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Inflation, Oil Revenue and Economic Growth in Nigeria: An Ardl Co-Integration Analytical Model

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ABSTRACT
This study examined the relationship between inflation, oil revenue, and economic growth in Nigeria between 1987 and 2022 is the primary goal of this study. The World Bank and the Central Bank of Nigeria provided the data used in the study's analysis. The unit root test was utilized to determine whether the study's variables were stationary, the ARDL Co-integration test was employed to assess long-term relationships, and the Granger causality test was employed to determine the direction of relationships between the variables. The dependent variable for the study project is the gross domestic product (GDP), and the other variables are inflation (INF), effective exchange rate (EEXR), gross capital formation (GCFC) and oil revenue (OIR). The study demonstrated the beneficial effects of oil money on economic expansion. The study further demonstrated adverse connection between economic growth and inflation. Therefore, this study recommends that the government adopt annual spending caps in order to reduce inflation. It also recommends that the government construct new refineries and refurbish existing ones in order to break the long-standing pattern of exporting crude oil at a low cost and purchasing refined oil at a high one. Because refined oil imports reduce oil earnings, rebuilding refineries is crucial. Additionally, a number of rules and guidelines should be established and closely followed to ensure that the money taken from the oil sector is handled appropriately in order to achieve the nation's goal of economic growth.

Introduction

The Nigerian economy is heavily dependent on oil and gas as their source of finance for their budget. So, it is safe to depict that the Nigerian economy is reliant on revenue generated from oil and gas. Since its discovery in 1859, oil has been a fundamental energy source and has become more important to the global economy, surpassing coal as the primary energy source. Following the oil rush that followed the discovery of petroleum, oil rose to become one of the most precious commodities in the world.

Oil has become so vital to the growth of the world's economy that a world without it may lead to a failure in the system making the world economy too weak to function and develop. One of the macroeconomic objectives of a country is to reduce the rate of inflation in a country, inflation is the persistent rise in the general price level. It can also be referred to as the general increase in the average level of income needed to live a comfortable life in a country. It illustrates how prices for goods and services in a country's economy are constantly rising [1]. This illustrates how money loses value when inflation increases, lowering the amount of goods and services that can be bought.

A significant factor in lowering the GDP rate could be inflation rate. If the rate of inflation is high, the government may respond by enacting fiscal policy, which uses contractionary measures like raising taxes and cutting spending, to lower the amount of money in circulation. This lowers citizens' disposable income, which may then lower demand and ultimately result in a decrease in productive activities, which lowers GDP. According to Ogiri, Amadi, Uddin and Dubon, Volatility is a measure of how likely it is for oil prices to rise or decrease dramatically in a short period of time [2]. That oil price changes in Nigeria, particularly up until the mid-1980s and earlier, were factored into price rises. Large price swings have occurred, indicating a marked rise in the volatility of the actual oil price. This has made the market uncertain and forced businesses to put off investments [3]. Nigeria's economy is totally dependent on oil export revenue, according to Englama, Duke, Ogunleye, and Ismaik, making it especially vulnerable to unanticipated fluctuations in oil prices [4]. In other words, the government will make an effort to control

spending in order to prevent it from exceeding revenue when oil prices fall. The upper class will oppose pay cutbacks during these times, mostly because they believe the public has a right to the oil revenue.

An unplanned incident that significantly affects the overall direction of the economy is referred to as an external shock. These impacts, which can be favorable or unfavorable, can include growth and development especially in area of job creation, high unemployment. An external shock can trigger oil prices which also increases inflation rates in the economy. The impact of oil fluctuation on Nigeria's economy is difficult to assess because oil has long been the lifeblood of the country's economy. Nigeria's total reliance on oil production for income has obvious negative consequences for the economy. Oil became Nigeria's main source of revenue once agriculture was abandoned for oil, and it was expected to bring significant economic growth. Nigeria's economy currently relies mostly on the export of crude oil, which accounts for 14% of GDP, 80% of the nation's yearly budget revenue, and over 90% of all export earnings. Nigeria's economy was based primarily on agriculture before oil was discovered; it did not rely on oil for its primary source of income. In fact, during 1960 and 1966, the primary industry and source of revenue for about 90% of the country's labor force was agriculture. But mining, particularly oil mining, grabbed the lead over farming after oil was discovered and the oil boom of the 1970s. In 1970, oil export revenue accounted for approximately 59% of Nigeria's GDP [5]. Changes in oil prices have been largely blamed for both the fall of nations and the recession that has sunk poorer countries. When there are shifts in the supply and demand for oil due to political upheaval, non-economic crises, and economic expansion, crude oil prices typically fluctuate significantly.

According to Lim and Lim, a rise in oil prices causes liquidity to rise, which in turn increases the amount of money in circulation and rises inflation [6]. Because oil is so important to Nigeria's economy—it's used for transportation, industry, and a lot of other things—it's not unusual to see a relationship between oil prices and inflation. The cost of production and transportation increases in response to rising oil prices, devaluing currency. Unlike inflation caused by an increase in aggregate demand, this kind of inflation is referred to as "cost push inflation." Adenuga, Hilili and Evbuomwan are of the opinion that inflation has both internal and foreign causes, however given the extent of government spending in Nigeria, the causes of inflation may be primarily external [7]. This was evident in Nigeria during the first oil boom, when a high rate of money supply, excessive government project spending, and the country's remarkable renaissance made it difficult to meet the country's rising demand for goods. All of these factors contributed to high rates of inflation. As a consequence, we may say that inflation will affect the revenue gotten from oil and, as a result, economic growth, either positively or negatively.

