

# Oil Price Transmission, Deficit Financing and Capital Formation (Transmisi Harga Minyak, Pembiayaan Defisit dan Pembentukan Modal)

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## ABSTRACT

*This study investigated the magnitude of the transmission effect from oil price, to deficit financing, and capital formation using the Generalised Method of Moment approach. Based on the Nigerian data, the findings reveals a significant but small inverse oil price transmission effect, through the oil revenue channel to deficit financing. This indicates that growth in public spending is currently pacing faster than government revenue, due to poor fiscal management. In contrast, the transmission effect from oil price, through the oil revenue and deficit financing channels, to capital formation is significantly positive but minute in magnitude. The weak response of capital formation to the transmission effect from oil price, is due to the increasing use of oil proceeds in funding government's recurrent outlays over the years. Hence, channelling positive growth in oil prices, and repositioning the use of deficit financing to growing capital formation as against consumption demands, will increase diversification of government revenue base and investors' confidence in the economy through growth in FDI inflows.*

*Keywords: Oil price; transmission; deficit financing; capital formation; Nigeria.*  
*JEL: E22, E32, E62, H54, H61, P35.*

## ABSTRAK

*Kajian ini mengkaji magnitud kesan transmisi daripada harga minyak, kepada pembiayaan defisit, dan pembentukan modal di Nigeria menggunakan pendekatan Generalized Method of Moment (GMM). Hasil kajian menunjukkan terdapat kesan transmisi yang signifikan dan songsang berskala kecil bagi harga minyak melalui saluran transmisi hasil minyak kepada pembiayaan defisit. Didapati pertumbuhan dalam perbelanjaan awam bergerak lebih pantas daripada hasil kerajaan, disebabkan pengurusan fiskal yang lemah di negara ini. Sebaliknya, kesan transmisi daripada harga minyak, melalui hasil minyak dan saluran pembiayaan defisit, kepada pembentukan modal adalah positif dengan ketara tetapi dalam magnitud kecil. Tindak balas pembentukan modal yang lemah terhadap kesan transmisi daripada harga minyak, adalah disebabkan oleh peningkatan penggunaan hasil minyak dalam membiayai perbelanjaan berulang kerajaan selama ini. Oleh itu, menyalurkan pertumbuhan positif dalam harga minyak, dan meletakkan semula pembiayaan defisit kepada pembentukan modal yang semakin meningkat berbanding permintaan penggunaan, akan meningkatkan kepelbagaian asas hasil kerajaan dan keyakinan pelabur terhadap ekonomi melalui pertumbuhan aliran masuk FDI.*

*Kata kunci: Harga minyak; transmisi; pembiayaan defisit, pembentukan modal; Nigeria*

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## INTRODUCTION

As the effect of the COVID-19 pandemic ravage the world, oil prices plummeted due to the virus' effect on the demand side of the international oil market. Also on the supply side, the price war between Saudi Arabia and Russia created an international oil glut, and further exacerbated the downward trend in oil prices. Consequently, oil rich economies, especially the developing ones, have been severely hit by acute shortage in oil revenues due to the pandemic's crash

of crude oil prices. Nigeria is one of such countries impacted by the steep decline in government revenues. Owing to the fact that oil exports accounts for around 96 percent of the total Nigerian export (see Ebi 2018; Aladejare 2020; Ebi & Nyong 2021). Hence, making oil revenues extremely crucial in funding the yearly budget, as well as meeting the import demands of the country. This is why whenever there is a persistent drop (or rise) in oil price, the fiscal obligations of the government experience sudden negative (or positive) shocks. For instance, oil price dropped from around \$67



per barrel in December 2019, to below \$30 per barrel in March 2020. A period most world economies were in lockdown due to the pandemic. Both the demand and supply side sources of the decline, collectively ensured an oil price value loss of about 45 percent within three months. Thus, this necessitating a downward review of the Nigerian 2020 budget in March 2020 from ₦10.59 trillion to ₦9.09 trillion by the fiscal authorities (a difference of ₦1.5 trillion). The government's claim was that such reductions in the budget will only affect subsidy payments on refined petroleum products, and unessential recurrent spending, while capital spending remains unchanged.

Predictably, deficit financing in most oil dependent developing economies usually grow in times of falling oil prices. Nigeria is no exception, with deficit financing being regarded as a fiscal policy measure for growth stimulation, through investment in capital formation. Deficit financing can be regarded as a traditional means often deployed for the purpose of attaining economic growth and development, especially in developing countries (Eyiuche 2000). This is because, developing economies are often characterised by low levels of domestic savings and capital formation, high level of poverty and unemployment, massive infrastructure deficit, dependence on primary production, weak economic fundamentals, etc. Therefore, fiscal authorities in developing oil dependent countries often use deficit financing to cushion effects of falling oil prices; while relying heavily on a strong external reserve as a buffer. For instance, although deficit financing was anticipated to grow in Saudi Arabia, their strong external reserve is a sure buffer to meet budgetary demands for at least another five years if oil prices should fall below \$30. Comparatively, external reserve in Nigeria are well drained. Two factors accounted for this, first, the fact that the country only fully exited an economic recession in 2018, which was due to falling oil prices between mid-2014 to 2016 (Aladejare 2018), forced the government to adopt an expansionary fiscal approach of spending its way out of the recession. Second, the increase in demand for foreign exchange to fund imports, saw external reserve dipped to about \$36 billion in March 2020 from \$47.6 billion in mid-2018.

