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MACROECONOMIC CONSEQUENCES OF NIGERIA'S OIL RESOURCE AVAILABILITY AND EXHAUSTIBILITY

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Abstract

In the context of oil resource availability and exhaustibility, this article examines the impact of oil incomes on macroeconomic variables such as money demand, consumption, and investment. The study develops an econometric model for Nigeria in order to evaluate the hypothesis that the abundance of oil resources has a wealth or confidence effect on perceived incomes, altering the cash balance, consumption, and investment behavior of economic agents. The confidence impact was discovered to be present and large, and it was conveyed through cash balance demand, consumption, and investment. The findings demonstrate that the availability of resources engenders a sense of security, which has a negative impact on private sector savings and investment. The effect, on the other hand, mitigates the inflationary effects of monetary policy expansion. Government productive investment, consumption smoothing behavior, generating sufficient and effective incentives for the private sector, and investing in physical capital assets are all suggested as ways to drive growth, according to the findings.

Keywords: Resources, Availability, Exhaustibility, Macroeconomic Variables

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Introduction

Nigeria is a major oil exporter and a member of the Organization of Petroleum Exporting Countries (OPEC). Oil was commercially discovered in Nigeria in 1956 and production began in 1958. However, the civil war in the late 1960s disrupted commercial production and other economic activities. Paradoxically, as a source of blessing, oil is more importantly a source of economic instability. Since then, the management of resources has been the responsibility of the federal government, and the distribution (and management) of resources between Nigerian states and regions has created very sensitive political problems (Malachy, Abayomi and Simon, 2018).

The weaknesses inherent in the structure of the Nigerian economy are reflected in its over-reliance on imports from its production bases. In essence, oil export revenues fell below the pre-oil boom era, leading to external and financial imbalances (Malachy, Abayomi and Simon, 2018).

Many resource-rich emerging countries have been reported to achieve little more than transitory resource booms. When their resources are reaping windfalls or there are resources to be exploited, their economies expand swiftly; however, after the windfall or resources have been exploited, their economies shrink (Graham and Ovadia 2019).

The way oil-rich economies are influenced by variations in the flow of cash provided by oil resources has received a lot of attention. This is in reference to the "Dutch sickness" effect, which highlights the potential impact of the oil boom on the economy. The second key concern is oil resource exhaustibility, which has received insufficient attention. Although International Monetary Fund (2012) acknowledge that oil exhaustibility has significant implications for macroeconomic management, they view exhaustibility as a long-term issue

with little or no repercussions in the short term. This viewpoint has been challenged since exhaustibility is likely to alter future income expectations, resulting in variations in perceived wealth, which might affect economic agents' confidence and behavior in the short term (Adam and Folawewo, 2000). It is suggested that the failure of resource-rich countries to sustain economic growth is due to the usage of rents (economic surpluses) generated when resources are exploited, rather than the physical depletion of natural resources.

Nigeria's oil resources have always been and will continue to be vital economically, but their stock may be lower than it was three decades ago. What impact will their disappearance have on the country's liquidity, consumption, and investment? We ask this because resource rent is a form of economic excess that countries might employ to fund investment, consumption, or a combination of the two. The goal of this research is to look at how the availability and exhaustibility of oil resources affect Nigeria's domestic liquidity, consumption, and investment performance. There are five sections to the paper. Following this introduction, section 2 is the literature, while section 3 provides the methodology. Technique and empirical analyses are presented in section 4. The summary and conclusion are presented in section 5.

Literature Review

Many oil exporters suffered oil windfalls and the "Dutch disease" effect in the 1990s (Montiel 2000). Through its influence on income, consumption, and investment rates, the oil windfall had a significant positive impact on the domestic economy. Several oil producers, such as Nigeria, took out large loans on the premise that their crude oil prices would remain high or that any price decrease would be transitory.

Negative terms-of-trade shocks (a significant drop in oil prices) change income and relative prices, affecting consumption, savings, and investment. The macroeconomic perspectives of Iwayemi (1990) explain why crude oil endowment is neither a necessary nor sufficient condition for sustainable economic growth and development. They exploited the Dutch sickness effect, which is connected to the real currency rate appreciation associated with the oil export boom. The home industry's competitiveness in the foreign market is harmed by the rising exchange rate.

Warner (2000) uses quarterly data from 1981 to 1985 to calculate an investment model to see if Mexico's investment decline was due by the debt problem or falling oil prices. One of the conclusions is that as expenditure fell in reaction to lower terms-of-trade (global oil prices), demand contraction lowered other product prices relative to this price, lowering investment demand. This and other studies have the flaw of assuming that oil profits go directly to the private sector (Frankel, 2010).

