International Journal of Current Advanced Research
ISSN: O: 2319-6475, ISSN: P: 2319-6505, Impact Factor: 6.614
Available Online at www.journalijcar.org
Volume 9; Issue 06(C); June 2020; Page No.22564-22572
DOI: http://dx.doi.org/10.24327/ijcar.2020.22572.4443

Research Article

THE ASYMMETRIC EFFECT OF CRUDE OIL PRICE SHOCKS ON FISCAL POLICY

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Economics

A R T I C L E I N F O

Article History:
Received 13th March, 2020
Received in revised form 11th April, 2020
Accepted 8th May, 2020
Published online 28th June, 2020

Key words:

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A B S T R A C T

The paper responds to the need for empirical knowledge about the asymmetric effects of crude oil prices on fiscal policy in Ghana. The study used time series data spanning from 1980-2018 and adapted the Nonlinear ARDL model from Shin *et al*., (2014). An index was created for fiscal policy variable (Taxation and government expenditure). The study established that oil price shocks affect fiscal policy through two channels (i) government expenditure (ii) tax revenue. The result revealed from a double-edged view that oil price hasa two-way impact (positive and negative). An increase in oil price; (a) increases government expenditure hence limit fiscal pace (b) and at the same time increases tax revenue through oil tax revenue. The study establishes a strong evidence that the impact of oil price volatility on fiscal policy in Ghana differs substantially in the short run and long run. We establish persuasive evidence of long run asymmetry in the linkage between crude oil price and fiscal policy confirming the relevance of asymmetric nonlinear in this context. However, the short run relationship between oil price and fiscal policy is symmetrical. In particular, the asymmetric relationship suggests that the response of fiscal policy to negative oil price shock is greater in magnitude as compared to a positive shock. We found that the asymmetric impact of oil price shock on government expenditure in Ghana is a long-run phenomenon. Our empirical findings would inform the government on how to manage political pressure in the midst of the volatile energy market.

INTRODUCTION

Crude oil is one of the most appreciated none renewable natural resources in the world. Since the late 1960s, the international energy market has experienced important structural changes and many oil importing and exporting countries have been affected differently by these oil price swings (Elafif, Alsamara & Gangopadhyay, 2017, IMF 2014). Crude oil price fluctuations affect government budget, trade balance and macroeconomic performance (Ju *et al* 2015). The degree of the impact of oil price fluctuationis subjected to the country's economic diversification and its dependence on oil. According to El Anshasy and Bradley (2012), fiscal policy is a medium through which oil price volatility affects macroeconomic variables in oil exporting countries and that it has a countercyclical ability to immune the economy. Oil producing countries are not homogeneous as countries differ in these - respect: (i) countries are at different stages of their development. (ii) Oil contributes to government financial position and export disproportionately (iii) in some countries oil ownership and extraction are in the hands of the state but other countries the extraction is in the hands of the private sector.

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Rich oil-producing countries benefit from crude oil price hikes and suffer income losses during a burst of crude oil price bubble from the international energy market.

However, oil importing countries benefit from a decline in oil prices and incur more cost to import crude oil during price hikes. This indicates that the impact of crude oil price volatility on any country could be subjected to the degree of dependence on oil.

Ghana is a crude oil exporting economy, however, due to technical challenges, Ghana still imports crude and refined oil for its domestic consumption. The discovery of oil in 2007 led to a tightly fought elections in 2008, 2012 and 2016 in Ghana, due to the expected new oil revenues. A situation that generated spending pressures that the Ghanaian economy could not contain despite the existence of the petroleum Revenue Management Act (2011). Ghana commercial oil exploration started in 2010. However, this did not immediately translate into any significant growth performance until 2011 when Ghana experienced one of its highest growth rates of 14%. Ghana could not sustain this growth as the economy took a downward nosedive. This was attributed to institutional weakness (quality institutions) which made the resource cure hypothesis took a precise form in Ghana. Indeed, fiscal rules were not supported by strong legal structures neither was the integrity of the stabilization saving fund spared. The processes and procedures for projecting revenues accrued from oil extraction were not immune to political upward pressures (Bawumia 2017;Solimano and Guajardo, 2017). Ghana as a net importer of crude oil stands to spend more on crude oil importation during a period of increase in crude oil prices. However, the imposition of oil export tax which is predicated on oil pricesas well as capital gain tax could increase government revenue and create more fiscal space. This makes the impact of crude oil price fluctuation in Ghana complex hence invokes empirical discussions. Therefore, a careful empirical enquiry into the impact of oil price shocks on government fiscal policy is very necessary. The fiscal policy in this study encapsulates taxation and government spending.

Literature review

Theory of fiscal policy

Thefiscal policy theory which was propounded by Leeper (1991) suggests that the ultimate objective of policymakers is to promote and maintain social welfare. The social welfare hinges on socio-economic variables such as economic growth, inflation rate, job creation, literacy rate, life expectancy, quality environment among other variables. The theory further explains taxes and spending as the instruments for achieving these policy objectives. This implies that fiscal balance or deficit has effects on stabilization policies.

The theory of fiscal policy like other theories makes some explicit assumptions. These include (i) government decides which policy instrument to employ in pursuance to its economic objectives.(ii)The existence of government representative to pursue public interest and not their parochial interest. (iii) The existence of the legislature to enact laws and provide the authorization to spend money within the budget frame and period and (iv) the existence of the executive branch of government which has control over the policy instruments. However, the validity or falsity of these assumptions is outside the scope of this paper.

Empirical review

The plethora of studies that have examined the impact of crude oil price fluctuations on economic performance have established either positive or negative correlation depending on whether or not the country is an importer or exporter of crude and refined oil. Earlier studies, Darby 1982, Hamilton (1983), Sachs and Warner (1995) suggest a strong negative relationship between crude oil prices and economic performance. This notion has been subjugated by recent studies (Jimenez-Rodriguez & Sanchez, 2009) which suggests that crude oil price fluctuation has less influence on economic performance.

However, some studies (Brunnschweirler and Bulte 2008, Brunnschweirler 2007) have argued that the earlier studies, (Darby 1982, Hamilton 1983) focused on short-run interaction between oil price and macroeconomic variables such as GDP. Again, Sachs and Warner's findings suffer endogeneity problem, yet Sachs and Warner's regression has shaped the empirical discuss. In recent years, as more quality data became available, the empirical enquiry has been extended beyond the short run analysis to incorporate long run relationships (Hooker ((2002), Arezki, and Kareem, (2010, Lardic and Mignon (2006), Bawumia (2017), Cashin *et al* (2014).

Resource endowments create channels through which macroeconomic variables are affected. Atkinson and Hamilton (2003) found a negative impact of oil price on government investment, others like Alexeev and Conrad (2009), established a negative effect of oil price shock on macroeconomic efficiency.