Hence, this supports why fiscal policy in oil dependent economies such as Nigeria is substantially affected by oil price volatility. Such effect is transited to the budget through uncertainty in oil revenues. Consequently, whenever there is a shortfall in oil revenues, the size of deficit financing is usually scaled-up to augment for the fiscal deficit created. Indicating that deficit financing in Nigeria is usually deployed for sustainability in public spending obligations, which includes investment in capital formation. Consequently, since the 1970s, the size of deficit financing in Nigeria's annual budget has continued to grow. Reason being that various governments have always stressed the need for

such increase for infrastructural development. However, studies such as (Baunsgaard 2003; Bello 2004; Agundu & Dagogo 2008; Idenyi et al. 2017) have observed that despite the oil booms and the annual increases in deficit financing, infrastructural development in Nigeria still leaves much to be desired. Intuitively, effects from rising public debt and servicing cost could be constituting the bulk of deficit financing, thereby limiting its effect on capital formation. For instance, Nigeria's external debt-to-export ratio from 1970-2017 was about 143 percent (Ebi & Imoke 2017; WDI 2019). An indication that over a 100 percent increase in the country's exports would be required only for external debt repayment. In such scenario, the magnitude to which deficit financing responds to changes in oil price, through oil revenue may be minute.

A number of studies such as El Anshasy and Bradley (2012); Yusoff (2013); Idenyi et al. (2017); Aladejare (2019); Iwatsubo and Ogasawara (2019); Eregha et al. (2022), had examined the effect of oil price or oil revenue on government spending, fiscal deficit, investment or capital formation, mostly in developing oil exporting countries. The nearest of these papers to the present paper is that of Yusoff (2013) who analyzed the effects of oil price fluctuation on the economy and fiscal policy response to the Malaysian economy using a co-integration test, variance decomposition (VDC) and impulse response function (IRF) analysis under the unrestricted vector autoregression (VAR) methodology. The paper concluded that fiscal policy is the main mechanism channel that determines the degree to which oil price shocks affect the economy.

This paper differed from that of Yusoff (2013) in methodology and country of application as well as other related studies in that, none of them simultaneously examined the significance and magnitude of the transmission path, from oil price to deficit financing and capital formation as done in this paper. Rather, a direct independent effect from oil price to deficit and capital formation is what obtains in the existing literature. Neglecting the magnitude of oil price's effect on deficit financing and capital formation in an oil dependent country such as Nigeria, could yield bias in terms of oil price significance to infrastructural development of the country. Reason is that, capital formation does not directly respond to fluctuations in oil price, but rather indirectly, through generated oil revenue and the adopted fiscal policy of the government.

Hence, the focus of this paper is to evaluate the magnitude of this transmission channel from oil price, to deficit financing and capital formation in Nigeria. Unearthing this transmission effect will show the extent to which changes in oil price contributes to the growth of deficit financing; and capital formation in an oil dependent economy such as Nigeria. To achieve this, the magnitude of the pass-through effect from oil price to deficit financing was deciphered; with oil revenue as

the 'vehicle'. Secondly, the pass-through effect from oil price to capital formation is determined, with oil revenue and deficit financing playing a moderating role. Methodologically, the chain rule effect between the variables was analysed using the Generalised Method of Moment (GMM) technique; and applied on annual time series data from 1970 to 2017. Noteworthy, there is a dearth of this nature of study in the literature on oil producing countries in developing countries, and particularly for Nigeria.

Following this section is section 2 which gives an overview of oil price, deficit financing and capital formation in Nigeria. Section 3 covers the study's literature review, while in section 4, the study's methodology is presented. Sections 5 and 6 covers the study's result analysis and conclusion respectively.

#### OVERVIEW OF OIL PRICE, DEFICIT FINANCING AND CAPITAL FORMATION IN NIGERIA

After the ills of a civil war that lasted from 1967-1970, Nigeria began commercial exploration of crude oil in 1970. Between the 1970-1980 period, the average annual growth rate in crude oil price stood at 40.04 percent (see Table 1), hence, the country enjoyed early booms in oil revenue. At the same time, deficit financing was first recorded in the 1970 budget, and had remained an annual norm ever since. The 1970 budget which was meant for post-civil war reconstruction of damaged infrastructure and national integration, saw for the first time the Federal Government outlay lying above estimated revenue. Thus, average annual deficit financing-to-budget ratio stood at an average annual of 22.41 percent (see, Table 1), while average annual capital formation per GDP was 12.54 percent within the period. To fund the deficit, the Federal Government relied on foreign and domestic borrowing, as well as other funds made up of public, special and trust funds, treasury clearance funds, etc.

The period between 1981-1990 witnessed tremendous decline in the average annual growth rate of oil price to -1.44 percent (see, Table 1). This massive decline was attributed to the oil glut experienced in the international oil market at the commencement of the decade. Hence, Nigeria suffered huge decline in oil receipts, and as a consequence, there was a major shortfall in oil revenues needed to fund the budgets. By mid-1986, the country had slipped into a recession. To curb the recessionary effects, the government introduced a Structural Adjustment Programme (SAP) which saw deficit financing grow significantly within the period. Average annual deficit financing-to-budget ratio rose to 32.93 percent; while average annual capital formation per GDP further declined to 9.46 percent (see, Table 1). The growth in deficit financing in this period was seen by the Federal Government, as the only avenue

to sustain its growing expenditure. Thus, borrowing especially from domestic sources were preferred.

Within the 1991-2000 period, oil price had recovered and began to trend upward. Table 1 shows that the average annual growth rate of oil price was 4.99 percent. On the other hand, average annual deficit financing-to-budget ratio declined to 25.80 percent. As expected, the growth in oil revenues meant a cut in deficit financing in the budget. Within the period, the average annual capital formation per GDP declined to 3.1 percent, despite improvements in oil revenue.

