



EXPLORING THE ASYMMETRIC LINKAGE BETWEEN COMMODITY PRICES AND FISCAL PERFORMANCE IN NIGERIA

 **Opeoluwa Adeniyi Adeosun¹⁺**

 **Fisayo Fagbemi²**

¹Graduate Student of Department of Economics, Obafemi Awolowo University, Ile-Ife, Nigeria.

Email: addyadeosun@gmail.com Tel: +234-806-905-7214

²Independent Researcher, Nigeria.

Email: Fisay4real@yahoo.com Tel: +234-806-752-4045



(+ Corresponding author)

ABSTRACT

Article History

Received: 25 April 2019

Revised: 27 May 2019

Accepted: 1 July 2019

Published: 23 August 2019

Keywords

Commodity prices

Fiscal performance

Public debt

NARDL

Nigeria.

The paper examines the asymmetric relationship between commodity prices and fiscal performance in Nigeria between 1984 and 2017 using the non-linear autoregressive distributed lag (NARDL) cointegration technique. In the analysis, the existence of a long-run cointegration relationship between the oil prices, cocoa prices and fiscal outcome is confirmed as well as the asymmetric impact of commodity prices. The study shows that changes in oil prices have a substantial influence on both debt (% of GDP) and external debt stocks. It is demonstrated that since Nigeria's fiscal operation is largely financed by the proceeds from commodity exports, especially crude oil, in the long run, unanticipated rise or decline in oil prices could have significant effect on public debt levels in the country. Further evidence reveals that an increase in cocoa prices positively and strongly enhances debt (% of GDP), but with no evidence of such effect on external debt stocks, indicating that an increase in cocoa price may not result to a large reduction in external debt stocks. In sum, the study asserts that there is a host of potential significant impacts associated with primary commodity prices (cocoa) on fiscal policy design and economic development in both long and short run. Hence, the study posits that to cushion the effect of commodity price fluctuations, it is crucial to launch several initiatives that would enhance the diversification of the economy. This can be better achieved through the provision of financial incentives and strong regulatory framework for the development of agricultural sector.

Contribution/Originality: This study contributes to the existing literature by examining empirically possible asymmetry in the nexus between commodity prices and fiscal outcomes in the context of Nigeria.

1. INTRODUCTION

In most African countries, developments in the commodity sector significantly determine growth trajectory. The nexus between international commodity prices and economic performance is both strong and complex (Bruckner and Ciccone, 2010). Commodity prices offer substantial economic incentives that induce decisions relating to public expenditure, employment, consumption, resource allocation and trade. Essentially, the link between commodity dependence and macroeconomic measures is a highly crucial aspect of fiscal policy. Hence, commodity price movements often shape development outcomes of sub-Saharan African (SSA) countries (UNCTAD, 2017). Although a given commodity price change may not affect all countries in a uniform way, volatile commodity prices can undermine efforts towards attaining sustainable fiscal levels. In particular, the gains of commodity windfalls during boom times are by far outweighed by the adverse effects caused by price volatility and

low-price periods, which seem to be longer than boom times. For instance [Van der Ploeg and Poelhekke \(2009\)](#) postulate that, in resource-rich countries, volatility in world commodity prices exacerbates poor economic performance. As such countries are prone to the vagaries of volatility and terms-of-trade shocks that hamper their capacities to introduce and implement policies that can lead to structural transformation, improving fiscal performance may be hindered. Policy inconsistency due to commodity price fluctuations can cause pressure on SSA countries' balance of payments. Thus, these external stress and volatility may trigger fiscal imbalance.

Nigeria is one of the commodity-dependent countries. Over the years, the country's potential for a sound institutional and fiscal framework tends to be undermined by external market shocks, in spite of substantial efforts to salvage the economy. During slump periods, the effectiveness of expansionary fiscal policies is typically hampered in the country, as government often resorts to impulsive under-spending. This is because commodity prices and rents are difficult to influence by any government. It is noteworthy that Nigeria's public debt rose significantly in 2015 due to a price crash in the global market ([Proshare, 2018](#)). The fact that a sharp commodity price drop can create instability within the economy is a strong indication that commodity price fluctuations play an important role in fiscal policy design. Hence, the extent of such effect on the overall fiscal state should be well examined in order to simulate probable measures that may cushion possible vitiating impacts. This serves as another example of the relevance of designing the right policy framework for counteracting persistent cyclicalities in the commodity market. Besides, the emergence of policies that can stimulate improved fiscal outcomes through systematic analysis of this salient issue.

The global commodity market crisis poses significant challenges to fiscal policies in developing countries, particularly in Nigeria, since they are well exposed to commodity market. There is renewed debate on how this acute severity can be addressed, yet the effect of commodity prices on fiscal performance has been a subject of considerable controversy in policy circles. In particular, this has led to dire concerns that commodity price movements could complicate fiscal policy management and borrowing approach, thereby threatening debt sustainability. In light of this, a number of studies offer some evidence in this regard. For instance, in order to explain the response of both monetary and fiscal policy to natural resource price shocks, [Berg et al. \(2013\)](#) built a three-sector dynamic stochastic general equilibrium (DSGE) model with a financial side, while [Araujo et al. \(2016\)](#) developed a two-sector model with private and public investment, and also several frictions, such as absorptive capacity and borrowing constraints. They argue that current account dynamics and fiscal outcomes are affected by commodity price shocks. In case of Africa, few findings reveal procyclical health and education policy ([Jensen, 2000](#); [Beegle et al., 2008](#)). However, in Latin American countries, education expenditure is often found to be countercyclical ([Schady, 2004](#) for Peru). In addition, literature indicates that commodity price-fiscal policy nexus is mostly treated with the use of cointegration, error correction model and causality tests without accounting for possible asymmetric effect ([Ibrahim, 2015](#)). This rather raises skepticism as regard their conclusions. Thus, this study adopts ([Shin et al., 2011](#)) nonlinear ARDL cointegration approach (NARDL) as a build up to the [Pesaran and Shin \(1999\)](#) ARDL model. In general, since none of these contributions specifically centers on Nigeria's case, the debate is then pushed forward by examining empirically this question: is there evidence that commodity price movements substantially induce fiscal uncertainty or outcomes in Nigeria?

The main contribution of the study is to make for possible asymmetry (non-linearity) in the relationship between commodity prices and fiscal measures in the context of Nigeria. The model adopted reflects the specific features of Nigeria's economy, the particular role of oil and cocoa prices and their peculiar influence on fiscal performance from 1984 to 2017. The rest of the paper is organized as follows: The immediate section reviews related literature. Section 3 presents the methodological adopted. Section 4 contains results and discussion. Finally, section 5 concludes.

2. LITERATURE REVIEW

2.1. Theoretical Literature

In developing countries, natural resource output often accounts for a considerable share of government revenues. Given that such source of revenues are highly volatile and susceptible to exogenous commodity price cycles, commodity price fluctuations potentially contribute to procyclicality of fiscal policy in the country. In most natural resource dependent countries, procyclicality fiscal spending decisions do occur as a direct response to commodity price booms/busts. Hence, commodity production and revenues may form the large portion of public revenue (Sinnott, 2009). The author stresses that as large commodity price volatility would trigger highly volatile overall revenues, government spending and the fiscal balance could be affected as well. The excessive reaction of political leaders to revenue increase may result to fiscal imbalance. Thus, there should be the optimal fiscal response to commodity price fluctuations (booms and busts). Following the Barro (1979) tax-smoothing model, the government needs to spread the tax burden over time to reduce its burden. This implies tax rates should be proportional to the level of output, and also government spending and output should co-move. Barro's proposition is based on the assertion that in response to transitory income movements, policy actors can espouse to countercyclical debt approach. As a consequence, temporary positive/negative commodity price shocks, either positive or negative, ought to be saved/dissaved, and in turn reflected by fiscal deficit decrease/increase. In line with the permanent-income hypothesis, it is further emphasized that corresponding changes in expenditure should be induced by permanent shocks, and with no effect on the overall fiscal balance. Nonetheless, it has been difficult to differentiate transitory from permanent shocks in the case of commodity booms and busts.