The increased in Ghana's debt after the discovery of oil, reflects the preposition by Mansoorian (1991) who postulates that the discovery of natural resources may encourage countries to assume unsustainable debt stock.Prior to oil discovery, Ghana debt stock stood at 26 percent of GDP. Thanks to the Highly Indebted Poor Country (HIPC) initiative in 2002 as well as the Multilateral Debt Relief Initiative (MDRI) in 2006 which reduced Ghana's unsustainable debt stock from 156.3 percent of GDP in 2000 to 26 percent in 2006(IDA and IMF,2007). It was envisaged after the oil discovery that Ghana's reliance on oil import was over and in consonance with the 'better time'' hypothesis (Van Der Ploeg 2011), Ghana was perceived to be free from donors and international financial institutions clutches. Despite the exportation of oil in June, 2010, Ghana's debt stock rose from 26 percent to 55 percent of GDP between 2006 and 2012 (Allegret, Mignon &Sallenave, 2015). The increase in debt stock was due to a high budget deficit driven by a decline in tax revenue coupled with higher government spending (Ayesu, 2013).

Ghana has experienced an abysmal growth rate during periods of crude oil price hikes particularly between the period of 1972 and 1983 (Ayeetey and Harrigan (2000), Fosu and Aryeetey (2008). Within the same period, Ghana also experienced high levels of economic mismanagement, corruption and foreign exchange instability (Center for Study of African Economy, 2014).The question that evokes empirical discussion is whether the economic adversity was due to unpredictable oil price shocks. Ghana embarked on restructuring of the economy in the period when oil prices were low yet the economy experienced positive growth of 5 percent in 1993 (Killick 2010). Countries that export crude oil consider increase in crude oil as favorable but tooil importing countries this could be detrimental.

Agyemang (2013), who examined the correlation between fiscal policy and economic growth established a bidirectional casualty relationship between fiscal policy and economic growth. In a subjugated hypothetical view, Anyanwu *et al* (2018), suggests that there is a unidirectional reverse causality between oil price shock and economic growth in Ghana. An increase in crude oil prices reduces inflation, exchange rate appreciation, and improvement in oil-driven industrial activities for oil exporting countries. However, the reverse is the case for oil importing countries (International Energy Agency, 2012). Ghana's crude oil consumption constitutes about 52 percent, 92 percent and 96.7 percent for manufacturing sector, transport sector and the Agricultural sector respectively (CSAE, 2014 and Agyemang,2013).

Ghana's resource curse phenomenon is not based on reduced growth and oil revenue resulting from crude oil price volatility but rather due to government expenditure above the economically optimal level and high borrowing against future oil revenue. The empirical argument advance by Van Der Ploeg (2011) posits that this mostly occurs, especially when a country's political party expects to be expelled from office in upcoming elections.Budget deficits in Ghana can be attributed to the government subsidizing oil price and this tends to have a negative effect between oil price and economic growth (Ocran, 2007).

DATA AND METHODOLOGY

Sources of data

The study used the official time series datafor all selected variables from 1980 to 2018.The data for government expenditure, tax revenue, debt stock, and monetary policywere obtained from the ministry of finance and bank of Ghana database. The data on crude oil prices were obtained from OPEC statistical database while, exchange rate, trade volume and Inflation data were sourced from the World Bank's World Development Indicators. In this study, government expenditure (GEXP) is proxy by government consumption expenditure as a percentage of GDP, tax revenue (TAX) is proxy by total government tax revenue as a ratio of GDP, Debt stock (DEBT) is proxy by external debt stock as a percentage of GDP, monetary policy (M2) is proxy by broad money supply as a percentage of GDP, oil price (ROP) is proxy by annual average oil price, trade volume (TRADE) is proxy by export volume as a percentage of GDP, the exchange rate (EXCH) is proxy by the real exchange rate and inflation (INF) is proxy by the consumer price index. Debt stock, trade volume and tax revenue were control variables. Exchange rate and inflation were the deterministic variables.

The broad money supply was captured to represent the influence of monetary policy; it is within the powers of the government to print money in situations of liquidity challenge though it has macroeconomic consequences. Therefore, since government can print money to finance the increase in oil price, hence the relevance of money supply in this study.

The government can deal effectively with the challenge of oil price shock through export. In periods of a concurrent increase in oil price and rise in export prices and volume, the impact of the increase in oil price could be mitigated by trade surplus. This oil price hike would not have its fiscal policy cost.

The study also monetized the debt stock. Government expenditure includes interest payment accruing from outstanding debt stock. Therefore, the incorporated Debt and interest payment are due to the fact that the existing debt could have an important implication on the economy as a whole and consequently on fiscal policy.

METHODOLOGY

There are various econometric approaches to modelling the partial sum decomposition of variables. Principally among them is the Regime Switching model, Smooth transition model among others. However, these models do not provide the lavishness of a cohesive model that is, the model iscapable of integrating the short run error correction method and long run nonlinearities coherently. And the linear representation which under pins non-stationary cointegrating variables are excessively restrictive (Shin, Yu & Greenwood-Nimmo, 20014).

Owing to these limitations outlined, among others, the study adapted Shin, Yu & Greenwood-Nimmo (2014) asymmetric nonlinearities Autoregressive Distributed Lagged model (NARDL) model which is more superior capabilities for contemporaneously modelling nonlinearities and asymmetry for both long run and short run cointegrating systems. The NARDL is able to combine variables in the model specification that are made up of I(0) and l(1). The NARDL exonerate itself from serial correlation (Autocorrelation) and deals with weak instrumental variables to cater for endogeneity of all independent variables. The data structure used in this study best suit the intuition and flexibility of the NARDL.

Estimable model

Linear Autoregressive Distributive Lag (ARDL) was used based on the model by Pesaran and Shin (1998). Conducting the bound test procedure as well as the error correction model, the following equations werespecified.