Growth in oil price continued to trend upward in the 2001-2010 period; rising by 14.02 percent on an average annual basis. Also within the period, average annual deficit financing-to-budget ratio declined further to 14.96 percent. Aside the steady rise in oil revenues, two other factor also ensured the decline in the size of deficit financing. They are the enactment of the Central Bank of Nigeria (CBN) Act of 2007, which accorded full operational autonomy to the CBN. The act empowered the CBN to refuse the Federal Government's request to finance its deficit beyond 5 percent of the previous year's actual revenue. The second was the enactment of the fiscal responsibility act (2007), which also limits government's spending in excess of 3 percent of the country's GDP. Both laws were measures aimed at synchronizing the fiscal policy stance of the Federal Government, with the monetary policy goals of the CBN. In spite of the fall in deficit financing, capital formation per GDP on an average annual basis increased to 3.91 percent.

After the remarkable growth in oil prices in the past two decades (i.e., 1991-2000 and 2001-2010), the upward trend in oil price continued till 2012 when it peaked at \$114.21 (BP statistical review of world energy 2018). However, from 2013-2016, oil price continued to drop; such that its average annual growth rate for the 2011-2017 period was -1.93 percent (see, Table 1). The once again volatile oil revenues posed serious fiscal challenges to the government; and by 2016 the country entered into another recession. As expected, the average annual deficit financing-to-budget ratio climbed remarkably to 31.3 percent; while average annual capital formation per GDP also grew to 8.75 percent (see, Table 1).

It is therefore not unlikely that Nigeria will witness tremendous growth in deficit financing in the nearest future. Intuitively, the revenue shock posed by the COVID-19 pandemic has left the government borrowing excessively from the international community, to safeguard against government bankruptcy. Already, there are indications of the economy sliding back into another recession due to poor oil revenues from effects of economic lockdowns. Hence, deficit financing is anticipated to rise further and aggravate the threat of fiscal unsustainability; due to Nigeria's mono-product economy, while capital formation may also end-up worsening.

TABLE 1. Average annual growth rate of oil price; deficit financing per budget and Gross fixed capital formation per GDP in Nigeria (1970-2017)

YEAR	OPRG	DEFBGT	GFCGDP
1970-1980	40.04	22.41	12.54
1981-1990	-1.44	32.93	9.46
1991-2000	4.99	25.80	3.10
2001-2010	14.02	14.96	3.91
2011-2017	-1.93	31.33	8.75

Note: OPRG = Average annual growth rate of oil price; DEFBGT = Average annual growth rate of deficit financing per budget; and GFCGDP = Average annual growth rate of Gross fixed capital formation per GDP

## LITERATURE REVIEW

### THEORETICAL LITERATURE REVIEW

In the public sector economics literature, Buchanan and Wagner were able to show that government's revenue and spending were inversely related. Thus, reduction in government receipts is believed could result in increase in government spending. Their reasoning stems from the fact that when taxes are lowered, there is a growing public perception that government budgeted programs have also reduced. Thus, new pressures will be exacted on the government to embark on fresh programs by the citizens. When the government choose to respond to such demands, public expenditure is anticipated to follow an upward path. Consequently, the fiscal budget deficit of the government will also rise, and hence, growth in deficit financing as well.

Furthermore, the displacement effect proposition of Peacock and Wiseman suggest that government spending is usually expected to rise in times of uncertainty. This uncertainty could result from an economic recession; thus, the government has the responsibility of spending more to salvage the economy from a total collapse. Peacock and Wiseman theory noted that public outlay is believed to grow in a step like fashion; rising when there are uncertainties and stabilizing in times of recovery. The model further noted that the temporary rise in government expenditure resulting from attempts to salvage the economy from a total collapse, has the tendency of becoming a permanent phenomenon in public spending (Aladejare 2013). This growth in public outlay can also raise the level of government revenue through increased taxes. However, the situation with Nigeria is such that the taxable public are always receptive to paying more. In addition, inherent structural tax administrative challenges such as high level of tax avoidance and evasion, high level of income and wealth inequality, demographic pressures, and government inefficiency, further contributes to the need and growth in deficit financing when oil revenues are uncertain. Also,

for the purpose of political relevance, governments have not been able to significantly diversify its tax revenue base. This is because citizens are always sceptical of the effective use of the tax revenues in achieving job creation, through investment in capital formation in Nigeria.

### EMPIRICAL LITERATURE REVIEW

There exist various studies that have examined the effect from oil price or oil revenue on government spending, fiscal deficit, investment or capital formation; specifically, in developing oil exporting countries. Beginning with studies that indicated significant oil price and oil revenue effect on government spending; Gelb (1988), conducted a study on the effect of oil revenue on government spending in six oil exporting countries using the Ordinary Least Square (OLS) technique, the study was able to conclude that whenever there is an increase in oil price, government revenue also rises; while the additional revenue further triggers increase in public expenditure. In a related study, El Anshasy and Bradley (2012) reported a robust direct positive connection from oil price volatility to government outlay in 16 oil-exporting nations; through the systemic General Method of Moment (GMM) approach. Hamdi and Sbia (2013) examined the nexus existing between oil income, government outlay and economic prosperity for Bahrain, by adopting a multivariate cointegration technique and error-correction model. Findings from the study reveals that oil incomes prevail as the essential means of actualising economic prosperity, and the fundamental source of funding public outlay in the country. In the study by Adedokun (2018), and using a Structural Vector Auto-Regressive (SVAR) approach, the study revealed that oil price shocks do not significantly predict variations in public outlay in the short-term but in the long-term. However, the predictive power of oil revenue shocks was found to be very significant both in the short and long-term. Recently, Eregha et al. (2022) examined the dynamic connection between fiscal and current account deficits conditioned on oil price fluctuation in selected African oil-producing countries for the period 1981–2018. Using a Dynamic Fixed Effect and the Augmented Mean Group techniques due to cross-sectional dependence, results validated the twin deficits hypothesis for the selected African oil-producing countries. The paper pointed that positive oil price shocks should not be assumed to be permanent shocks so as to smoothen consumption as well as implementation of a robust fiscal rule and framework for managing excess crude oil prices for stabilization.