The contribution of commodities to procyclicality through their relationship with the level of recurrent expenditures that cannot be easily reversed during bust periods points to the prevalence of such a spending response to commodity booms. In developing countries, booms have been persistently accompanied by unsustainable rises in public sector spending (Cuddington, 1989) while in busts period, governments do find it difficult to cut expenditure accordingly. As the boom ends, reducing government spending is delayed. In bad times, due to the entrenched spending habit, reversing expenditure trends seems unattainable, which leads to increasing deficits. For instance, Medas and Zakharova (2009) indicate that some countries have employed the past oil windfalls for public sector wage increase. This has occurred in Bolivia and Trinidad and Tobago, and commodities boom Argentina during the hydrocarbons windfalls. Given the political consequence and pressure, when commodity prices fall, some particular areas of the budget, like infrastructure maintenance projects and public sector wage/salary size are most difficult to adjust downward. Political economy elucidations for procyclical expenditures responses to good times are strongly associated with commodity cycles in the literature (Tornell and Lane, 1999).

A procyclical fiscal policy has been the rule all over the world. It is not a peculiar feature of certain regions or determined by particular set of institutions (Talvi and Vegh, 2005). In contrast, El Anshasy and Katsaiti (2013) emphasizes that the quality of institutions matters in fiscal performance. A commodity boom is a significant conduit for procyclical policies which does not necessarily require whether governance system is strong or weak. For example, few expositions by Gavin *et al.* (1996); Stein *et al.* (1999) indicate that procyclicality is indeed evident in Latin America, while it also exists in OECD countries (Arreaza *et al.*, 1999; Lane, 2003). In an optimal fiscal policy model, Talvi and Vegh (2005) give a non-specified political distortion that makes running budget surpluses expensive for the government owing to excessive inducement to increase spending. The budget surplus will deviate much from its average value as the political pressures to spend become more important with rising fluctuations in government revenues. A vital component of the harmful effect of such fluctuations is the fiscal response to commodity price changes or movements. The authors posit that expansionary fiscal policy in most developing countries is caused by the higher variability of the tax base in relation to that of developed countries. In this context, fiscal dependence on volatile commodity revenues could induce the variability of the tax base, and in turn influences fiscal performance. Unstable fiscal position and poor performance would thus be exacerbated by the

substantial share of rents obtained from commodity production. Rising and falling commodity prices trigger unexpected revenue fluctuations. In general, natural resource rents tend to be more volatile compared with non-natural resource rents due to external shocks and persistent changes in global market. Theoretically, the link between fiscal stance and commodity prices or trade cycles in developing countries has been firmly established (Kaminsky, 2010; Erbil, 2011). Dominance view suggests the existence of higher cyclicity of fiscal policy in resource-dependent countries. Hence, the fiscal trajectory could be greatly determined by commodity price fluctuations (rise and fall) in Nigeria, given the nature (commodity-based) of her economy.

2.2. Empirical Review

In the literature, the prevailing stance is that there exists a relationship between commodity price fluctuations and fiscal performance in most economies. But series of conflicting findings are evident in the literature. While some small open economies have been prone to the impact of the commodity price shocks, some economies have been able to create enough buffers to attenuate the impact of the shocks. Some studies establish a case for institutional role and exchange rate regimes (Rautava, 2004; El Anshasy and Katsaiti, 2013). The study of Medina (2010) in a comparative analysis using Vector Auto Regression (VAR), reveals much similarity in the responses of fiscal revenues to commodity price shocks between commodity exporting Latin America and High income countries; whereas the magnitude of the primary expenditure reaction varies across countries. The author argues that the role institution plays in explaining the distinct behaviours exhibited by countries. In a similar work, Sinnott (2009) make a comparison between the fiscal dependence on minerals between commodity dependent Latin American and Caribbean countries using the Ordinary Least Square (OLS) technique. The study indicates that there is a positive government revenue reaction to price changes; however the study could not establish a significant reaction of government spending for the panel of countries. Kumah and Matovu (2007) adopt the Structural VAR approach to unravel the extent to which volatile commodity prices culminate the probability of fiscal underperformance and the transitory impact of price shocks on the sequencing mode of tax and expenditure policy undertone under two broad tax regimes. With the Selection of four commonwealth countries, comprising two oil-exporting commodity and non-oil exporting countries, it is indicated that commodity price increases have a significant effect on tax collection, expenditure and the fiscal balance. Essentially, the findings suggest a higher response from taxes and expenditure on average under the active tax regime than the passive regime. Also focusing on Latin American countries, Zettelmeyer and Hollar (2008) estimate the nexus between commodity and non-commodity revenue and economic cycle, and evaluate commodity revenues using alternative medium term commodity price projections. With the use of OLS and Johansen co-integration estimate, the author conclude that structural revenues improve as a share of GDP, whereas structural primary balances depict surpluses in countries under consideration.

Focusing on European countries, Borensztein and Reinhart (1994) examine the macroeconomic determinants of commodity prices in Eastern Europe and Former Soviet union, with emphasis on commodity supplies under an extended traditional structural approach. While incorporating commodity supply in the analysis, findings support the notion that commodity supplies affect commodity prices in a negative and predictable manner. In another study on the OECD countries, Labys and Maizels (1993) assess the role of commodity price fluctuations in economic instability by making comparison with earlier studies using the Granger-Causality approach. Their findings show that the feedback effect between foreign commodity prices and national prices among other macroeconomic indicators, in selected countries, appears to be much stronger than earlier findings. However, a caveat is that the study does not capture possible asymmetry that might exist in the relationship among the selected variables. Spatafora and Samake (2012) in a study comprising 116 low and middle income countries, establish a case for financial hedging essentially in attenuating the impact of commodity price shocks on fiscal performance under different exchange rate regimes. Results indicate that fiscal variables (revenue, expenditure, deficits and debt)

response substantially and positively to commodity price shocks. On the other hand, the LICs relatively exhibit strong fiscal reaction, as the expenditure component exhibits stronger responses than revenue component. [Cashin et al. \(2002\)](#) analysis the booms and slumps cycle in world commodity prices using the [Bry and Boschan \(1971\)](#) algorithm. Findings reveal asymmetry in commodity price cycles, in that price slumps last longer than price booms. Further evidence confirm that the magnitude of the impact of fall in slumps lasts longer than price booms.

In more recent studies, [Medina and Soto \(2016\)](#) using a Dynamic Stochastic General Equilibrium (DSGE) model, explore the macroeconomic effect of copper price shocks under different regimes for fiscal and monetary policies, and investigate the importance of exchange rate flexibility as well as the role of imperfect credibility of fiscal rule in the Chilean economy. The authors argue that copper aftershock price transcends more to output expansion and real exchange rate increase under the expansive fiscal policy and non-Ricardian household than a structural balance fiscal rule. [Makin \(2013\)](#) posits that the severity of the Dutch disease of commodity price boom in an open economy is a function of how floatable its exchange rate. In a country specific analysis, [Rautava \(2004\)](#) establishes a significant long and short run relationship between oil price and real exchange rate fluctuations and their influences on the Russian economy. Also, using DSGE model to capture the optimal fiscal reaction to resource price shocks in LICs with limited infrastructure, [Agénor \(2016\)](#) reveals that shocks with prolonged transitional dynamics do not have long run effects.