Decomposing fiscal policy into government expenditure and tax revenue. We modelled it as:

$$\Delta Gexp_t = \boldsymbol{\psi}_0 + \alpha_1 Gexp_{t-1} + \alpha_2 OilP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 Exp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta OilP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta Exp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} + \mu_t \quad (1)$$

With the error correction term

$$\Delta Gexp_t = {}_0 + \alpha_1 Gexp_{t-1} + \alpha_2 OilP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 Exp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta OilP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta Exp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} \; \mathbf{Z}ECM_{t-i} + \varepsilon_t \quad (2)$$

We introduce tax revenue as the left hand variable

$$\Delta Tax_t = \mu_0 + \alpha_1 Tax_{t-1} + \alpha_2 OilP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 Exp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta OilP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta Exp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} + \varepsilon_t \quad (3)$$

Long run model

$$Tax_t = \mu_0 + \alpha_1 Tax_{t-1} + \alpha_2 OilP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 Exp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta OilP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta Exp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} + \boldsymbol{\delta} ECM_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta FP_t = \boldsymbol{\psi}_0 + \alpha_1 FP_{t-1} + \alpha_2 OilP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 Exp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta OilP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta Exp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} + \varepsilon_t \quad (5)$$

The short run variation in the modelis captured by introducing the error correction term into the short run. Thus, when there are shocks in the short run model, the effect will be absorbed by the long run coefficients. Therefore, model re-specification of the short run model is required by incorporating the error correction term as:

$$\Delta FP_t = \boldsymbol{\psi}_0 + \alpha_1 FP_{t-1} + \alpha_2 ROP_{t-1} + \alpha_3 Debt_{t-1} + \alpha_4 M2_{t-1} + \alpha_5 GExp_{t-1} + \alpha_6 Exch_{t-1} + \alpha_7 Inf_{t-1} + \sum_{i=1}^{p-1}\gamma_1 \Delta FP_{t-i} + \sum_{i=0}^{q-1}\gamma_2 \Delta ROP_{t-i} + \sum_{i=1}^{q-1}\gamma_3 \Delta Debt_{t-i} + \sum_{i=0}^{q-1}\gamma_4 \Delta M2_{t-i} + \sum_{i=1}^{q-1}\gamma_5 \Delta GExp_{t-i} + \sum_{i=0}^{q-1}\gamma_6 \Delta Exch_{t-i} + \sum_{i=1}^{q-1}\gamma_7 \Delta Inf_{t-i} + \boldsymbol{\lambda} ECM_{t-i} + e_t \quad (6)$$

Where PF, ROP, Debt, M2, GExp, Exch, Inf, represent the fiscal policy, Oil price, Debt stock, Money supply, government Expenditure, Exchange rate, inflation, and Export respectively. Delta(Δ) denote first-order difference of the variables. The short run coefficients are represented by α_j while γ_j refers to the long run coefficients of the model. Again j=1, 2, 3, 4, 5, and $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = 0$. The assumption underlying the linear ARDL is that the relationship between the dependent and the independent variables are linear. In an instance where the relationship is not linear, the inferences drawn from the model becomes misleading. To correct this potential deficiency (misleading conclusion), the researchers introduced the nonlinear ARDL to capture the asymmetric relationship between the explained and explanatory variables proposed by Shin *et al*. (2014).

Modelling asymmetry

Asymmetric Nonlinear Autoregressive Distribution Lag RDL (NARDL) Model

The study adapted the model specification by Shin *et al*., (2014). The study specified the asymmetric cointegration relationship:

$$Z_{it} = \delta^+ y_t^+ + \delta^- y_t^- + \tau' s_t + u_t \ldots\ldots\ldots\ldots\ldots \quad (7)$$

Where Z_t and y_t are stationary at level l(0) and first difference l(1), δ^+ and δ^- are the associated asymmetric long run parameters. $y_t = (y_0 + y_t^+ + y_t^-)$represents a k x 1 vector of regressors disintegrated into positive and negative which enter the model asymmetrically. δ^+andδ^- represent the partial sum processes of positive and negative changes in the independent variable y_t within the threshold of 0. It is defined as $y_t^+ = \sum_{j=1}^{t} \Delta y_j^+ = \sum_{j=1}^{t} max(\Delta y_j, 0)$ and $y_t^- = \sum_{j=1}^{t} \Delta y_j^- = \sum_{j=1}^{t} max(\Delta y_j, 0)$. Lastly, s_t represent g x 1 vector of other regressors entering the model symmetrically.

An extension from the PesaranShin & Smith, (2001) Autogressive Distributed Lag framework, the study modelled the short and long runs asymmetric error correction model as:

$$\Delta Z_t = \beta_0 + \beta_1 z_{t-1} + \alpha^+ y_{t-1}^+ + \alpha^- y_{t-1}^- + \sum_{i=1}^{r} \gamma_i \Delta z_{t-i} + \sum_{i=0}^{s} \left(\lambda_i^+ \Delta y_{t-i}^+ + \lambda_i^- \Delta y_{t-i}^- + \lambda_{s,i} s_{t-i}\right) + \varepsilon_t \ldots\ldots\ldots\ldots \quad (8)$$

Where $\alpha^+ = -\beta/\delta^+$ and $\alpha^- = -\beta/\delta^-$ are the long run asymmetric parameters. There are four sequential steps Shin *et al*., (2014) identified. These include the followings. (1) According to Shin *et al*., (2014) the equation (3) is estimated using the Ordinary Least Squares estimator (OLS) and employing the F_{PSS} statistics.

To check whether or not there is any relationship between the interest variables such as Z_t, y_t^+ and y_t^- which are stationary

To test whether or not there long run contemporaneous relationship between the variables under study. According to Shin *et al*., (2014) the hypothesis that, $\alpha = \alpha^+ = \alpha^-$ needs to be tested to ascertain if there is short run asymmetry in the variables of interest or not. Thus for any short run asymmetry to be established, the hull hypothesis can take the form of (a) $\lambda_i^+ = \boldsymbol{\lambda}_i$ fall all values ranging from I = 1, 2, 3, …q or (2) $\Sigma_{i=0}^{q-1} \lambda i^+ = \sum_{i=0}^{q-1} \lambda i^-$

The final step requires the use of the nonlinear Autoregressive Distributed Lag (NARDL) model specified in equation (3) above to derive two dynamic multipliers represented as m_h^+ and m_h^- the first multiplier shows a positive change in the independent variable y_i^+ and the second multiplier depict a negative changes in the independent variable y_i^-.

Explicitly, $m_h^+ = \sum_{i=0}^{h} \frac{\partial z_{t+1}}{\partial y_t^+}$, where as $m_h^- = \sum_{i=0}^{h} \frac{\partial z_{t+1}}{\partial y_t^-}$
Where h could take values 0, 1, 2.

Modelling the relationship between oil price shocks and fiscal policy

The study modelled the impact of oil price shocks on fiscal policy and its components using the adapted NARDL model from Shin *et al*., (2014). The study controlled for monetary policy and macroeconomic variables as described in the next few paragraphs. To establish the asymmetric effect of crude oil price on the fiscal policy, the study partially decomposed the explanatory variables into positive and negative effects. Hence the study specified the following econometric model (equation 4) to establish the asymmetric cointegrating (long run) relationship:

$$z_t = a_0 + a_1^- OPS_t^- + a_1^+ OPS_t^+ + a_2 MPV_t + \varepsilon_t \ldots\ldots\ldots \quad (9)$$

Where z_t represents the prices of fiscal policy (composite index for government spending and taxation). OPS is the measure of exogenous oil price shock which has been disaggregated into positive and negative partial sum of the increase and decrease in crude oil price. MPV is the collection (vector) of the controlled variables(debt stock, money supply, trade volume). These variables include monetary policy and macroeconomic variables such as inflation, official exchange rate. a_i represents the parameters to be estimated and ε_t is the random disturbance term.