In addition, previous studies have shown a strong dependence of a budget deficit on oil revenue. For instance, Niki et al. (2009) reports that budget deficit in Iran is a function of oil revenue, due to the huge reliance on oil revenue by the government. By adopting the SVAR approach, the study noted that deficit financing

declined more when there is a positive shock to oil revenue than to tax revenue. Komeyjeni and Varhami (2012) using the OLS approach, further observed that the effect of oil revenue on budget deficit for Iran is negative. Similarly, Monjazeb et al. (2014) using the OLS approach, concluded that oil revenues have a negative effect on budget deficit in oil exporting countries. Aladejare (2019) adopted a symmetric and asymmetric Auto-Regressive Distributed Lag (ARDL) model, and ascertained that oil revenue plays a significant role in the growth of government spending in Nigeria; which correspondingly leads to growth in government budget deficit. However, the effect was only substantial when the role of asymmetry was incorporated into the nexus. The study noted that in periods of declining oil prices, government spending is usually increased through deficit financing for investment purposes.

Ebi and Ubi (2016) investigates the relationship between budget deficit and the trade deficit, taking into cognizance the role of oil revenue in both trade account balanced and being the main driver of fiscal stands in Nigeria. Annual secondly time series data on the relevant variables were obtained over the period 1970 to 2014. Granger causality analysis and the Vector Autoregressive (VAR) estimation techniques were employed in examining the direction and magnitude of causal ordering among the variables. Their results confirmed twin deficits hypothesis, but with a stronger causal ordering running both directly and indirectly from trade deficit to budget deficit through exchange rate and oil revenue. They maintained that, since oil revenue is an important channel in the causation order, and the fact that oil revenue is externally determined by oil price and quota of oil production, Nigerian government should diversify the sources of her revenue away from oil dominance in order to reduce the external forces from trade deficit, exchange rate and oil revenue on budget deficit in Nigeria. This finding was further supported by Ebi and Ayodele (2017).

Equally, a number of studies have also shown adverse effect of oil revenue on capital formation. For instance, Akpokodje (2003) by adopting the OLS technique, showed that export earning in Nigeria have the tendency of reducing capital formation in the short-term. Noting further that government fiscal policy variables may exact more impact on capital formation, so long as they impact output directly. Using the VAR framework, Hadiwibowo (2010) observed for Indonesia that public receipts and current outlay affected investment and economic grow adversely. The study revealed that development outlays contributed positively to growth in investment and the economy. Idenyi et al. (2017) evaluated the effect of oil export on capital formation in Nigeria using the Vector Error Correction Mechanism (VECM), and found that the former had a substantial adverse impact on the later. Thus, concluding that rather than oil export stimulating

growth in capital formation, it actually retards it. In a dynamic panel study conducted by Mehrara (2008) on the asymmetric nexus between oil revenues and output growth in oil-exporting countries; the study findings confirmed that for countries with high reliance on oil revenue and weak institutions, de-associating public outlay from current revenue and oil income shocks affects output. Specifically, the study noted that oil shocks inversely impacted on output growth, just as periods of booms/positive oil shocks have restricted effect in triggering growth in the economy. Contrary to the above adverse effect of oil revenue on capital formation and using the Vector Autoregressive (VAR) technique, Ibrahim et al. (2019) found that oil price and oil revenue actually Granger cause capital formation in Oman.

Some studies have also indicated ambiguous effect of fiscal deficit on capital formation. For example, Charkraborty (2007) studied the impact of fiscal deficit on capital formation, and the direct and financial crowding out effect on private investment in India using the VAR framework. Conclusion deduced from the study suggest that, there is no real or direct crowding out of private capital formation by public investment; rather, a complementarity effect was observed between the two. Therefore, indicating a positive effect of fiscal deficit on private investment in India. Hadiwibowo (2010) investigated the relationship between fiscal policy, investment and long-run economic growth for Indonesia using the VAR framework. Empirical result of the study revealed that physical capital accumulation is the main contributor to Indonesia's economic growth. In the study by Paiko (2012), the effect of deficit financing on private investment was examined for Nigeria. By using the OLS technique, the study revealed an inverse relationship between deficit financing and private investment. Thereby, suggesting that deficit financing in Nigeria crowds out private investment. Similarly, Ezeabasili and Nwakoby (2013) re-examined the effect of fiscal deficits on private investment in Nigeria. The study utilized the OLS, the two stage least square, the use of impulse response analysis and variance decomposition, to conclude that fiscal deficit in Nigeria has had an adverse contribution on private investment. Abirami and Panda (2015) investigated the effects of fiscal deficit on private sector investment in India using the VAR framework. The study submits that in the long-run, there is a significant negative effect of fiscal deficit on private investments. A study by Iwatsubo and Ogasawara (2019) identified domestic and external factors that affected international capital flows by analyzing how changes in the crude oil price had affected international capital flows in emerging countries that are net exporters of crude oil and those that are net importers. Using a Panel data analysis method, the paper warned that, Attention should be paid not only to exogenous variables, such as global economic conditions and the crude oil price,

but also to the state of domestic economic fundamentals as a significant factor of international capital flows and capital formations. In relation to Oman Economy, Javed, et al. (2020) examined the relation of the oil sector with Oman's economic growth, using data from a range of 1989 to 2018. The data were analyzed with the help of the ARDL cointegration approach and Granger causality test. The results showcased that economic performance is significantly affected by the oil price, crude oil production, and gross capital formation, and the total revenue and oil revenue insignificantly influence capital formation.