Some authors emphasis the influence of institutional frameworks in an economy. Accordingly, [El Anshasy and Katsaiti \(2013\)](#) investigate the interaction of different institutional proxies and fiscal policy on the growth stance of resource-abundant economies. The study essentially focuses on the transmission channel through which the quality of fiscal performance influences institutions in ensuring growth. The authors show that higher growth rates is a precursor for improve fiscal performance spurred by better governance, strong democracy and budget transparency. Similar work of [Cespedes and Velesco \(2013\)](#) makes a case for the influence of institutional quality in the fiscal cyclical behaviour of commodity rich countries. Therefore, their findings revealed that improvements in institutions could trigger counter cyclical behaviour unlike pro cyclical behaviour associated with weak institutions. A panel study comprising 93 countries was conducted by [Arezki and Brückner \(2010\)](#) to examine the relative effects of commodity price shocks on external debt under two regimes; autocracy and democracy. Employing Least Squares and system-GMM techniques, the study confirms (in the presence of positive commodity price shocks) a significant reduction in external debt, risk of default, expenditures in democracies; but no significant decrease was found for autocracies.

In reference to African economies, [Nziramasanga and Obidegwu \(1981\)](#) establish that the presence of inflationary pressures, which exhibits strong response on the expenditure side, reduces the effect that increases copper price have on the economy. A plausible reason for the strong response is adduced to the inelastic supply side with respect to price and a slow response to demand increases. Also, in a panel analysis involving 28 sub-Saharan African countries, [Nashashibi and Bazzoni \(1994\)](#) investigate the nexus between fiscal performance and macroeconomic aggregates using descriptive analysis. The study reveals that the tax bases of countries investigated depend significantly on their imports and import substitutes. They argued that for countries that aim to restore their real exchange rate to its equilibrium value, adopting a fixed exchange rate strategy could widen their fiscal deficits; emphasis was laid on CFA franc countries. However, those countries with flexible exchange rate fail to achieve price stability but are able to achieve fiscal balance, competitiveness and growth. In view of the preceding review, it is evident that there is paucity of empirical findings on the role of commodity sector in the development of fiscal policy regarding Nigeria. Hence, the thrust of this study is hinged on enhancing the understanding of the linkages between commodity prices and fiscal performance in Nigeria.

3. METHODOLOGY AND DATA DESCRIPTION

This study draws insight from the works of Barro (1979); Tornell and Lane (1999); Talvi and Vegh (2005) as regards theoretical underpinnings guiding the inherent problem of procyclicality in commodity-rich economies. Essentially, commodity prices are prone to fluctuations in global market which consequently affect the effectiveness of fiscal measures. Therefore, Equation 1 gives an explicit econometric model depicting such relationship;

$$f_i = \alpha_0 + \beta_1 ogap_i + \beta_2 cp_i + \beta_3 gov_i + \beta_4 exr_i + \mu_i \quad (1)$$

The path of commodity prices is not linear due to swings (changes) inherent in the global market; therefore, the assumption of symmetric nexus between fiscal performance indicators and commodity prices may not be tenable or robust. Essentially, many works in the literature rather treated commodity price-fiscal policy nexus with application of cointegration, error correction model and causality tests without capturing for possible asymmetry (Ibrahim, 2015). This rather raises skepticism regarding the conclusiveness of their findings. Thus, the study follows (Shin et al., 2011) nonlinear ARDL cointegration approach (NARDL) as a build up to the Pesaran and Shin (1999) ARDL model. Through NARDL, this study accounts for asymmetry (non-linearity) in commodity prices for both long run and short run. Hence, the study adopts Shin et al. (2011); Ibrahim (2015) in Equation 2 to capture the possible asymmetry in commodity prices (oil price and cocoa price) as the key variables of interest;

$$f_i = \alpha_0 + \beta_1 ogap_i + \beta_2 cp_i^+ + \beta_3 cp_i^- + \beta_4 gov_i + \beta_5 exr_i + \mu_i \quad (2)$$

f_i denotes both total debt (scaled by GDP) and external debt stocks as indicators of fiscal performance. The study also incorporates the *ogap* (output gap), hinged on the Barro (1979) tax smoothing model to account for the effect of business cycle on Nigeria's fiscal position. The *ogap* is the difference between actual and potential GDP; the potential GDP is extracted from the actual GDP using the Hodrick and Prescott filter with a smoothing parameter; $\lambda=100$.

Furthermore, *cp* represents commodity prices (oil price and cocoa price); *gov* is an institutional proxy for bureaucratic quality to explain the quality of governance in fiscal operations, while *exr* is the effect of exchange rate on fiscal performance. Also, Equations 3 and 4 reflect a decomposition strategy where commodity price is decomposed into its positive and negative variations. Therefore, cp^+ and cp^- which equals Δcp^+ and Δcp^- are the partial sums of positive and negative changes in commodity price (*cp*);

$$cp^+_i = \sum_{j=1}^i \Delta cp^+_i = \sum_{j=1}^i \max(\Delta cp_i, 0) \quad (3)$$

$$cp^-_i = \sum_{j=1}^i \Delta cp^-_i = \sum_{j=1}^i \min(\Delta cp_i, 0) \quad (4)$$

The long run nexus between commodity price increase and fiscal indicators is β_2 , while the β_3 denotes the nexus between fiscal indicators and commodity price reduction. The transmission mechanism (pass through) of commodity price swings in (2) readily explains its asymmetric long run nexus with fiscal performance.

Equation 5 reflects the ARDL version of Pesaran et al. (2001) as espoused in Shin et al. (2011).

$$\begin{aligned} \Delta \tilde{f}_t = & \alpha + \beta_0 \tilde{f}_{t-1} + \beta_1 \text{ogap}_{t-1} + \beta_2 cp^+_{t-1} + \beta_3 cp^-_{t-1} + \beta_4 \text{gov}_{t-1} + \beta_5 \text{exr}_{t-1} \\ & + \sum_{j=1}^p \phi_j \Delta \tilde{f}_{t-j} + \sum_{j=0}^q \phi_j \Delta \text{ogap}_{t-j} + \sum_{j=0}^u (\theta_j^+ \Delta cp^+_{t-j} + \theta_j^- \Delta cp^-_{t-j}) \\ & + \sum_{j=0}^r \psi_j \Delta \text{gov}_{t-j} + \sum_{j=0}^s \gamma_j \Delta \text{exr}_{t-j} + \mu_t \end{aligned} \quad (5)$$

Here, p , q , r and s indicate lag orders, $\sum_{j=0}^u \theta_j^+$ captures the short run effects of commodity price increase on fiscal performance indicators. $\sum_{j=0}^u \theta_j^-$ measures the short run influence of commodity price decrease on fiscal outcome; the asymmetric long run nexus of commodity price changes on fiscal stance is also incorporated in the model. In addition, Equation 6 depicts the asymmetric dynamic multiplier effect of percentage changes in cp^+_t and cp^-_t on fiscal outcome \tilde{f}_t as h tends towards infinity. This is represented as follows;

$$m_h^+ = \sum_{j=0}^h \frac{\partial \tilde{f}_{t+j}}{\partial cp^+_{t-1}}, m_h^- = \sum_{j=0}^h \frac{\partial \tilde{f}_{t+j}}{\partial cp^-_{t-1}} \quad h = 0, 1, 2, \dots \quad (6)$$

It is noteworthy that as $h \rightarrow \infty$, $m^+_h \rightarrow \beta_2^+$ and $m^-_h \rightarrow \beta_3^-$ where β_2^+ and β_3^- are the asymmetric long run coefficients respectively. Here m^+_k and m^-_k denote the dynamic adjustment patterns which are asymmetric.