The study specified the disaggregated crude oil prices into positive and negative effects as:

$OPS_t = (OPS_0 + OPS_t^+ + OPS_t^-)$

And

$$z_t = \delta^+ OPS_t^+ + \delta^- OPS_t^- + \varepsilon_t \ldots\ldots\ldots\ldots \quad (10)$$

whereε_t is the random error term which is independently identically distributed (iid)

Substituting equation (5) into equation (3). This yields the following non- linear asymmetric model

$$\Delta z_t = \beta_0 + \beta_1 z_{t-1} + \gamma^+ OPS_{t-1}^+ + \gamma^- OPS_{t-1}^- + \sum_{i=1}^{r} \delta \Delta z_{t-i} + \sum_{i=0}^{s} \left(\varphi_i^+ \Delta OPS_{t-i}^+ + \varphi_i^- \Delta OPS_{t-i}^- + \delta_{s,i} MPV_{t-i}\right) + \epsilon_t \ldots\ldots\ldots\ldots \quad (11)$$

Here, $\gamma^+ = -\beta/a_1^+$ and $\gamma^- = -\beta/a_1^-$

Estimating equation (11) through the use of standard NARDL to examine whether or not there is contemporaneous relationship between the levels of the seriesz_t, OPS_t^+, and OPS_t^- using the F-statistics (F_{pss}) as suggested by the proponents.

Using the Wald test statistics to establish if any, the long and short runs symmetry between the variables. Long run symmetric relationship exist only if thedisaggregated crude oil price shocks slope coefficients are equal. Thus $\gamma = \gamma^+ = \gamma^-$. And to establish short run symmetrical relationship, study tested the null hypothesis that, $\varphi_i^+ = \varphi_i^-$ for instances where i = 1, 2, 3, …….p or $\Sigma_{i=0}^{p-1} \varphi_i^+ = \sum_{i=0}^{p-1} \varphi_i^-$.

The study finally derived the Random disturbance multipliers m_q^+ and m_q^-. From equation (11), the NARDL multiplier m_q^+ is accompanied by OPS_t^+ and the second multiplier m_q^- is accompanied by changes in OPS_t^-.

Empirical procedure

The data analysis was done in four stages. The first stage provided a descriptive statistics of the variables to uncover variations around the means of the variables as well as their distributional properties. The second phase established the stationarity of the series. The third stage provided co integration of the variables. The fourth stage dealt with the lag selection criteria for co integration to avoid spurious results. The fifth and final phase estimated the NARDL model with its associated diagnostic tests.

Descriptive statistics

The study presents the descriptive statistics as a summary of the nature the dataset. The study use the arithmetic mean to describe the centrality of the dataset. We elaborated on the data further by measuring the dispersion through the use of the variances and standard deviation. The study also used the skewness and the Kurtosis to describe the individual and combined variable sizes respectively. The results as presented in Table 1 shows that the series are consistent and normally distributed.

Table 1 Descriptive statistics

Variable	Mean	Variance	St. deviation	Skewness	Kurtosis	Joint
GExp.	34.3031	40.8377	6.3904	-0.0667	2.3534	0.2317
Tax	12.2148	16.0619	4.0077	0.2652	3.8549	0.7047
M2	35.9317	61.4902	7.8415	-0.0261	1.7939	0.5028
ROP	41.2739	88.8984	9.4286	1.1213	3.0205	0.4457
Trade	65.9254	91.4856	9.5648	-0.4245	2.1197	0.8463
Debt	73.2649	928.7409	30.4752	0.2624	2.3316	0.3930
Exch.	32.73	6.4584	41.7114	0.0240	0.5589	0.0720
Inf.	18.1890	34.2318	5.8507	1.0966	2.7407	0.8624

For forecast and policy relevance, the study explored to establish the necessary conditions that merit NARDL model, and to avoid erroneous application, the estimation as well as the interpretations of NARDL model, the study established the significance or otherwise of the trends in the variables.

Using the Augmented Dickey-Fuller (1981) test of stationarity, the null hypothesis of unit root could not be rejected in all variable cases. This means some variables possessed unit root problem, hence not stationary at level. Since the divergence of the variable from its mean affect the long run equilibrium condition, the series were purged of these trends through first order differentiation.

Table 2 Unit root test

Variables	Level		First Difference	
	Intercept	Trend	Intercept	Trend
ROP	1.7783	1.1130	3.6038*	-0.1136*
TAX	15.6230***	0.1418	0.1983**	0.0021**
EXP	11.1064***	-0.1053***	.0009*	-0.0055*
EXCH	28.7660	0.2482	-5.2710***	0.5334***
M2+	9.2951**	0.0139	1.5997**	-0.0835**
DEBT	24.81989**	-0.3389	-3.2643**	0.1623**

Graphical analysis

The study tested the stationarity properties of the series. Figures 1 and 2 depict the graphical evidence of the trends in variables and how these trends were removed to attain stationarity.

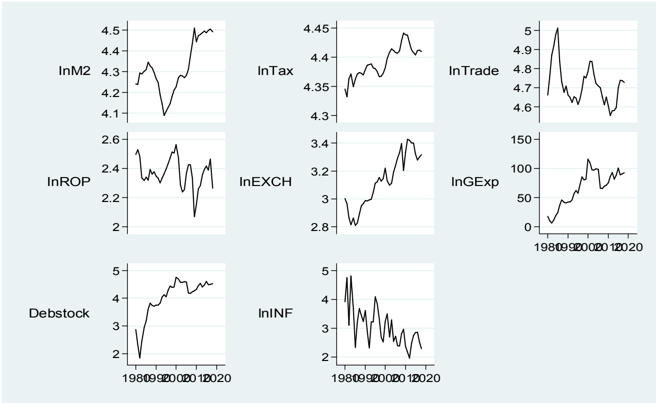

Fig 1 variable at levels

From fig 1, the series plots of the selected variables show that except oil price, all the other variables have trends. Modelling a trending variables would produce spurious results leading to misleading conclusions. Because in a short run deviation of the variable from its mean will not return to the long run mean over time. Therefore, for forecast and predictive purposes such behavior in variables cannot be modeled unless purified.

To eliminate this deficiency in the selected variables, the study transformed the variables by detrending them. This was to ensure that the selected variables obtain a constant variance which would be independent of time and revert around their constant long run means. The ultimate goal of the variables purification process is to ensure that the empirical results are consistent.