Because oil profits are entirely received by the government in most developing nations, oil resources move to the private sector indirectly. The fact that a big portion of oil revenue goes to the government may stimulate spending while severely impacting private-sector savings and investment (Iwayemi 2001). Although studies of the implications of petroleum resource exhaustibility for optimal production and pricing strategies in petroleum-based economies abound in the literature, short-run macroeconomic models of such economies have largely ignored the issue of the depletability of the main source of economic surplus or rent (Hodler, 2010). Many of these studies treat exhaustibility as a long-term notion with little or no short-term repercussions.

In contrast to them, Vaez-Zadeh (1989) uses a macroeconometric method to investigate the short-run macroeconomic implications of the availability of oil resources in Venezuela. The study investigated whether the abundance of natural resources has a "confidence effect" on future income expectations, which influences economic agents' spending and portfolio decisions. When the confident effect is present, the impact of oil price changes on the level and variability of money demand, the balance of payments, and inflation

is considerably pronounced, according to the model, which was evaluated for the period 1965-81.

Studies of the "Dutch sickness" have also revealed this impact. It develops as a result of the impact of resource availability on future expected income, which can alter savings behavior, consumption patterns, and asset portfolio composition.

Pinto (2014) investigates the relationship between oil prices, deficits, inflation, and real exchange rate appreciation in Nigeria and Indonesia before and during the oil boom (1970-85). He emphasizes that what mattered during the boom was the spending effect and its impact on non-oil resource allocation. He points out that within a decade after the first oil shock, Nigeria was confronted with a slew of economic issues, including a severe decrease in its agriculture sector, a drop in non-oil sold products, and the accumulation of external debt. Indonesia, on the other hand, maintained a conservative foreign debt strategy, a market-oriented agricultural policy, and a distinct fiscal and currency rate policy.

The theoretical requirement linking resource rents to economic sustainability is identified by Hartwick (2018). The study looks at the situation of a country with only nonrenewable resources and no other sources of investment capital than resource rents. He demonstrates that even a country in such a dire circumstance may keep its per capita consumption constant in perpetuity if it invests (or saves) a portion of its rents in repeatable, physical capital. Solow (1986) contends that spending this amount in physical capital sustains a country's overall capital stock (natural capital + physical capital) and, as a result, its consumption options. In circumstances involving renewable resources, technological advancement, and a growing population, the rule has been proven to be correct. Other forms of capital, he believes, are highly substitutable for natural resources. That is, a decrease in natural resource intake can always be compensated for by a greater reliance on physical capital investment and technological advancements. The extent of its empirical validity, according to Maler (1986), "we simply do not know."

Natural resource depletion theory usually agrees that the optimal rate of extraction is established at the point where the resource's marginal productivity in all of its applications is equalized (Devarajan and Fisher 2016). The marginal productivity of oil if left underground is represented by the predicted rate of oil price inflation, whereas the marginal productivity of the resource if invested in financial assets is represented by the rate of return on financial assets (or the interest rate) (Vaez-Zadeh 1989). As a result, the optimal rate of extraction is equal to the rate of interest; however, if predicted oil price inflation is larger than the rate of interest, the optimal or best policy is to keep the resources underground, and vice versa (Maler 1991)

Methodology

The model's analytical approach is designed to take into account the key characteristics of an oil-based economy like Nigeria. Expected oil wealth should have a significant impact on macroeconomic indicators such as money demand, consumption, and investment. It is also more applicable to Nigeria because of the availability of data.

The model is based on an exogenous foreign oil price; the rate of depletion is always equal to the OPEC quota demanded at the current market price. As a result, revenue from oil will be exogenous. Nigeria is a small country because it is impossible to alter the price or output of oil sufficiently to reach a desired income. The impact of oil enters the model from the demand side, since these resources influence demand for real balances, consumption, and investment products. Because government obtains all oil earnings, the impact of oil riches on private sector behavior is indirect in the scenario.

Because the stock of oil can be considered as accumulated funds to be used in the future, this indirect effect is the confidence impact of oil resources (Vaez-Zadeh 1989). This optimism about future earnings will result in a change in their long-term earnings. This will have an impact on their savings, investment, and spending habits. As a result, the indirect

impact of oil resources on current real-balance holdings, consumption, and investment is mediated by expectations about future revenue. The provided investment function is used to separate the effect of oil riches on productive potential.