Annual time series data spanning through the period of 1984 to 2017 on total public debt (% of GDP), external debt stock as well as data for Gross domestic product and exchange rate were sourced from the World Development Indicators edition. The choice of debt component of fiscal operation was informed from its importance as a veritable means of financing fiscal operations in commodity-dependent countries; thus, it is seen as the final outcome of a country's fiscal position. Oil and cocoa prices are used as measures of commodity prices, and they were obtained from the World Bank commodity price database (the pink sheet). The study use oil prices given the substantial role of oil sector in Nigeria's fiscal operation. Furthermore, cocoa is selected to represent the country's nonoil sector (agriculture). This is expected to make a case for possible diversification drive of the economy. Thus, the study accounts for the response of fiscal indicators to commodity price movements. Also, Gross domestic product and exchange rate are used as control variables to capture the effect of business cycle and exchange rate trends on fiscal performance respectively. Finally, based on the institutional perspective, bureaucratic quality, as a governance indicator, is sourced from International Country Risk Guide (2018 Edition).

4. EMPIRICAL RESULTS AND DISCUSSION

Given that in both linear and non-linear ARDL model, the series should be either I (0) or I (1), and in some cases, theoretical propositions allow for the combination of I (0) and I (1), the unit root properties of the variables are examined with the use of Augmented Dickey Fuller (ADF) and Phillip Peron (PP). Accordingly, the tests indicate that none of the variables is integrated of I (2) or more. With the confirmation of the order of integration of the series in Table 1, employing ARDL model is well suited for the study. Also, in line with the main focus of the study, the presence of long and short-run asymmetries is tested based on the Wald test. Across models, the tests establish the existence of asymmetric relationship. Although with different significant levels, findings reveal that

the optimal model for the association between commodity prices and fiscal measures should include asymmetric relation in the long run as well as in the short run. Hence, the ARDL model is specified based on asymmetric relation, following the possible asymmetric effect of both oil and cocoa prices on fiscal outcomes. Similarly, the multiplier graph, in Figure 2, also buttresses the existence of asymmetric responses between commodity prices and fiscal indicators. For non-linear ARDL model, in Table 2, bounds F-tests are employed to ascertain the cointegration relationship among the variables. In accordance with Pesaran *et al.* (2001) as the computed F-statistics in the models are greater than the upper bound critical value, the null hypothesis of no cointegration is rejected at 1% and 5% significant level. Furthermore, in Figure 1, the parameters' stability, in mean and variance respectively, is confirmed by Cumulative Sum of Recursive Residuals (CUSUM) and Cumulative Sum of Squares of Recursive Residuals (CUSUMSQ), with the falling of both CUSUM & CUSUMSQ within the critical boundaries. The robustness of the estimates are validated by the diagnostic tests (Durbin Watson (D.W), Ramsey reset test, normality test and serial correlation) in Table 3. Essentially, while the long and short run linear ARDL models are presented in Table 4 and 5 in the Appendix respectively, given the presence of asymmetric relationship across models, the analysis is mainly centered on non-linear ARDL in Table 2 and 3. In view of the model specifications, in the study, Model (1) represents the exclusive inclusion of oil price as a determinant of fiscal outcome, whereas Model (2) implies the use of cocoa price as a commodity price indicator. In all, two fiscal indicators are included exclusively: debt (% of GDP) & external debt stocks.

Table-1. Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test results.

Variable	Augmented Dickey Fuller		Phillips-Perron	
	Level	First difference	Level	First difference
Debt (% of GDP)	-1.01 (0)	-4.94 (1)***	-0.97	-4.79***
External debt stocks	-1.20 (0)	-3.34 (2)**	-1.12	-5.65***
Oil price	-3.37 (3)**	-5.35 (0)***	-1.31	-5.35***
Cocoa price	-1.37 (2)	-4.35 (2)***	-1.64	-2.91**
Output gap	-2.37 (1)*	-3.30 (2)**	-2.07	-4.46***
Exchange rate	1.98 (0)	-3.21 (0)***	1.60	-3.21**
Bureaucratic quality	-1.47 (0)	-2.95 (0)**	-1.69	-2.95**

***, **, & * Indicates the level of significance at 1%, 5% & 10% respectively. Figures in (.) represents lag length selected by AIC criterion. The PP length was selected by Newey-West Band Width.

Based on model (1), the long-run estimated results in Table 2 show that an increase in oil prices has a substantial influence on both debt (% of GDP) and external debt stocks. This implies that 1 percent rise in oil prices results to a significant decrease in debt (% of GDP) (0.02% contraction) as well as external debt stocks (0.03 % reduction). On the other hand, a decrease in oil prices leads to a significant increase in both fiscal indicators at the same rate. Specifically, the effect of oil price increase is larger on external debt stocks compared with debt (% of GDP) in the long run, but it is the same in the short run (0.02%). These results reveal that oil price is a key determinant of fiscal outcomes. Regarding model (2), findings indicate that a rise in cocoa prices has a positive and substantial effect on debt (% of GDP), while it has a negative but insignificant effect on external debt stocks, suggesting that an increase in cocoa prices may not account for a significant reduction in external debt stocks. Further evidence indicates that a decrease in cocoa price, in the long run, would cause a substantial increase in both fiscal indicators. Given that Nigeria's fiscal operation is largely financed by the proceeds from commodity exports, especially crude oil, unanticipated rise or decline in oil prices could affect public debt levels in the country. Hence, these findings reveal the magnitude of influence commodity prices, in terms of oil price, have on the debt sustainability. Since public spending is strongly determined by oil rents in most oil producing countries (including Nigeria), the estimates buttress the significant role of oil price movements in fiscal performance. This assertion corroborates the work of Labys and Maizels (1993); Van der Ploeg and Poelhekke (2009). However, results explain the negligible impact of agricultural sector (cocoa) in the budgetary process. For instance, Nigeria's fiscal planning is basically hinged on activities in the oil sector. As a consequence, other sectors are typically accorded little

attention when designing fiscal policy, thereby accounting for the minimal effect of agricultural product prices in fiscal outcome (UNCTAD, 2017).

Table-2. Long run asymmetry ARDL estimates.

Variable	Model 1 (oil Price)		Model 2 (cocoa price)	
	Debt (% of GDP)	External debt stocks	Debt (% of GDP)	External debt stocks
Output gap	0.002 [1.07]	0.004** [2.50]	0.002 [1.08]	0.01** [2.06]
Exchange rate	-0.01*** [-3.47]	-0.003** [-2.08]	0.01 [1.14]	0.01** [2.25]
Bureaucratic quality	-0.01 [-0.11]	-0.36 [-0.36]	-0.97*** [4.64]	-0.77*** [-4.12]
Oil price ⁺	-0.02** [-3.37]	-0.03*** [-10.82]		
Oil price ⁻	-0.02** [-2.16]	-0.02*** [-3.79]		
Cocoa price ⁺			1.32** [2.74]	-0.09 [-0.22]
Cocoa price ⁻			-1.76*** [-3.98]	-0.95** [-2.04]
Test of asymmetry	9.03**	6.57**	4.38*	2.76*
F-Bounds Test				
	F-statistic	Level of significance	Lower bounds	Upper bounds
Model 1				
Debt (% of GDP)	4.78**	1%	3.93	5.23
External debt stocks	6.91***	5%	3.12	4.25
Model 2		10%	2.75	3.79
Debt (% of GDP)	7.55***			
External debt stocks	4.47**			

*, ** & *** Indicate statistical significance at 10%, 5% and 1% respectively, whilst figures in [-] are t-values.