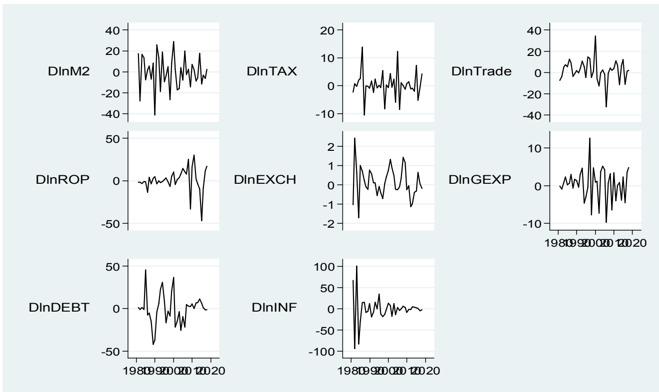

Fig 2 First Difference Plot

As depicted in figure 2, the variables have been purged off their unit root through first order differencing and are now mean reverting. By implication when there is a short run deviation of the variable from its mean, it will return to its' the long run mean over time. This makes the long run predictive behavior of the variables consistent and reliable.

Bound test of Cointegration

The study tested for the existence of long run relationship between the variables. Using the bounds test (t_BDM) proposed by Banerjee *et al* (1998) and Pesaran, Shin & Smith (2001). The t_BDM test the significance of feedback coefficient. The study also used the F_PSS test to establish the significance of the variables. The study established that the F-statistics (4.28) is greater than the critical vales of the upper bound (3.61). Therefore, the null hypothesis of no cointegration was rejected in favour of the alternative hypothesis, meaning, there is long run relationship between the explained and explanatory variables.

Table 3 Rank of cointegrating equations (Johansen Test)

Rank	Parameters	Eigenvalues	Trace statistic	Critical value
0	56	0.8528	146.3327	124.24
1	69	0.8065	94.6281	94.15
2	80	0.5935	50.2886*	68.52
3	89	0.4565	25.9832	47.21

Optimal lag selection

We acknowledge that the dependent of the left hand variable (fiscal policy) on the explanatory variables is scarcely an instantaneous. Thus, we expect a time lapse for fiscal policy to respond to variations in the selected independent variables. Therefore, we computed the optimal lag length empirically as shown in table 3.

Table 4 Optimal lag selection criterion

Lag	LL	LR	df	P	FPE	AIC	HQIC	SBIC
0	-122.74				68.9337	7.07101	7.08635	7.11545
1	-117.46	10.556	64	0.001	53.9904	6.82656	6.85724	6.91544
2	-113.07	8.7893*	64	0.003	44.4837*	6.63258*	6.6786*	6.76589*
3	-113.06	0.0194	64	0.889	47.1009	6.68917	6.86692	6.75053
4	-112.56	0.99079	64	0.320	48.5256	6.718	6.7947	6.94019

From table 4, thoughall the the lag selection criteria show an ideal lag length of two(2), the Akaike Information Criterion (AIC) was selectedd because that gives the lowest value. The AIC suggested an optimal lag of two. Therfore the study used the optimal lag of two for both denpendent and independent variables.

DISCUSSION OF FINDINGS

The models establishing linearity between oil price and other macroeconomic variables may not provide sufficiently rich inferences or forecasts. We begin by disintegrating fiscal policy into government spending and tax revenue and regressing each on the explanatory variables as shown in tables 5 and 6.

Asymmetry impact of oil price shocks on government spending

Table 5 shows the results of the long run and short run responses of government expenditure to the dynamics in crude oil price. The NARDL results provide both short run and long run coefficients representing the partial sums decomposition of oil price. The study through the Wald test tested the null hypothesis of symmetry against the alternative of asymmetry for short run and long run. The long run and short run asymmetric effect of crude oil price on the expenditure is tested using the F_*pss*-statistics. Since the F_*pss* test are statistically significant, it gives a resounding evidence of a long and short run asymmetry. The empirical results shows that, a positive change (increase) in oil price has a positive significant effect on government expenditure. This suggests that when oil price appreciate it causes the government to spend more to obtain the same barrel of oil like before. Specifically a percentage increase in crude oil prices could cause government expenditure to increase by 0.24 percent, but no significant evidence was found for a decrease in crude oil on government expenditure. Again, the study established long run asymmetric effect of oil price on government expenditure and we found strong evidence of short run and long run oil price asymmetry. However, the magnitude of the long run asymmetry is greater than the short run asymmetry. This implies a non- linear relationship between oil price and government spending. The validity of the results is unquestionable because the Wald test rejected the null hypothesis (no long run asymmetry) and there evidence correctly specified long run relationship.

Table 5 Long run coefficient and asymmetry test

dependent variable: ΔInGExp						
Long run coefficient		**Long run effect[+]**		**Long run effect[-]**		
Variable	**Coefficient**	**F-Stat**	**P-Value**	**Coefficient**	**F-Stat**	**P-Value**
InROP	0.244***	61.49	0.000	0.052	0.762	0.406
InDebt	-0.529	0.863	0.377	-2.893***	13.31	0.005
InM2	0.270	0.664	0.436	0.518	1.391	0.269
InTrade	0.004	0.00133	0.972	0.713***	18.78	0.002
	Long Run Asymmetry			***Short Run Asymmetry***		
		W_{LR} F-Stat	P-Value	W_{LR} F-Stat		P-Value
InROP		8.122**	0.019	6.602**		0.030
InDebt		12.67***	0.006	3.321		0.102
InM2		5.205**	0.048	2.356		0.159
InTrade		22.13***	0.001	4.231*		0.070
		Statistics and diagnostics				
		Stat.			P-Value	
X^2_{SC}		32.63			0.877	
X^2_{HET}		0.019			0.890	
X^2_{FF}		0.407			0.754	
X^2_{NORM}		0.623			0.794	
t- *BDM* = -3.7551					F-*PSS* = 5.4658	

*Note: ***, ** and * denote 1%, 5% and 10% significance levels respectively, "–"and "+" denote negative and positive partial sums decomposition in oil price fluctuations.* LR^+ *and* LR^- *are the long run coefficients associated with positive and negative changes in oil prices respectively.* W_{LR} *is Wald test (the null hypothesis) for long run asymmetry and* W_{SR} *refers is the Wald test (the null hypothesis) for additive short run asymmetric condition.*

The study used the bootstrap (dynamic multiplier) approach proposed by Hansen (1999) and the smooth transition regression proposed by Gonzales *et al* (2005) to show the travers to equilibrium in the long and short run when there is exogenous shock. The response of government expenditure to changes in crude oil price was found to be rapid to decrease in crude oil price than an increase in oil price as shown in figure 3.

