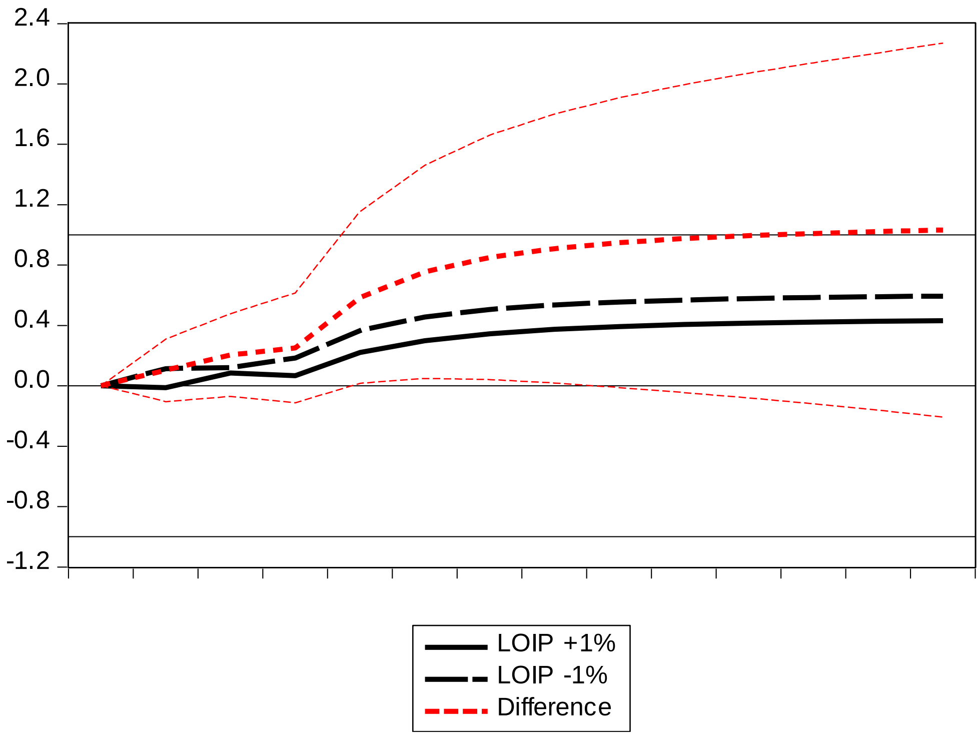


**Fig. 7: Dynamic multiplier for oil price – income inequality (*ina*) link.**

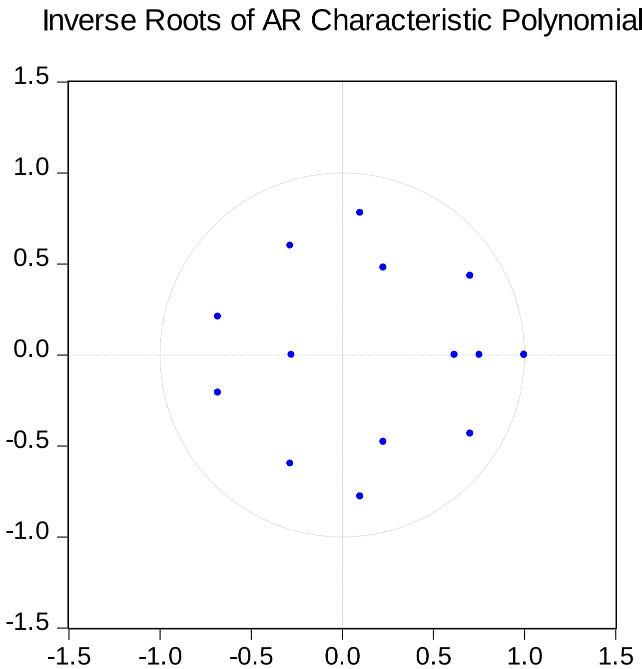


**Fig. 8: Inverse Roots of AR Characteristic Polynomial**.