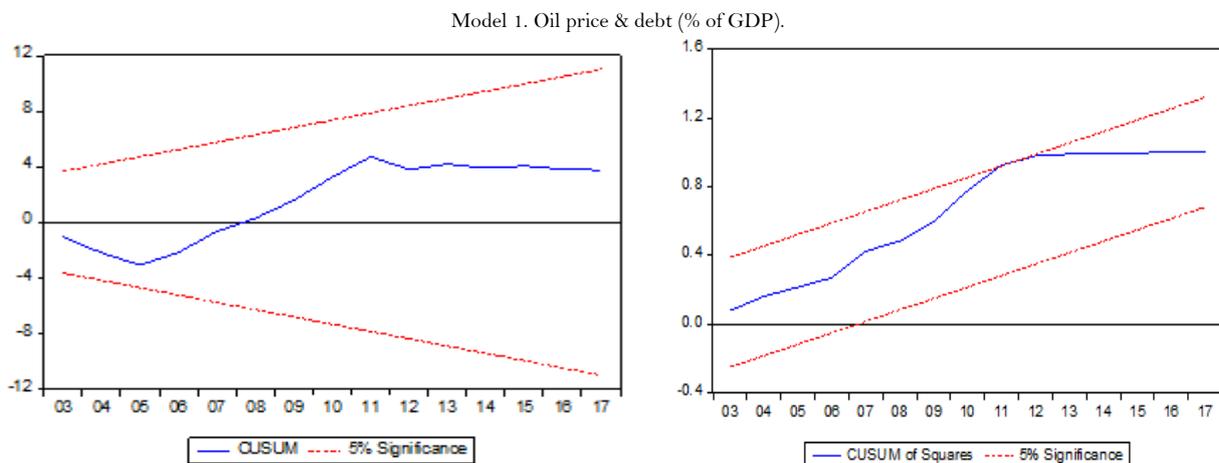
Table-3. Short run asymmetry ARDL estimates.

Variable	Model 1 (oil Price)		Model 2 (cocoa price)	
	Debt (% of GDP)	External debt stocks	Debt (% of GDP)	External debt stocks
Constant	3.56*** [6.07]	5.13*** [7.15]	2.75*** [7.45]	1.71*** [5.95]
CointEq(-1)*	-0.74*** [-6.19]	-1.07*** [-7.32]	-0.57*** [-7.71]	-0.95*** [-6.07]
ΔOutput gap	0.001*** [3.36]	-0.002 [-0.22]	-0.001 [0.85]	-0.002 [-2.24]
ΔExchange rate	-0.001 [-0.58]	-3.88 [-0.01]	-0.42*** [-3.18]	-0.43** [-2.17]
ΔBureaucratic quality	-0.20* [-2.01]	-0.44*** [-3.76]	0.04 [0.40]	-0.51** [-3.21]
ΔOil price ⁺	-0.02*** [-4.96]	-0.01* [-1.98]		
ΔOil price ⁻	0.02*** [3.63]	0.03** [5.28]		
ΔCocoa price ⁺			-0.21 [-1.10]	0.20* [1.51]
ΔCocoa price ⁻			-0.56*** [-3.18]	-0.07 [-0.24]
Test of asymmetry	12.49**	3.11*	6.99**	5.47**
Diagnostic test				
D.W	2.06	2.03	2.19	2.04
Ramsey reset test	0.79	0.19	0.15	0.16
Normality test	0.62	0.62	0.9	0.82
Serial correlation	0.04	0.47	0.23	0.32

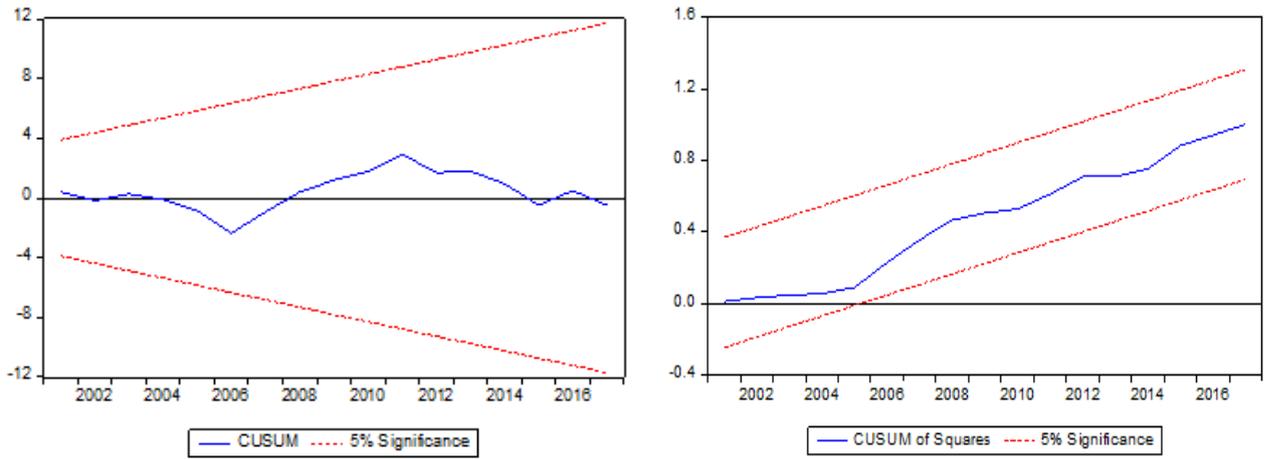
*, ** & *** Indicate statistical significance at 10%, 5% and 1% respectively, whilst figures in [-] are t-values.

In relation to the effect of control variables, findings reveal that exchange rate has a statistically significant effect on fiscal performance with the inclusion of oil price in model (1), but such effect does not hold in model (2) when cocoa prices are included. In view of this empirical evidence, one could elucidate that as oil price rises or falls (since oil sector is the mainstay of the economy), exchange rate would appreciate or depreciate disproportionately, which in turn could affect fiscal outcomes substantially. In contrast, given the little influence of the agricultural output, any change in cocoa prices may not necessarily induce larger changes in exchange rate that can significantly shape fiscal measures. On bureaucratic quality, the estimates support the notion that improved bureaucratic system could lead to effective fiscal management and performance. Nonetheless, the insignificance of bureaucratic quality in model (1) could be attributed to the low values of governance indicators in most African countries (Anayiotos and Toroyan, 2009). In addition, as oil rents give rise to financial recklessness, administrative laxity and rent-seeking behavior, poor governance would be pervasive in oil exporting countries (like Nigeria). Thus, the quality of public institutions might not explain fiscal performance in such countries (Hodler, 2006; Badinger and Nindl, 2014). With regard to output gap, the estimated parameters are positive and significant under external debt stocks in the two models, but insignificant in gross public debt. In general, this implies a weak countercyclical response to lower primary balance in the long run. This means that government tends to borrow more even in periods of economic busts or slumps (Jensen, 2000; Beegle et al., 2008).