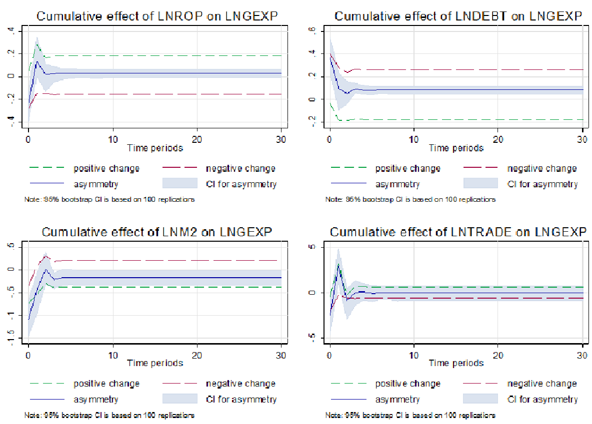

Figure 3 Dynamic adjustment of government expenditure to changes in crude oil price

Table 6 presents the relationship between oil price and tax revenue. The results provide partial sums decomposition of the positive (OP+) and negative (OP-) as 0.512 and -0.157respectively. The empirical results suggest that an increase (positive shock) in oil price has a positive significant effect on tax revenue. This signifies that when oil price appreciates it augment tax revenue. The study could not establish any significant effect of a decrease in oil price on tax revenue. The sign (negative) of a decrease in oil price and the magnitude of an increase in oil price make it intuitively reasonable to assume that Ghana's total tax revenue is driven largely by oil tax revenue. To be precise, a percentage increase in oil price could lead to an increase in tax revenue by 0.51 percent.

Again, the study established a significant long run oil price asymmetry on tax revenue but could not find any significant effect of short run asymmetry. This implies that the impact of oil price on tax revenue is asymmetrical in the long run but symmetrical in the short run. From table 6, the short run estimated coefficientchanges from negative as in the case if a decrease in oil price to positive. The the study concludes that while the effect of oil price oil tax revenue is symetrical in the short run butthere is unambiguous eveidence for long run asymmetry between oil price and tax revenue in Ghana.

Table 6 Long run coefficient and asymmetry test

dependent variable: ΔInTax						
Long run coefficient		**Long run effect[+]**		**Long run effect[-]**		
Variable	**Coefficient**	**F-Stat**	**P-Value**	**Coefficient**	**F-Stat**	**P-Value**
lnROP	0.512***	42.73	0.000	-0.157	1.211	0.300
lnDebt	2.731**	4.879	0.055	-7.268***	11.51	0.008
lnM2	-0.535	0.4096	0.538	2.409**	3.946	0.078
lnTrade	0.230	0.7789	0.400	1.432***	11.95	0.007
	Long Run Asymmetry			Short Run Asymmetry		
		W_{LR} F-Stat	P-Value	W_{LR} F-Stat		P-Value
	lnROP	4.381**	0.006	0.2645		0.619
	lnDebt	3.179	0.108	0.0060		0.940
	lnM2	4.386*	0.066	6.09**		0.036
	lnTrade	8.172	0.019	0.8019		0.394
		Statistics and diagnostics				
		Stat.		P-value		
	X^2_{SC}	28.86		0.4162		
	X^2_{HET}	2.591		0.1075		
	X^2_{FF}	1.138		0.4066		
	X^2_{NORM}	0.5579		0.7566		
	t-*BDM* = 4.7613			F-*PSS* = 5.0519		

*Note: ***, ** and * denote 1%, 5% and 10% significance levels respectively, "–"and "+" denote negative and positive partial sums in oil price fluctuations. LR^+ and LR^- are the long run coefficients associated with positive and negative changes in oil prices respectively. W_{LR} is Wald test for the null hypothesis for long run asymmetry and W_{SR} refers is the Wald test for the null hypothesis for additive short run asymmetric condition.*

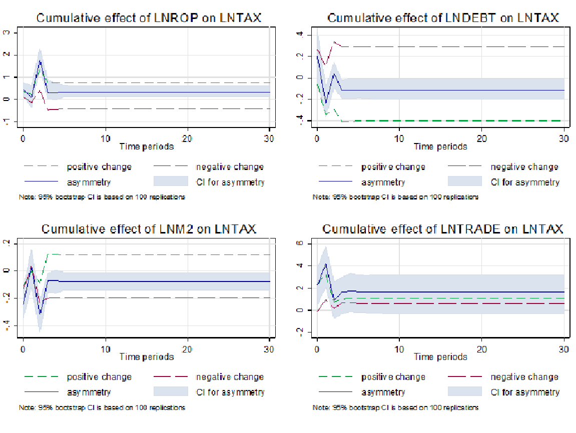

Figure 4 Dynamic adjustment of tax revenue to changes in crude oil price

Fig 4 confirms that the overall existence of a positive relationship between positive oil price shock and tax revenue. The effect of a positive shock in crude oil price is dominant over the negative shock. Furthermore, an asymmetric reaction to oil price is also established. Surprisingly the study established positive relationship between debt stock and tax revenue in Ghana. The positive shock is dominant over negative shock.

The third and most important stage, we used the Principal Composite Analysis (PCA) to compute a single value (fiscal policy) from the two variables (government expenditure and tax revenue). The result from the PCA show that government expenditure explains about 87 percent of the variation in fiscal policy since it has an eigen-value greater than two (2). Table 7 present the empirical relationship between crude oil price and Fiscal policy in Ghana.

We report a summary of the long and short run partial sum decomposition result for the effect of the oil price variation of fiscal policy in table7 since that is the focal point of this study. The positive (OP^+) and negative (OP^-) partial sum decomposition are -0.234 and -0.298 respectively.From these partial sum coefficients, the signs of the coefficients are surprisingly negative. Meaning a percentage increase in oil prices leads to 0.23 percent contraction in fiscal policy (decrease in government expenditure and or income tax). However, a negative oil price shock (decrease) has a positive significant effect on fiscal policy in Ghana. A percentage decrease in oil price leads to a 0.298 percentage increase in fiscal policy. This suggests that when oil price decreases, itcould create more fiscal pace for government. This fiscal space would enable government to spend more. These(signs and magnitude) could probably be explained by the institutionalization of the Ghana Stabilization fund which insulate government expenditure against positive oil price shock in the energy market. The partial sum coefficients suggest that, the impact of a negative change (decrease) oil price on fiscal policy is greater than a positive change(increase). We establish that, the impact oil price shock is asymmetrical in the long run and symmetrical in the short run. Interestingly, the impact of crude oil on fiscal policy changes from being negative to positive in the long run asymmetry. The Wald test rejected the null hypothesis in favour of the alternative asymmetric case for the crude oil prices.