The gap in the existing literature reviewed or a point of departure from these studies, especially those related to Nigeria is that none of them actually simultaneously examined the significance and magnitude of the transmission path, from oil price to deficit financing and capital formation as done in this study. Rather, a direct independent effect from oil price to deficit and capital formation is what obtains in the literature. Neglecting the magnitude of oil price's effect on deficit financing and capital formation in an oil dependent country such as Nigeria, could yield bias in terms of oil price significance to infrastructural development of the country. Reason is that, capital formation does not directly respond to fluctuations in oil price, but rather indirectly, through generated oil revenue and the adopted fiscal policy of the government. Thus, this constitute the gap this study fills in the literature.

## METHODOLOGY

As earlier noted, changes in oil price transmission to deficit financing in this study is premised to pass-through oil revenue. While the transmission effect from oil price to capital formation is premised to passes-through oil revenue and deficit financing. Hence, indicating nonlinearity in the relationship between oil price, deficit financing and capital formation. Furthermore, the presence of moderating variables and simultaneity in the relationship, can give rise to endogeneity issues and simultaneous bias. To remedy this effects, applying the OLS approach will be inappropriate, since it will produce bias and inconsistent estimates due to correlation effect between the regressors and the error term. Hence, the suitability of instrumental variable (IV) technique. The IV approach is known to yield efficient estimates, since it recognises the existence of a moderating variable (), which is correlated with the regressor () but uncorrelated with the error term. Thus, giving rise to the following moment condition.

$$Cov(z_t, y_t) - \alpha Cov(z_t, x_t) = 0 \quad (1)$$

This method of moments estimator then gives rise to the IV estimator for  $\alpha$ . Under the IV approach, the

possible reverse causation between the regressor and the error term; or measurement error of the regressor, is controlled with the use of instruments. An instrument is a variable that is indirectly associated with the explanatory equation, by being correlated with the identified endogenous regressor and conditional on the value of other independent variables. This therefore makes the IV approach an efficient estimating technique when investigating transmission nexus. However, the inclusion of level variables, exogenous variables, and lagged levels of endogenous variables as instruments in this study pose a risk of having weak instruments. Thus, the Generalized Method of Moment (GMM) method is adopted as being more appropriate. With the adoption of the GMM approach, endogenous variables are translated into predetermined variables so that they no longer correlate with the disturbance term in the equation. Furthermore, by incorporating lagged endogenous variables as part of the regressor variables, ensures that the GMM approach yields better estimates to the 2 or 3 stages least square IV technique.

Having the GMM estimator in its general form first entails, defining a set of population moment conditions. Thus, letting  $\gamma$  denote a vector of unknown parameters to be estimated,  $w$  a vector of random variables, and  $j$  a vector of functions, then, the population moment conditions can be expressed generally as:

$$E[j(w_t, \gamma)] = 0 \quad (2)$$

Equation 1 is a unique case of equation 2; given we have  $k$  moments and  $k$  parameters, which demands a method of moments estimator and each moment can exist in a sample. Generally, however, it is possible to have more moment conditions above the number of parameters to be evaluated, while it is also impossible to generally have all the moments met simultaneously. Thus, it is important to have a trade-off between the moments as to how close each tends towards zero. It is this resulting trade-off that forms the argument for the GMM approach. Hence, the GMM estimator is derived base on the value of  $\gamma$ , which for a specific sample of  $T$  observations minimises

$$f(\gamma) = T^{-1} j(w_t, \gamma)' G_t T^{-1} j(w_t, \gamma) \quad (3)$$

where  $G_t$  denotes a positive semi definite matrix known to converge in probability to a matrix of constants. The GMM approach is known to be consistent for any matrix  $G_t$  that aligns with this restriction.

The study simultaneous model is expressed as follows:

$$dfg_t = \alpha_0 + b_1 lop_t + b_2 lor_t + b_3 lcf_t + b_4 dfg_{t-1} + u_t \quad (4)$$

where  $dfg$  is deficit financing per GDP sourced from Central Bank of Nigeria (CBN) annual statistical bulletin;

$lop$  is the log of oil price, sourced from the BP statistical review of world energy;  $lor$  is the log of oil revenue sourced from the CBN annual statistical bulletin; and  $lcf$  is the log of gross fixed capital formation sourced from the CBN. The lag of  $dfg$  is used as a control variable in the equation. The study data employed for this study is annual time series data from 1970 to 2017.  $dfg$  is treated as an endogenous variable in Equation 4. This is due to the effect of oil price on deficit financing through oil revenue. Furthermore, for the reason that oil revenue is a function of oil price, oil revenue is also treated as an endogenous variable as captured in equation 5.

$$\begin{aligned} lor_t = & \beta_0 + \beta_1 dfg_t + \beta_2 lop_t \\ & + \beta_3 lcf_t + \beta_4 lor_{t-1} + e_t \end{aligned} \quad (5)$$

where  $lor_{t-1}$  is the lag of oil revenue and is used as a control variable. Gross fixed capital formation is also assumed to be an endogenous variable, since it is expected to grow with favourable oil prices through increase in oil revenue, assumed expended on infrastructure projects. Also, it is assumed that the primary goal for deficit financing is to grow capital formation, hence, we have equation 6 expressed as follows.

$$\begin{aligned} lcf_t = & \pi_0 + \varphi_1 dfg_t + \varphi_2 lop_t \\ & + \varphi_3 lor_t + \varphi_4 lcf_{t-1} + \varepsilon_t \end{aligned} \quad (6)$$

where  $lcf_{t-1}$  is the lag of gross fixed capital formation and is used as a control variable.