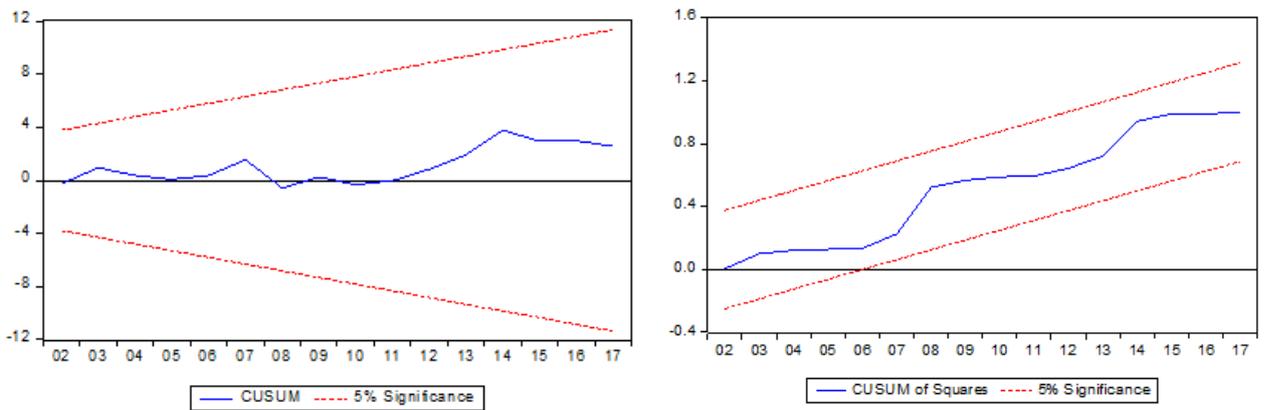
Table 3 shows the results of short run asymmetry ARDL estimates. Oil prices is also linked to fiscal performance in the short run, since oil rents serve as a crucial input for the running of public affairs. In model (1), Oil price hikes can threaten fiscal outcomes, as findings indicate significant and negative association between oil price increase and fiscal indicators (debt (% of GDP) and external debt stocks). On the other hand, like in the long run, a fall in oil prices also has substantial influence on fiscal operation. Regarding the short run effect of cocoa prices, results are similar to the one obtained in Table 2 in terms of signs and significant impact. This reflects a host of potential significant effects associated with primary commodity prices on fiscal policy design and economic development. In relation to control variables, both exchange rate and bureaucratic quality somewhat have the effect analogous to previous section Table 2. However, with the exemption of model (1) under debt (% of GDP), output gap has an insignificant and negative effect on fiscal measures, suggesting a weak procyclical reaction of fiscal policy to output fluctuations in the short run. By and large, the error correction terms (lie between 0.57 and 1.07) are significantly and negatively signed at 1% level of significance, thereby conforming to theoretical expectation. Overall, empirical evidence seems to support the proposition that commodity price boom may be a boon for many commodity-dependent countries, including Nigeria.



Model 1. Oil price & external debt stocks.



Model 2. Cocoa price & debt (% of GDP).



Model 2. Cocoa price & external debt stock.

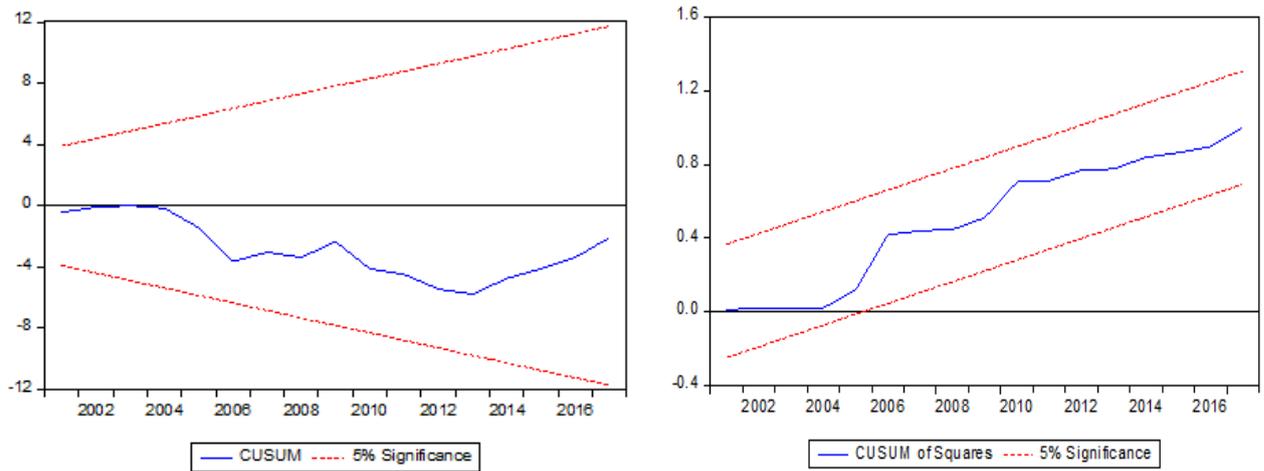


Figure-1. Cusum (left) & cusumsq (right).

Source: Author's computation in E-views 10 econometrics package.

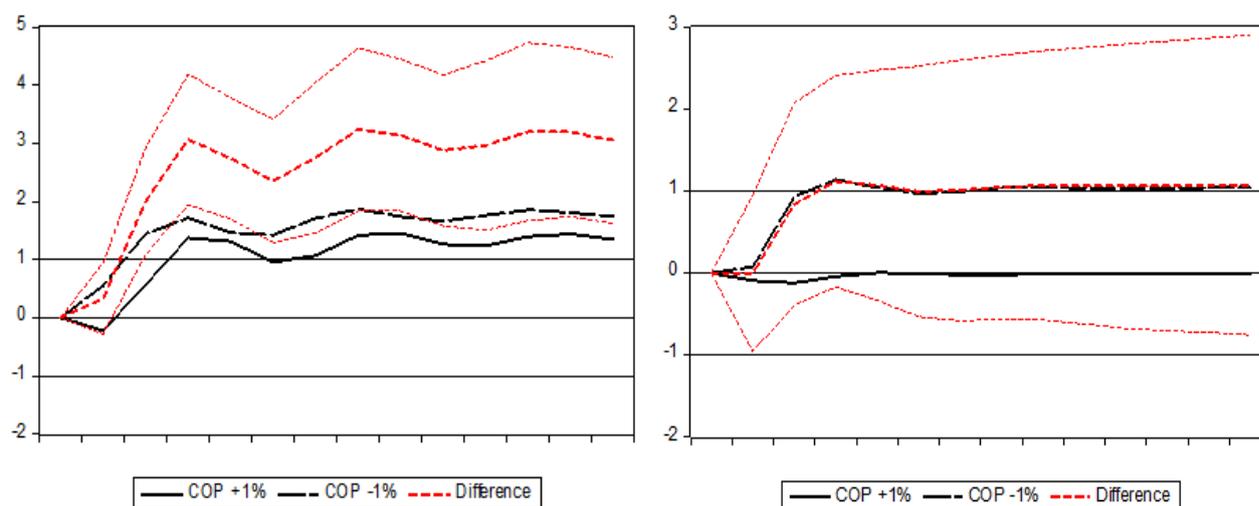


Figure-2. Multiplier's graph.

Source: Author's computation in E-views 10 econometrics package.