Model Specification

The model consists of three equations and three endogenous variables, as described. The parameters are based on Vaez-(1989). The following are the equations and variable definitions:

$$\begin{split} MD &= \beta_0 + \beta_1 Y + \beta_2 F + \beta_3 INT + \mu \\ 1 \\ C &= \alpha_0 + \alpha_1 Y + \alpha_2 F + \alpha_3 CMD + \mu \\ 2 \\ INVT &= \delta_0 + \delta_1 Y + \delta_2 INT + \delta_3 F + \delta_4 CS - \delta_5 DSR + \mu \\ 3 \end{split}$$

MD Stands for cash balance demand (or money demand); Non-oil income is denoted by Y, predicted oil wealth is denoted by F, domestic interest rate is denoted by INT, and consumption is denoted by CMD Stands for change in money demand; INVT stands for gross investment; and DSR stands for external debt service.

Demand for cash balances is a positive function of non-oil income, predicted oil wealth, and is inversely related to the domestic interest rate, according to equation I. The association between predicted oil wealth and cash balance demand is a confidence effect, which is consistent with Friedman's (1959) notion that money demand is determined by long-term rather than short-term income. The inclusion of non-oil income in the equation allows for a test of the hypothesis that the elasticity of money demand in relation to oil should be significantly different from that in relation to non-oil revenue, reflecting the government's prominent position in oil-related transactions. Interest rate is used to express yield on domestic assets because speculative demand for money is important.

Non-oil income, projected oil wealth, and wealth proxied by changes in money demand are all positive functions of consumption level. The formula is based on the lifecycle hypothesis or perpetual income theory (Spanos, 2014). The positive or negative effect of consumption from cash balances is intended to be captured by the change in money demand in this formulation, which is assumed to reflect changes in wealth.

Finally, gross investment is defined as a negative function of interest rate (opportunity cost of capital) and debt service ratio, while gross investment is a direct function of non-oil income, predicted oil wealth, and capital stock. Both consumption and gross investment were divided into public and private sector components for the estimation. This was done so that the impacts of the independent variables on consumption and investment in the private and public sectors could be determined, and policies could be targeted at these sectors to increase productivity and economic growth. Furthermore, the disaggregation is aided by the fact that oil wealth in Nigeria is totally received by the government and passed on to the private sector indirectly. This situation could boost government consumption while hurting private investment.

An increase in non-oil income may enhance desirable investment levels, whereas an increase in capital costs would lower them. The impact of increased predicted oil wealth on investment should be positive. This, however, is contingent on the immediate benefit of increased oil revenue. If the immediate benefactor is the government, as it is in Nigeria, the direction of the effect will be determined by the projected pattern of government spending. If government expenditures are seen as complimentary to private investment, the desired private investment may increase (such as infrastructural investment).

However, if government expenditures are projected to compete with private expenditures, that is, concentrated on projects typically performed by the private sector, desired private

investment will drop. The definition also takes into account the possibility of debt overhang. According to the research on debt overhang, lowering the debt payment ratio should result in more current investment. The projected revenue from oil is defined as:

$$F_t = \pi_{t-1} S_t \tag{4}$$

According to Vaez-Zadeh (1989). Where S_t the stock of proved oil reserves at time t, and represents the price of oil at that moment. As a result, oil price expectations can be expressed as π_{t-1} . Equation 4 depicts the influence of oil resource availability on confidence or wealth. It also represents the idea of oil exhaustibility, as S_t is projected to decrease over time.

Estimation technique, results and interpretations

Various econometric methodologies have been utilized in the analysis of the relationship between economic variables throughout time. The standard single equation strategy, employing the ordinary least squares (OLS) method, was used in early econometric estimations. Indirect least squares (ILS), two-stage least squares (TSLS), maximum likelihood method (MLM), and other further adaptations of the single equation technique exist (Ramanathan 1992). These more recent strategies were developed to deal with large-scale macroeconomic models or to capture the complicated interaction between macroeconomic variables (e.g. simultaneous equation models).

Cointegration/ECM, first established by Sargan (1964) and popularized by Engle and Granger (1987), captures both the static long-run economic theory and allows for a more flexible approach to short-run dynamics modeling. Granger (1988) established that the ECM's value stems from its ability to explain long-run equilibrium relationships through the process of short-run economic data dynamics. Because we are interested in the short-run macroeconomic consequences of oil resource availability and exhaustibility, we adopt the single-equation technique in the form of TSLS in this article. Resource exhaustibility is likely to change future income expectations, resulting in shifts in perceived wealth, which may affect economic agents' confidence and behavior in the near run.