Another primary question relates to the transmission channel of oil price to deficit financing and capital formation. To this end, we investigate the indirect effect of oil price on deficit financing, and capital formation by solving equations 4-6 simultaneously. A chain rule effect was then applied to derive the actual coefficients for the transmission effects.

The transmission channel of oil price:

on deficit financing:

$$\frac{\partial dfg}{\partial op} = \frac{\partial dfg}{\partial or} * \frac{\partial or}{\partial op} = b_2 * \beta_2$$

on capital formation:

$$\frac{\partial cf}{\partial op} = \frac{\partial cf}{\partial dfg} * \frac{\partial dfg}{\partial or} * \frac{\partial or}{\partial op} = \varphi_1 * b_2 * \beta_2$$

## RESULTS AND DISCUSSION

### DESCRIPTIVE STATISTICS

Output in Table 2 shows that the mean deficit financing-to-GDP ratio from 1970 to 2017 is approximately 2.35%. Obviously, this value falls below the deficit financing cap of 5% provided in the CBN Act of 2007 and the 3% cap in the 2007 fiscal responsibility act. However, the

highest deficit financing-to-GDP ratio is about 8.61%, while the lowest had been -9.54%. The mean oil price is revealed to be about \$36, while the maximum and minimum values for the period was approximately \$114 and \$1.80 respectively. Oil revenue for the period had a mean value of approximately \$1804 billion, while the maximum and minimum values are approximately \$8879 billion and \$0.16 billion respectively. Capital formation averaged approximately \$15 billion, while the maximum and minimum values were about \$28.93 billion and \$1.88 billion respectively. Comparing these values with what is earned as oil revenue shows the inefficient devotion of funds for capital accumulation in the country.

TABLE 2. Descriptive statistic output

	<i>dfg</i>	<i>op</i>	<i>or</i>	<i>cf</i>
Mean	2.35	36.02	1804.18	15.18
Maximum	8.61	114.21	8878.97	28.93
Minimum	-9.54	1.80	0.16	1.88
Std. Dev.	3.13	31.02	2601.34	7.04
Obs.	48	48	48	48

Note: *dfg* = deficit financing per GDP; *op* = oil price; *or* = oil revenue and *cf* = gross fixed capital formation

### UNIT ROOT AND CORRELATION TESTS

A preliminary condition for regression analysis involves unit root testing, especially when  $T > 30$ . The essence is to avoid a situation of having spurious regression if any of the series should attain stationarity at  $I(2)$  or not being stationary. Unit root test was performed at level and at first difference for with the constant, with the constant and trend term, and without constant and trend. A summary of the Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) unit root test results are presented in Table 3. The ADF test result shows that the study variables attain stationarity mainly at the first difference level. Only is the variable stationary in the level form. Likewise, the Phillips-Perron unit root test also confirms the ADF test result. Hence, the null hypothesis of a unit root presence in the series can be rejected mainly at the 1 percent significance level.

Table 4 shows the correlation matrix of variables in the study model. Deficit financing is revealed to be negatively correlated with oil price, oil revenue, and capital formation. A weak correlation is revealed to exist between the study variables with exception to oil price and oil revenue, which is expected. It is important to stress that the high correlation between both variables would not affect the outcome of the study findings, since oil revenue has been acknowledged as an endogenous variable and treated as a function of oil price. Thus, the correlation result is indicative of the reduced severity

TABLE 3. Unit root tests

	ADF Test			PP Test		
	With Constant	With Constant & Trend	Without Constant & Trend	With Constant	With Constant & Trend	Without Constant & Trend
<i>dfg</i>	-5.61*** <sup>a</sup>	-5.56*** <sup>a</sup>	-4.29*** <sup>a</sup>	-5.73*** <sup>a</sup>	-5.68*** <sup>a</sup>	-4.50*** <sup>a</sup>
<i>lop</i>	-2.85* <sup>a</sup>	-6.04*** <sup>b</sup>	-5.68*** <sup>b</sup>	-2.82* <sup>a</sup>	-6.04*** <sup>b</sup>	-5.66*** <sup>b</sup>
<i>lor</i>	-7.18*** <sup>b</sup>	-7.42*** <sup>b</sup>	-5.98*** <sup>b</sup>	-7.18*** <sup>b</sup>	-7.48*** <sup>b</sup>	-6.00*** <sup>b</sup>
<i>lcf</i>	-2.69* <sup>a</sup>	-6.52*** <sup>b</sup>	-6.67*** <sup>b</sup>	-2.72*** <sup>a</sup>	-8.06*** <sup>b</sup>	-8.30*** <sup>b</sup>

Note: *dfg* = deficit financing per GD; *lop* = log of oil price; *lor* = log of oil revenue and *lcf* = log of gross fixed capital formation

of the problem of multi-collinearity between the study variables.