5. CONCLUDING REMARK

Over the years, the global economy has faced series of fluctuations in commodity prices, which certainly have inimical effect on the macroeconomic and fiscal performance in most developing countries. The persistence of ups and downs commodity price movements necessitate the need to identify and offer a better understanding on how long-term effect of commodity prices could be addressed, and thus engenders sound policy options to remedy commodity-dependent effects. Although many country-level commodity cases have been studied, in order to project the response of fiscal actors in Nigeria's context, the paper examines the asymmetric relationship between commodity prices and fiscal performance in Nigeria between 1984 and 2017 using the non-linear autoregressive distributed lag (NARDL) cointegration technique. While two fiscal indicators are used (debt (% of GDP) and external debt stocks), oil and cocoa prices are employed as commodity price measures.

In the analysis, the existence of a long-run cointegrating relationship between the oil prices, cocoa prices and fiscal outcome are confirmed as well as the asymmetric impact of commodity prices. The linkage between commodity prices and fiscal measures is a highly relevant aspect of governance and development policy, since Nigeria is commodity-export-dependent. Through multiple avenues, empirical evidence establishes that commodity price movements can cause external stress that is harmful to public affair management. The study further elucidates that as Nigeria's fiscal operation is largely financed by the proceeds from commodity exports, especially crude oil, in the long run, unanticipated rise or decline in oil prices could have substantial effect on public debt levels in the country. On the other hand, a rise in cocoa prices positively and strongly enhances debt (% of GDP), but with no evidence of such effect on external debt stocks, indicating that an increase in cocoa price may not result to a large reduction in external debt stocks. Fundamental observations from the findings reveal that with an improvement in agricultural output (cocoa), a rise in primary commodity prices (such as cocoa) may significantly drive improved fiscal performance. Also, it is demonstrated that, in the short run, oil price movements are key determinants of fiscal outcomes. In sum, the study assert that there is a host of potential important effects associated with primary commodity prices (cocoa) on fiscal policy design and economic development in both long and short run. Hence, the study posits that to cushion the effect of commodities price fluctuations, it is crucial to launch several initiatives that would enhance the diversification of the economy. This can be better achieved through the provision of financial incentives and strong regulatory framework for the development of agricultural sector.

Funding: This study received no specific financial support.

Competing Interests: The authors declare that they have no competing interests.

Acknowledgement: Both authors contributed equally to the conception and design of the study.

REFERENCES

- Agénor, P.R., 2016. Optimal fiscal management of commodity price shocks. *Journal of Development Economics*, 122: 183–196. Available at: <https://doi.org/10.1016/j.jdeveco.2016.05.005>.
- Anayiotos, G. and H. Toroyan, 2009. Institutional factors and financial sector development: Evidence from Sub-Saharan Africa, IMF Working Paper No WP/09/258.
- Araujo, J.D., B.G. Li, M. Poplawski-Ribeiro and L.-F. Zanna, 2016. Current account norms in natural resource rich and capital scarce economies. *Journal of Development Economics*, 120: 144-156. Available at: <https://doi.org/10.1016/j.jdeveco.2015.10.005>.
- Arezki, R. and M. Brückner, 2010. International commodity price shocks, democracy, and external debt (No. 10-53). International Monetary Fund.
- Arreaza, A., B.E. Sorensen and O. Yosha, 1999. Consumption smoothing through fiscal policy in OECD and EU countries. In: Poterba, J.M., von Hagen, J. (Eds.), *Fiscal Institutions and Fiscal Performance*. University of Chicago Press, Chicago IL, pp: 59–80.
- Badinger, H. and E. Nindl, 2014. Globalisation and corruption, revisited. *The World Economy*, 37(10): 1424-1440. Available at: <https://doi.org/10.1111/twec.12156>.
- Barro, R.J., 1979. On the determination of the public debt. *Journal of Political Economy*, 87(5): 940-971.
- Beegle, K., R.H. Dehejia, R. Gatti and S. Sofya Krutikova, 2008. The consequences of child labor: Evidence from longitudinal data in rural Tanzania. Policy Research Working Paper No. 4677, World Bank, Washington, DC.
- Berg, A., R. Portillo, S.-C.S. Yang and L.-F. Zanna, 2013. Public investment in resource-abundant developing countries. *IMF Economic Review*, 61(1): 92-129. Available at: <https://doi.org/10.1057/imfer.2013.1>.
- Borensztein, E. and C.M. Reinhart, 1994. The macroeconomic determinants of commodity prices. *Staff Papers*, 41(2): 236-261. Available at: <https://doi.org/10.2307/3867508>.
- Bruckner, M. and A. Ciccone, 2010. International commodity price shocks, growth, and the outbreak of Civil War in Sub-Saharan Africa. *The Economic Journal*, 120(544): 519-534. Available at: <https://doi.org/10.1111/j.1468-0297.2010.02353.x>.
- Bry, G. and C. Boschan, 1971. *Cyclical analysis of time series: Selected procedures and computer programs*. New York.
- Cashin, P., C.J. McDermott and A. Scott, 2002. Booms and slumps in world commodity prices. *Journal of Development Economics*, 69(1): 277-296. Available at: [https://doi.org/10.1016/s0304-3878\(02\)00062-7](https://doi.org/10.1016/s0304-3878(02)00062-7).
- Céspedes, L.F. and A. Velesco, 2013. Was this time different?: Fiscal policy in commodity republics. *Journal of Development Economics*, 106(2014): 92-106. Available at: <http://dx.doi.org/10.1016/j.jdeveco.2013.07.012>.
- Cuddington, J., 1989. Commodity export booms in developing countries. *The World Bank Research Observer*, 4(2): 143-165. Available at: <https://doi.org/10.1093/wbro/4.2.143>.
- El Anshasy, A.A. and M.-S. Katsaiti, 2013. Natural resources and fiscal performance: Does good governance matter? *Journal of Macroeconomics*, 37: 285-298. Available at: <https://doi.org/10.1016/j.jmacro.2013.05.006>.
- Erbil, N., 2011. Is fiscal policy procyclical in developing oil-producing countries? IMF Working Paper No 171.
- Gavin, M., R. Hausmann, R. Perotti and E. Talvi, 1996. . *Managing fiscal policy in Latin America*. OCE Working Paper No 326. Office of the Chief Economist, Inter-American Development Bank, Washington, D.C.
- Hodler, R., 2006. The curse of natural resources in fractionalized countries. *European Economic Review*, 50(6): 1367-1386. Available at: <https://doi.org/10.1016/j.euroecorev.2005.05.004>.
- Ibrahim, M.H., 2015. Oil and food prices in Malaysia: A nonlinear ARDL analysis. *Agricultural and Food Economics*, 3(1): 1-14. Available at: <https://doi.org/10.1186/s40100-014-0020-3>.
- Jensen, R., 2000. Agricultural volatility and investments in children. *American Economic Review*, 90(2): 399-404. Available at: <https://doi.org/10.1257/aer.90.2.399>.
- Kaminsky, G., 2010. Terms of trade shocks and fiscal cycles. NBER Working Paper, No 15780.