Long-run impacts have been considered by certain economists, such as Knight and Mathieson (1980). Only high-frequency (quarterly or monthly) data would be employed for the estimation of cointegration/ECM if one is interested in testing for short-run dynamics and forecasting the long-run equilibrium relationships of the variables under study. Furthermore, because the interaction between macroeconomic variables and oil wealth is complicated and indirect, the chosen method of study (TSLS) is acceptable. It's critical to consider a variety of channels through which the variables interact. Over identified equations or models are estimated using TSLS.

In order to analyze the intricate interactions involved, a single equation in the form of OLS will be insufficient. Similarly, because we are addressing the short-run effect and there are several equations to be estimated, cointegration/ECM will be ineffective. The simultaneous nature of the relationships necessitates a model that can represent both direct and indirect (feedback) effects. Simultaneity bias can be eliminated in this manner.

As a result, utilizing annual data from 1980 to 2019, the model's behavioural relationships were estimated using the TSLS estimation technique. The study's data comes from secondary sources such as CBN reports and publications, as well as the National Bureau of statistics (NBS), Statistics abstracts, reports from the Nigerian National Petroleum Corporation, publications from the International Financial Statistics (IFS), and so on. Because experimenting with log-form yielded a poor result, the data reported below were calculated in linear form.

Table 1: TSLS Estimates Result for the Money Demand Equation

| Regressor | Coefficient | t- value |
|-----------|-------------|----------|
| Constant | 22.052 | 4.712 |

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| Y | 0.212 | 4.625 |
|--------------------|--------|--------|
| F | 0.008 | 2.108 |
| INT | -2.961 | -2.903 |
| Summary Statistics | | |
| R^2 | 0.838 | |
| SER | 85.464 | |
| Dw statistics | 1.745 | |
| F-Statistics | 45.109 | |

Source: Authors' computation.

Table 2: TSLS Estimates Result for Private Consumption

| Regressor | Coefficient | t- value |
|--------------------|-------------|----------|
| Constant | 13.468 | 2.754 |
| Y | 1.050 | 11.500 |
| CMD | 0.113 | 0.102 |
| F | 0.032 | 3.655 |
| Summary Statistics | | |
| R^2 | 0.964 | |
| SER | 156.59 | |
| Dw statistics | 2.034 | |
| F-Statistics | 225.981 | |

Source: Authors' computation.

Table 3: TSLS Estimates Result for Government Consumption

| Regressor | Coefficient | t- value |
|--------------------|-------------|----------|
| Constant | 25.795 | 8.007 |
| Y | 0.727 | 5.616 |
| CMD | 2.630 | 4.166 |
| F | 0.148 | 4.773 |
| Summary Statistics | | |
| R^2 | 0.843 | |
| SER | 73.753 | |
| Dw statistics | 1.631 | |
| F-Statistics | 44.849 | |

Source: Authors' computation.

Table 4: TSLS Estimates Result for Private Investment

| Regressor | Coefficient | t- value |
|--------------------|-------------|----------|
| Constant | -0.315 | -1.820 |
| Y | 0.016 | 1.195 |
| CS | 0.189 | 1.953 |
| F | -0.001 | -3.982 |
| INT | -0.069 | -1.255 |
| DSR | -0.143 | -1.533 |
| Summary Statistics | | |
| R^2 | 0.883 | |
| SER | 6.509 | |
| Dw statistics | 1.634 | |
| F-Statistics | 34.701 | |

Source: Authors' computation.

Table 5: TSLS Estimates Result for Government Investment

| Regressor | Coefficient | t- value |
|--------------------|-------------|----------|
| Constant | -18.329 | -0.961 |
| Y (-1) | 0.299 | 2.673 |
| CS | -0.299 | -0.804 |
| F | 0.005 | 3.468 |
| INT | 2.766 | 1.190 |
| DSR(-1) | -0.544 | -1.527 |
| Summary Statistics | | |
| R^2 | 0.927 | |
| SER | 26.872 | |
| Dw statistics | 1.843 | |
| F-Statistics | 61.138 | |

Source: Authors' computation.