TABLE 4. Correlation Matrix of variables

	<i>dfg</i>	<i>lop</i>	<i>lor</i>	<i>lcf</i>
<i>dfg</i>	1			
<i>lop</i>	-0.07	1		
<i>lor</i>	-0.06	0.81	1	
<i>lcf</i>	-0.12	0.28	-0.02	1

Note: *dfg* = deficit financing per GDP, *lop* = log of oil price, *lor* = log of oil revenue and *lcf* = log of gross fixed capital formation

#### GMM ANALYSIS

Results in Table 5 shows that for equation 4, oil revenue has a negative substantial effect on deficit financing. Also, the lag of deficit financing has a positive significant effect on current levels of deficit financing. In Equation 5, deficit financing significantly and inversely affects oil revenue which aligns with the study of Aladejare (2019) for Nigeria and Yusoff (2013) for Malaysia. Likewise, deficit financing adversely affect growth

in capital formation as reported in empirical studies such as Akpokodje (2003), and Idenyi et al. (2017) for Nigeria et al. (2020) for Oman Economy. Oil price as anticipated shows a positive substantial effect on oil revenue. However, oil price and lagged oil revenue, both have positive effects on oil revenue. For Equation 6, deficit financing has a significant inverse effect on capital formation which aligns with Paiko (2012) and Ezeabasili and Nwakoby (2013) for Nigeria. The lagged capital formation also has significant positive effect on capital formation.

The endogenous test conducted on equations 4 to 6 indicate the presence of endogeneity in each equation, thus, validating the use of GMM approach for the study. Furthermore, the diagnostic test on the strength of the instruments for each equation reveals that the instrumental variables adopted are robust. The Sargen-Hansen (S-H) test of over-identifying restrictions shows that the instruments as a group are exogenous, which is a precondition for adopting instruments in the IV approach. The test for higher order serial-correlation using the Q-statistic reveals the absence of serial-correlation in the residuals of equations 4 to 6 up to the third lag. The normality test on the model residuals are normally distributed.

TABLE 5. GMM estimated regression output

Equ. 4 <i>dfg</i>	Output	Equ. 5 <i>lor</i>	Output	Equ. 6 <i>lcf</i>	Output
Constant	5.92***	Constant	0.69***	Constant	1.20***
<i>lop</i>	-0.66	<i>dfg</i>	-0.05***	<i>dfg</i>	-0.07**
<i>lor</i>	-0.21*	<i>lop</i>	0.11**	<i>lop</i>	0.16
<i>lcf</i>	-0.01	<i>lcf</i>	-0.18***	<i>lor</i>	-0.01
<i>dfg</i> <sub><i>t</i>-1</sub>	0.19***	<i>lor</i> <sub><i>t</i>-1</sub>	0.94***	<i>lcf</i> <sub><i>t</i>-1</sub>	0.39**
Inst. rank	12	Inst. rank	13	Inst. rank	13
End. Test	3.41*	End. Test	8.75***	End. Test	5.89**
Inst. Test	163.64**	Inst. Test	242.81**	Inst. Test	447.91**
S-H Test	(0.83)	S-H Test	(0.35)	S-H Test	(0.40)
Q-stat.(3)	0.97	Q-stat.(3)	0.83	Q-stat.(3)	5.28
Norm. Test	0.48	Norm. Test	0.68	Norm. Test	7.15

Note: *dfg* = deficit financing per GDP; *lop* = log of oil price; *lor* = log of oil revenue; *lcf* = log of gross fixed capital formation; *dfgt*<sub>*t*-1</sub> = one-year lagged value of *dfg*; *lort*<sub>*t*-1</sub> = one-year lagged value of *lor*; and *left*<sub>*t*-1</sub> = one-year lagged value of *lcf*. End-Test = endogenous Test; Inst. Test = instrumental variable Test; S-H Test = The Sargen-Hansen Test; Q-Test = Q-statistic; and Norm. Test = The normality Test.



THE TRANSMISSION EFFECT FROM  
OIL PRICE TO DEFICIT FINANCING

In determining the transmission channel through which oil price affects deficit financing, the following chain function earlier stated was analysed.

Oil price transmission effect on deficit financing:

$$\frac{\partial dfg}{\partial op} = \frac{\partial dfg}{\partial or} * \frac{\partial or}{\partial op} = b_2 * \beta_2$$

Where the product of the earlier identified significant values of  $\frac{\partial dfg}{\partial or}$  which is  $b_2 = -0.2116$ , and  $\frac{\partial or}{\partial op}$

which is  $\beta_2 = 0.1141$ ; and their product (i.e.,  $b_2 * \beta_2$ ) yields  $-0.024$  approximately.

Deduced point from the above estimate suggest that an upward trend in oil price, will have a positive pass-through effect on oil revenue, before exacting a negative effect on deficit financing. Noteworthy, oil price direct effect on deficit financing as shown in Table 5 is insignificant. Thus, indicating that growth in deficit financing in Nigeria is directly responsive to effects from oil revenue than oil price. A reason for this is that oil price appreciation or depreciation within the budget year do not directly impact on deficit financing as oil revenue (see Aladejare 2019). Rather, the effects from oil price takes an indirect pass through oil revenues. Furthermore, the rise in oil revenues could be instigated by other factors such as royalty payments from oil companies, licensing and leasing of new and existing oil wells, drawings from the country's excess crude oil account etc., which often are functions of previous benchmarked oil prices rather than the current.

Higher oil revenue indicates a substantial increase in the amount of funds at the disposal of the fiscal authorities. Consequently, the increase in oil revenue will result to reduction in the value of deficit financing in the budget. Thereby giving a negative transmission effect from oil price to deficit financing. However, observing the magnitude of the coefficient suggest that the reduction in deficit financing, is only about 2.4 percent of the increase in oil price. This low response of deficit financing intuitively shows that growth in public spending is fast outpacing government revenue in Nigeria. One plausible cause could be the growth in the public debt both in principal and service cost. For instance, the cost of servicing Nigeria's debts in 1981 was about ₦1.03 billion; by 1990, it had grown to ₦23.82 billion, and by 2016 to ₦2,047.42 billion (CBN statistical bulletin 2017). An outcome that could be due to poor fiscal management in the country; and may further be exacerbated in the post COVID-19 periods. This is due to the astronomical rise in government debts and servicing cost created during the pandemic. Ever since the government locked-down the economy in late March 2020, it had increased borrowings to meet fiscal

obligations. Necessitated by the pandemic's adverse effects on oil revenues, and a weak external reserve.