The effect of the other explanatory variables (debt stock, money supply and trade) on fiscal policy are all statistically significant. The result suggests that in both increase and decrease in these explanatory variables, there are asymmetric effects on fiscal policy. The impact of the negative change in the other explanatory variables on the explained (fiscal policy) except money supply is greater than the positive change. More specifically, an increase (positive) debt stock has 1.68 impact on fiscal policy but a decrease in debt stock has an 8.14 impact on fiscal policy. An increase in export volume has 0. 13 impact on fiscal policy, and a decrease in trade volume has 1.65 impacts on fiscal policy in Ghana. However, an increase in money supply has a 2.40 impacts on fiscal policy while a decrease in the supply of money has 2.50 impacts on fiscal policy. The significance of the control variable indicate that omitting them could have resulted in incorrect projection and forecasting.

Table 7 Long run coefficient and asymmetry test

dependent variable: ΔInFP						
Long run coefficient	**Long run effect[+]**			**Long run effect[-]**		
Variable	**Coefficient**	**F-Stat**	**P-Value**	**Coefficient**	**F-Stat**	**P-Value**
lnROP	-0.234***	18.31	0.002	-0.298**	8.073	0.019
lnDebt	1.681*	3.698	0.087	-8.136***	24.34	0.001
lnM2	-2.395***	16.1	0.003	2.246**	6.242	0.034
lnTrade	-0.133	0.4828	0.505	1.648***	29.47	0.000
	Long Run Asymmetry			Short Run Asymmetry		
		W_{LR} F-Stat	P-Value	W_{LR} F-Stat		P-Value
lnROP		0.281**	0.029	1.154		0.311
lnDebt		10.92***	0.009	0.3768		0.554
lnM2		0.049	0.830	8.505**		0.017
lnTrade		22.29***	0.001	4.547*		0.062
		Statistics and diagnostics				
		Stat.		P-value		
X^2_{SC}		0.588		0.6447		
X^2_{HET}		4.317		0.1155		
X^2_{FF}		1.138		0.4066		
X^2_{NORM}		1.3677		0.1566		
	t-*BDM* = 4.7227			F-*PSS* = 5.4658		

*Note: ***, ** and * denote 1%, 5% and 10% significance levels respectively, "–"and "+" denote negative and positive partial sums in oil price fluctuations. LR^+ and LR^- are the long run coefficients associated with positive and negative changes in oil prices respectively. W_{LR} is Wald test for the null hypothesis for long run asymmetry and W_{SR} refers is the Wald test for the null hypothesis for additive short run asymmetric condition.*

Fig 5 confirms that the effect of the negative shock in crude oil price is dominant over the positive shock. Furthermore, an asymmetric reaction to oil price is also established between the other explanatory variables and fiscal policy. In all variable cases, the positive effect dominate the negative effects.

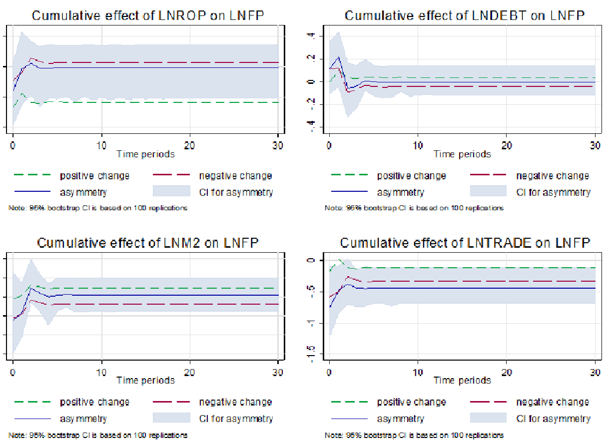

Figure 5 Dynamic adjustment of fiscal policy to changes in crude oil price

CONCLUSION

The study used the standard co integration and the bound tests to establish that there is a long-term co integration relationship between oil price shock and fiscal policy as well as other exogenous variables. After establishing the existence of long run relationship between the dependent and independent variables, we used the nonlinear ARDL model to establish how oil price variations can engender fiscal policy in Ghana. We have examined the impact of oil price shock on fiscal policy in Ghana without compromising the response in fiscal policy due to debt stock dynamics, money supply, export volume, interest rate and exchange rate over time. We analyzed the data in three stages: first, we established the impact of oil price changes on government spending. Second, we examined the effect of oil price fluctuations on tax revenue in Ghana. Third and the most important, we explored the impact of oil price shocks on fiscal policy.

We have established strong evidence that when oil price increases it causes the government to spend more to obtain the same barrel of oil as before. Specifically, a percentage increase in crude oil price could cause government expenditure to increase by 0.24 percent, but no significant evidence was found for a decrease in crude oil on government expenditure. The study also established the relationship between oil price fluctuation and tax revenue. The empirical results show that an increase (positive shock) in oil price has a positive significant effect on tax revenue. Thus the empirical enquiry reveals that a percentage increase in oil price leads to 0.512 percent in tax revenue.

We used the Principal Composite Analysis (PCA) to compute a single value (fiscal policy) from the government expenditure and tax revenue. The positive (OP^+) and negative (OP^-) partial sum decomposition are -0.234 and -0.298 respectively. From these partial sum coefficients, the signs of the coefficients are surprisingly negative. Meaning a percentage increase in oil prices leads to 0. 234 percent contraction in fiscal policy (decrease in government expenditure and or increase in income tax) however, a negative oil price shock (decrease) has a positive significant effect on fiscal policy in Ghana. A percentage decrease in oil price leads to 0.298 percentage increase in fiscal policy. This empirical justification is not surprising because the stabilization fund makes provision for government expenditure to be supported by the oil revenue in hard times. Increase in oil price becomes a bitter –sweet in Ghanaian context. This is because increase in oil price reduces the fiscal space as government spend more on oil import. However, the fiscal space can be off -set by oil tax revenue. From this empirical enquiry, it can be concluded that the asymmetric impact of oil price shock on fiscal policyin Ghana is a long run phenomenon.The significance of the control variables indicate that omitting them can lead to in wrong prediction and forecast.

Research limitation

This paper does not include the quality of existing institutions. Future work could examine if institutional quality could affect how fiscal policy response to oil price shock because quality institution could ensure fiscal policy discipline.

References

Agyemang, O. (2013). Fiscal Policy and Economic Growth in Ghana: Evidence from Time Series Data. *International Journal of Social Sciences*, *2*(10), 92-118.

Alexeev, M., & Conrad, R. (2011). The natural resource curse and economic transition. *Economic Systems*, *35*(4), 445-461.

Allegret, J. P., Mignon, V., &Sallenave, A. (2015). Oil price shocks and global imbalances: Lessons from a model with trade and financial interdependencies. *Economic Modelling*, *49*, 232-247.