The empirical results of the model are presented in tables 1 to 5. As seen in tables, many of the predicted equations' coefficients have the correct sign and are significant at conventional levels. For example, cash balance (equation 1) is correlated with non-oil revenue and predicted oil wealth, but not with interest rate. At conventional levels, all of the coefficients are significant. Only the size of the real interest rate is elastic, and the coefficients have the predicted sign. For example, a 0.08 percent increase in projected oil wealth, assuming all other factors remain equal, will increase money demand by 0.01 percent. The findings show that real interest rates, non-oil income, and predicted oil wealth are the key factors of money demand in Nigeria.

Non-oil income, changes in cash balance, and predicted oil wealth all have positive effects on private consumption, according to the second equations (2 and 3). Except for changes in cash holdings, all of the coefficients are extremely significant. The magnitude of the non-oil income coefficient is the only one that is elastic. Similarly, non-oil revenue, changes in money demand, and predicted oil wealth all influence government consumption. The coefficients are all statistically significant and have the anticipated sign. The change in cash balance coefficients are highly elastic. For example, a 14% rise in predicted oil wealth, assuming all other factors remain constant, will increase government consumption by 10%.

The findings suggest that non-oil income and predicted oil wealth are the most important predictors of private consumption. Changes in cash balance appear to have a small impact. Government consumption, on the other hand, is principally influenced by changes in money demand, predicted oil wealth, and non-oil revenue. Equations 4 and 5 reveal that private investment is negatively related to projected oil income (unexpected), interest rate, and debt service ratio, whereas it is directly connected to non-oil income and capital stock. Non-oil revenue and the interest rate are the only variables that aren't significant. In terms of private investment, all of the coefficients are inelastic. Non-oil revenue, predicted oil wealth, and interest rate, on the other hand, have a positive impact on government investment, whilst capital stock and debt service ratio have a negative impact.

The capital stock and the interest rate are negligible and show an unexpected sign. Only the interest rate variable's magnitude is elastic. The findings suggest that capital stock, debt service ratio, and predicted oil wealth are the most important predictors of private investment. Non-oil income and interest rates have a small impact. Government investment, on the other hand, is mostly determined by debt service ratio, non-oil income, and predicted oil income. Capital stock and interest rate have a small impact.

Policy consequences of findings

The findings have policy implications in the following ways: first, the effect of oil wealth on the behavior of economic agents in Nigeria is obvious because expected oil wealth is considerable in all of the equations estimated. Second, as with debt service ratio (debt overhang), projected oil riches has a negative influence on private investment. This represents how private agents perceive the conflicting nature of private and government investment expenditures. As a result of the confidence effect, the availability of petroleum resources affects the private sector's tendency to save and demand for investment. As a result, the government's productive actions will determine growth possibilities. The findings of Iwayemi (2001) show when the government receives oil revenue, it increases consumption while reducing private savings and investment back up this conclusion.

Third, because capital stock has a favorable impact on private investment, oil wealth can be used to buy more capital goods for productive reasons, boosting growth. This conclusion supports Solow's (1986) findings that physical capital investments maintain capital stock growth and can be used as a substitute for natural resources. The economy will be supported by fixed capital in the post-oil future.

Fourth, the positive impact on cash balance of predicted oil riches and non-oil income has consequences for domestic liquidity management and output forecasting. Because resource availability stimulates money demand, expanding monetary policy would be less inflationary in the presence of the oil wealth impact than in the lack of it. Finally, in light of fluctuating oil prices and the depletion of oil resources, consumption smoothing is required. During periods of high oil prices or high reserves, the country will save more and use the money to smooth consumption during periods of low oil prices or when oil supplies are exhausted.

As a result, the government's ability to embark on adequate productive initiatives or investments to offset the negative impact of predicted oil wealth on private investment will determine economic growth prospects. It should also pay attention to consumption smoothing behaviors that account for fluctuations in oil prices and prepare the country for ultimate oil depletion. It should also construct an incentive system for the private sector to compensate for the negative impact of oil wealth, and it should invest in physical capital assets to compensate for natural resource depletion.

Summary and Conclusion

Using an economic model, this article looked at the implications of the availability and exhaustibility of oil resources in Nigeria. The model takes into account the ways in which the availability and exhaustibility of oil resources affect macroeconomic variables including money demand, consumption, and investment. The findings support the theory that the availability of oil resources causes a confidence effect that affects economic agents. This influence was discovered to be communicated through money demand, consumption, and investment. The data show that the confidence effect has a negative impact on private saving and investment while having a beneficial influence on government consumption and investment. The confidence impact, on the other hand, mitigates the inflationary effects of monetary policy expansion. As a result, economic growth will be reliant on government productive activities, fixed capital investment, consumption smoothing behavior, and incentives for private sector investment.

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