THE TRANSMISSION EFFECT OF OIL PRICE ON CAPITAL  
FORMATION

To understand the transmission channel from oil price to capital formation, the following multivariate chain function as prior stated is being evaluated.

Oil price transmission effect on capital formation:

$$\frac{\partial cf}{\partial op} = \frac{\partial cf}{\partial dfg} * \frac{\partial dfg}{\partial or} * \frac{\partial or}{\partial op} = \varphi_1 * b_2 * \beta_2$$

Where the product of the earlier identified significant coefficients of  $\frac{\partial cf}{\partial dfg}$  which is  $\varphi_1 = -0.0714$ ,  $\frac{\partial dfg}{\partial or}$

which is  $b_2 = -0.2116$ , and  $\frac{\partial or}{\partial op}$  which is  $\beta_2 = 0.1141$ ;

yields (i.e.,  $\varphi_1 * b_2 * \beta_2$ ) approximately.

This result shows that a unit increase in oil price, will first go through the oil revenue channel, followed by the deficit financing channel, to produce an adverse minute effect on capital formation. The adverse effect of deficit financing on capital formation stems from the fact that from 1970 to date; empirical evidences have shown that a large portion of the funds meant for deficit financing usually get expended on recurrent outlay. For instance, despite the continuous rise in deficit financing from 1970 to 2017, capital expenditure of the Federal Government only exceeded recurrent spending in 1975-1983, 1986, and 1996-1999; that is, a total of fourteen years (CBN statistical bulletin 2009). On the other hand, the federal recurrent expenditure continued to grow and exceeded capital spending for the remaining thirty-three years; and in some cases, rising three times higher than capital spending especially from the 2000s (CBN statistical bulletin 2017). This phenomenon is anticipated to continue in the nearest future, due to the upward trajectory in government spending on social security and palliative measures, aimed at curbing the economic challenges as witnessed during the COVID-19 pandemic.

However, the negative transmission effect of oil price on deficit financing, results in a significant positive but very small transmission effect on capital formation. Intuitively, Nigeria relies on its proceeds from oil sales to finance capital formation. This is usually being implemented with the use of various government policies rolled out since the 1970s. However, the usual diversion of these proceeds into other ventures, could be the responsible factor for the minute positive transmission effect of oil price on capital formation. For instance, the objective to use the 1970s' oil boom proceeds during the second to the fourth national development plans (1970-1985), aimed at providing infrastructure facilities was halted by the need to stabilize new states created within

the period. Furthermore, the SAP which was aimed at restricting the economy, through export diversification; saw capital formation declined significantly within the period as the government focussed more on trying to sustain its growing consumption demands. During the rolling plan era (1990-1999), the goal to revitalize and rehabilitate existing infrastructure was also halted due to the rising recurrent spending of the government; and this trend was sustained into the 2000s. Therefore, accounting for the minute positive transmission effect of oil price on capital formation in Nigeria from the 1970s. in fact, with the attendant problems of COVID-19, it is expected that future government investment in new capital formation may be hindered. Since attention has to be paid to completing existing projects which are already threaten by dwindling funds. Furthermore, primary health concerns at project sites which had not been an issue before, are now going to take centre stage to avoid further spread of the virus.

### CONCLUSION

This study investigated the magnitude of the transmission effect from oil price, to deficit financing and capital formation in Nigeria using the GMM approach, from 1970-2017. Empirical result from the study revealed a significant but small inverse oil price transmission effect, through the oil revenue channel to deficit financing. Indicating that growth in public spending is pacing faster than government revenue, due to poor fiscal management in the country. On the other hand, the transmission effect from oil price, through the oil revenue and deficit financing channels, to capital formation is significantly positive but minute in magnitude. The weak response of capital formation to the transmission effect from oil price, is due to the increasing use of oil proceeds in funding government's recurrent outlays over time.

Hence, it is recommended that the fiscal planners of the government should ensure that deficit financing is primarily used for growing capital formation. Such effort will help to ensure the repayment of the borrowed funds used in financing the deficit in the budget; which is usually high in periods of shortfall in oil revenue as presently being experienced, and also reduce the cost and burden of debt on the economy. Similarly, for oil prices to significantly contribute to output growth, increase in the use of oil revenues, especially in oil price boom periods to fund capital formation should be encouraged. Such gesture will also stimulate the diversification of government's revenue base, through a diversified economy, and reduce effects of oil price shock on government fiscal responsibilities. Furthermore, by channelling the positive growth in oil price to investment in capital formation, and repositioning the use of deficit financing away from

consumption demands, it is expected that investors' confidence in the economy through growth in foreign direct investment (FDI) inflows will increase. In this regard, increase attention should be given to growing knowledge seeking FDI, as against resource seeking FDI to help give the country some level of economic immunity against pandemics. Consequently, output growth in the economy will be further enhanced, and the country's high level of unemployment reduced. The growth in FDI inflows will also reduce the challenge of a current account deficit posed by the increasing demand for consumables in the economy. Finally, investing in the numerous end products from crude oil will also reduce the uncertainty associated with crude oil revenue. Such move will further reduce demand for foreign exchange on external reserve from importers of such goods.

For future studies, it would be interesting to determine the magnitude of oil price transmission to deficit financing and capital formation at the state level, as this study is limited to a federal level of government analysis.

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