- Kumah, F.Y. and J.M. Matovu, 2007. Commodity price shocks and the odds on fiscal performance: A structural vector autoregression approach. *IMF Staff Papers*, 54(1): 91-112. Available at: <https://doi.org/10.1057/palgrave.imfsp.9450001>.
- Labys, W.C. and A. Maizels, 1993. Commodity price fluctuations and macroeconomic adjustments in the developed economies. *Journal of Policy Modeling*, 15(3): 335-352. Available at: [https://doi.org/10.1016/0161-8938\(93\)90037-q](https://doi.org/10.1016/0161-8938(93)90037-q).
- Lane, P.R., 2003. The cyclical behaviour of fiscal policy: Evidence from the OECD. *Journal of Public Economics*, 87(12): 2661-2675. Available at: [https://doi.org/10.1016/s0047-2727\(02\)00075-0](https://doi.org/10.1016/s0047-2727(02)00075-0).
- Makin, A., 2013. Commodity prices and the macroeconomy: An extended dependent economy approach. *Journal of Asian Economics*, 24: 80-88. Available at: <http://dx.doi.org/10.1016/j.asieco.2012.10.001>.
- Medas, P. and D. Zakharova, 2009. A primer on fiscal analysis in oil-producing countries. *IMF Working Paper*, 2009(56): 1-47. Available at: <http://dx.doi.org/10.5089/9781451872033.001>.
- Medina, J.P. and C. Soto, 2016. Commodity prices and fiscal policy in a commodity exporting economy. *Economic Modelling*, 59: 335-351. Available at: <https://doi.org/10.1016/j.econmod.2016.08.002>.
- Medina, L., 2010. The dynamic effects of commodity prices on fiscal performance in Latin America. *IMF Working Paper*, WP/10/192:1-28. Available from <https://www.imf.org/external/pubs/ft/wp/2010/wp10192.pdf>.
- Nashashibi, K. and S. Bazzoni, 1994. Exchange rate strategies and fiscal performance in sub-Saharan Africa. *Staff Papers*, 41(1): 76-122. Available at: <https://doi.org/10.2307/3867486>.
- Nziramanga, M.T. and C. Obidegwu, 1981. Primary commodity price fluctuations and developing countries: an econometric model of copper and Zambia. *Journal of Development Economics*, 9(1): 89-119. Available at: [https://doi.org/10.1016/0304-3878\(81\)90006-7](https://doi.org/10.1016/0304-3878(81)90006-7).
- Pesaran, M. and Y. Shin, 1999. An autoregressive distributed lag modelling approach to cointegration analysis. In: Storm S (Ed) *Econometrics and Economic Theory in the 20th Century: The Ragnar Frisch Centennial Symposium*, Chapter 11. Cambridge University Press, Cambridge.
- Pesaran, M.H., Y. Shin and R.J. Smith, 2001. Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, 16(3): 289-326. Available at: <https://doi.org/10.1002/jae.616>.
- Proshare, 2018. Driving effective fiscal spending in Nigeria as a part of fiscal consolidation. Proshare Economy Webpage. Available from <https://www.proshareng.com/news/Driving-Effective-Fiscal-Spending-In-Nig/Driving-Effective-Fiscal-Spending-In-Nig/41413>.
- Rautava, J., 2004. The role of oil prices and the real exchange rate in Russia's economy—a cointegration approach. *Journal of comparative economics*, 32(2): 315-327. Available at: [https://doi.org/10.1016/s0147-5967\(04\)00021-6](https://doi.org/10.1016/s0147-5967(04)00021-6).
- Schady, N.R., 2004. Do macroeconomic crises always slow human capital accumulation? *The World Bank Economic Review*, 18(2): 131-154. Available at: <https://doi.org/10.1093/wber/lhh036>.
- Shin, Y., B. Yu and M. Greenwood-Nimmo, 2011. Modelling asymmetric cointegration and dynamic multiplier in a nonlinear ARDL framework, Mimeo.
- Sinnott, E., 2009. Commodity prices and fiscal policy in Latin America and the Caribbean. World Bank Group. First draft: 1-40. September 2009.
- Spatafora, N. and I. Samake, 2012. Commodity price shocks and fiscal outcomes. *IMF Working Paper*, WP/12/112:1-47. Available from <http://econpapers.repec.org/RePEc:imf:imfwpa:12/112>.
- Stein, E., E. Talvi and A. Gristani, 1999. Institutional arrangements and fiscal performance: The Latin American experience. In: Poterba, J.M., von Hagen, J. (Eds.), *Fiscal Institutions and Fiscal Performance*. University of Chicago Press, Chicago IL, pp: 103-13.
- Talvi, E. and C.A. Vegh, 2005. Tax base variability and procyclical fiscal policy in developing countries. *Journal of Development Economics*, 78(1): 156-190. Available at: <https://doi.org/10.1016/j.jdeveco.2004.07.002>.
- Tornell, A. and P.R. Lane, 1999. The voracity effect. *American Economic Review*, 89(1): 22-46. Available at: <https://doi.org/10.1257/aer.89.1.22>.

UNCTAD, 2017. Commodities and development report 2017: Commodity markets, economic growth and development. New York and Geneva: United Nations Publication

Van der Ploeg, F. and S. Poelhekke, 2009. Volatility and the natural resource curse. Oxford Economic Papers, 61: 727-760.

Zettelmeyer, J. and I.V. Hollar, 2008. Fiscal positions in Latin America: Have they really improved? IMF Working Paper, WP/08/137:1-30. May 2008.

APPENDIX

Table-4. Long run symmetry ARDL estimates

Variable	Model 1 (oil Price)		Model 2 (cocoa price)	
	Debt (% of GDP)	External debt stocks	Debt (% of GDP)	External debt stocks
Output gap	0.01 [0.94]	0.004** [2.14]	0.01*** [5.45]	0.007*** [3.72]
Exchange rate	-0.02** [-3.09]	-0.01** [-2.58]	0.01 [0.53]	0.01 [2.82]
Bureaucratic quality	-0.003 [-0.02]	0.06 [0.65]	0.76** [2.75]	0.72*** [4.65]
Oil price	-0.01 [-1.01]	-0.04*** [-8.15]		
Cocoa price			0.18 [0.58]	-0.45** [-2.39]
F-Bounds Test				
	F-statistic	Level of significance	Lower bounds	Upper bounds
Model 1				
Debt (% of GDP)	3.44	1%	3.74	5.06
External debt stocks	4.86**	5%	2.86	4.01
Model 2				
Debt (% of GDP)	7.36***	10%	2.45	3.52
External debt stocks	5.10**			

*, ** & *** Indicate statistical significance at 10%, 5% and 1% respectively, whilst figures in [-] are t-values.

Table-5. Short run symmetry ARDL estimates.

Variable	Model 1 (oil Price)		Model 2 (cocoa price)	
	Debt (% of GDP)	External debt stocks	Debt (% of GDP)	External debt stocks
Constant	2.02*** [4.40]	0.82*** [3.58]	0.05*** [6.76]	0.09*** [5.52]
CointEq(-1)*	-0.39*** [-4.54]	-0.87*** [-5.42]	-0.88*** [-7.01]	-1.01*** [-5.58]
ΔOutput gap	0.002* [2.03]	0.001 [0.52]	0.001 [1.20]	-0.001 [-0.75]
ΔExchange rate	-0.001 [-0.23]	-0.003 [-1.01]	0.01*** [3.93]	0.01** [2.64]
ΔBureaucratic quality	-0.28** [-2.14]	-0.48*** [-3.38]	-0.39** [-2.83]	-0.60*** [-3.68]
ΔOil price	-0.003 [-0.85]	-0.02*** [-4.97]		
ΔCocoa price			-0.09 [-0.53]	-0.11 [-0.58]

*, ** & *** Indicate statistical significance at 10%, 5% and 1% respectively, whilst figures in [-] are t-values.

Views and opinions expressed in this article are the views and opinions of the author(s). The Economics and Finance Letters shall not be responsible or answerable for any loss, damage or liability etc. caused in relation to/arising out of the use of the content.