Anyanwu, F., Madume, J. V., &Dibiah, S. (2018). Effects of Total Short Term Debts to Total Assets on Net Operating Income of Deposit Money Banks in Nigeria. *INTERNATIONAL JOURNAL OF ECONOMICS AND FINANCIAL MANAGEMENT*, *3*(3), 10-14.

Arezki, Rabah and Kareem Ismail, (2010), "Fiscal Policy Responses of Oil Producing Countries to the Recent Oil

Price Cycle," IMF Working Paper No.10/28, (International Monetary Fund: Washington).

Aryeetey, E., Harrigan, J., &Nissanke, M. (Eds.). (2000). *Economic reforms in Ghana: The miracle and the mirage*. Africa World Press.

Atkinson, G., & Hamilton, K. (2003). Savings, growth and the resource curse hypothesis. *World development*, *31*(11), 1793-1807.

Ayensu, F. (2013). MANAGING GHANA'S OIL REVENUE: GHANA PETROLEUM FUNDS (Gpfs). *Asian Journal of Humanities and Social Sciences (AJHSS)*, *1*(2).

BANERJEE, A., J. DOLADO, AND R. MESTRE (1998): "Error-Correction Mechanism Tests for Cointegration in a Single-Equation Framework," Journal of Time Series Analysis, 19, 267–283.

Bawumia, M., &Halland, H. (2017). Oil discovery and macroeconomic management. *Extractive Industries*, 220.

Brunnschweiler, C. N., &Bulte, E. H. (2008). The resource curse revisited and revised: A tale of paradoxes and red herrings. *Journal of environmental economics and management*, *55*(3), 248-264.

Cashin, Paul, KamiarMohaddes, MaziarRaissi, and Mehdi Raissi, (2014), "The Differential Effects of Oil Demand and Supply Shocks on the Global Economy," Energy Economics, No. 44, pp. 113-34.

Darby M.R.(1982). The price of oil and world inflation and recession

Dickey, D. A., & Fuller, W. A. (1981). Likelihood ratio statistics for autoregressive time series with a unit root. *Econometrica: journal of the Econometric Society*, 1057-1072.

El Anshasy, Amany A. and Michael D. Bradley, (2012), "Oil Prices and the Fiscal Policy Response in Oil-Exporting Countries", Journal of Policy Modeling, No. 34, pp. 605-20.

Elafif, M., Alsamara, M.K., Mrabet, Z. and Gangopadhyay, P., (2017). The asymmetric effects of oil price on economic growth in Turkey and Saudi Arabia: New evidence from nonlinear ARDL approach. *International Journal of Development and Conflict*, pp.97-118.

Fosu, A., &Aryeetey, E. (2008). Economic growth in Ghana: 1960-2000. *Ghana: woeli publishing*.

Hamilton, J.D. 1983. "Oil and the macro economy since World War II."Journal of Political Economy 91: 228–248.

Hooker, M. A. (2002). Are oil shocks inflationary? Asymmetric and nonlinear specifications versus changes in regime. *Journal of Money, Credit and Banking*, 540-561.

IMF 2014. Economic Diversification in the GCC: The Past, the Present, and the Future. IMF Dec. 2014

International Energy Agency Staff. (2012). *Energy Statistics of Non-OECD Countries*. Organization for Economic.

Jimenez-Rodriguez, R., & Sanchez, M. (2009). Oil shocks and the macro-economy: a comparison across high oil price periods. *Applied Economics Letters*, *16*(16), 1633-1638.

Ju, K., Su, B., Zhou, D., Zhou, B. and Zhang, Y. 2015. "Oil price crisis responses: capability assessment and key indicator identification."Energy 93: 1353-1360.

Killick, T. (2010). *Development economics in action: A study of economic policies in Ghana*. Routledge.

Lardic, S., & Mignon, V. (2006). The impact of oil prices on GDP in European countries: An empirical investigation based on asymmetric cointegration. *Energy policy*, *34*(18), 3910-3915.

Mansoorian, A. (1991). Resource discoveries andexcessive'external borrowing. *The Economic Journal*, *101*(409), 1497-1509.

Ocran, M. K. (2007). A modelling of Ghana's inflation experience: 1960-2003. *Studies in Economics and Econometrics*, *31*(1), 119-144.

Pesaran, M. H. and Y. Shin (1998): "An Autoregressive Distributed Lag Modelling Approach to Cointegration Analysis," in Econometrics and Economic Theory: The Ragnar Frisch Centennial Symposium,ed.byS.Strom,Cambridge: CambridgeUniversityPress,EconometricSocietyMonographs, 371–413.

Pesaran, M. H., Y. Shin, AND R. J. Smith (2001): "Bounds Testing Approaches to the Analysis of Level Relationships," Journal of Applied Econometrics, 16, 289–326.

Qian, L., Qiu, L., Xin, F., & Hu, W. (2014). Energy management and torque coordination control for plug-in 4WD hybrid electric vehicle. *Transactions of the Chinese society of Agricultural Engineering*, *30*(19), 55-64.

Sachs, I., &Wamer, A. (1995). Natural Resource Abundance and Economic Growth," NBER Working Paper 5398 (Cambridge, Massachusetts: National Bureau of Economic Research.

Shahbaz, M., Van Hoang, T. H., Mahalik, M. K., &Roubaud, D. (2017). Energy consumption, financial development and economic growth in India: New evidence from a nonlinear and asymmetric analysis. *Energy Economics*, *63*, 199-212.

Shin, Y., B. Yu, and M. J. Greenwood-Nimmo (2014): "Modelling Asymmetric Cointegration and Dynamic Multipliers in a Nonlinear ARDL Framework," in Festschrift in Honor of Peter Schmidt: Econometric Methods and Applications, ed. by W. Horrace and R. Sickles, New York (NY): Springer Science & Business Media, 281–314.

Shin, Y., Yu, B. and Greenwood-Nimmo, M.J. 2014. "Modelling asymmetric cointegration and dynamic multipliers in a nonlinear ARDL framework." inHorrace, William C., Sickles, Robin C. (Eds.), Festschrift in Honor of Peter Schmidt. Springer Science & Business Media, New York (NY).

Solimano, A., & Guajardo, D. C. (2017). The copper sector, fiscal rules, and stabilization funds in Chile. *Extractive Industries*, *200*.

Van der Ploeg, F. (2011). Natural resources: curse or blessing?.*Journal of Economic literature*, *49*(2), 366-420.

Vidal, V., Pons, B., Brunnschweiler, J., Handschin, S., Rouau, X., &Mestres, C. (2007). Cooking behavior of rice in relation to kernel physicochemical and structural properties. *Journal of Agricultural and Food Chemistry*, *55*(2), 336-346.