Several researches and reports focus on the effect of oil price fluctuation on economic growth or the impact of inflation on economic growth but failed to consider the direction of causality that may exist among inflation, oil revenue and economic growth. This study seeks to analyze the effect of inflation and oil revenue on economic growth in Nigeria by analyzing the relationship between the three variables and the direction of causality among oil revenue, inflation and economic growth in Nigeria. In doing this, the study extends analyses from previous studies from 1985 to 2020 in order adequately evaluate the effect of oil revenue and inflation on economic growth of Nigeria. Other explanatory variables like effective exchange rate, capital formation and labour force also incorporated into the analysis to ensure results are robust.

Empirical and Theoretical Review
Empirical Literature

Gatawa, Abdulgafar, and Olarinde examined the impact of money supply, inflation, and interest rates on Nigerian economic growth using time series data from 1973 to 2013 [8]. Within an error correcting system, they applied the VAR Model and the Granger Causality Test. The findings suggest that a big money supply has a positive association with economic growth, whereas inflation and interest rates have a negative relationship with growth, especially over time, and the causality test revealed that none of the explanatory factors granger causes economic growth.

In a study, Motunrayo and Nicholas investigated how oil prices affected economic growth in seven oil-importing, low-income Sub-Saharan African (SSA) nations: Ethiopia, Gambia, Mali, Mozambique, Senegal, Tanzania, and Uganda [9]. The Auto Regressive Distributive Lag (ARDL) was used to achieve this. The Group's economic growth is slightly impacted by the price of oil in the near term, but it is significantly hampered in the long run. Conversely, short-run country coefficients show that oil prices have a considerable but varied impact on the economy of all seven of these countries. Using co-integration and error correction modeling, Sunday investigated the relationship between the volatility of oil prices and the expansion of Nigeria's infrastructure from 1981 to 2015 [10]. His analysis indicates that while oil price volatility and inflation rate had a detrimental influence on infrastructure expansion, real exchange rate appreciation had a positive effect on infrastructure investment. The study's findings demonstrated that although oil price volatility is both negative and statistically significant, interest rate volatility is likewise negative but not statistically significant. Inflation also significantly hinders the development of infrastructure.

Nuhu using a Vector error Correction model considered the impact of oil price instability on Economic growth in Nigeria, for the period of 1981-2015 [5]. Oil price and real effective exchange rate were positively related to economic growth, whereas government expenditure and inflation showed a negative relationship. It was also seen that Granger, the oil price, drove economic growth and the exchange rate, whereas Granger, the exchange rate, drove inflation. According to the variance decomposition result, fluctuations in oil prices are the main cause of variation in both economic growth and exchange rates. In contrast, the exchange rate is the main cause of variation in the inflation rate, followed by fluctuations in oil prices. Adamu investigated the impact of lower oil prices on the Nigerian economy on the international market [11]. In order to determine whether Nigeria's oil income before and after the decline in oil prices on the global market was significantly different, the study employed the Ordinary Least Squire (OLS) technique, which

included a T-test. The results showed that Nigeria's oil income and prices are significantly impacted by a decline in global oil prices.

Ogege and Bloupremo examines the uncertainty of oil price and its influence on the economic and non-economic activities of Nigerian economy [12]. The research made use of the annual time series data spanning between the year 1981 and 2018. Most of the variables were found to be stationary at order one after a unit root test was used to determine the degree of stationarity of the observed variables. In order to sufficiently investigate the relationship between the observed variables, the data used were examined using the least squares technique of data analysis. Contrarily, it demonstrated a negative and minor influence on the physical quality of life and education index. Crude oil price was found to favorably and insignificantly influence life expectancy but to significantly influence consumption per capita. The study concluded that there is a comparable relationship between the oil price and indices of Nigeria's economic development.

Anidiobu, Okolie and Oleka used descriptive and ordinary least squares on data from 1986 to 2015 to assess the impact of inflation on Nigerian economic growth [13]. The results demonstrate that the inflation rate has an insignificant positive association, the exchange rate has a significant positive relationship, and the interest rate has a negative insignificant relationship with Nigerian economic growth.

Using Vector Auto-regressive approach, Edesiri analyzed oil price and economic growth in Nigeria using a time span of 1980-2010 for evaluation [14]. The study revealed that oil price volatility has significantly influenced the level of economic growth in Nigeria. The result also showed signs of a negative relationship between the oil price volatility and the level of economic growth.

Alley, Asokemeh, Mobolaji and Adeniran carried out a study to determine how Nigeria's economic growth and the volatility of oil prices are related [15]. Using data from 1981 to 2012, the study applies the general methods of moment (GMM) to investigate the effects of shocks to oil prices on the Nigerian economy. Following appropriate robustness tests, the study concludes that while oil prices themselves greatly enhance economic growth, shocks to the price of oil barely slow it down. The idea that an increase in oil prices benefits oil-exporting nations like Nigeria is supported by the substantial positive impact of oil prices on economic growth. Shocks, however, have a detrimental impact on oil prices because they breed uncertainty and jeopardize efficient fiscal management of crude oil revenue.

Agbaeze, Nwoba, and Nwonu's study looked at how the Nigerian economy was affected by declining oil prices [16]. The study heavily depended on secondary data. Simple regression analysis, Pearson Product Moment Correlation, and Chi-Square are the methods utilized to analyze the data in order to determine the relationship and impact of oil prices on economic growth indicators, including foreign exchange earnings, aggregate spending, budget servicing, and the employment rate in the public sector. According to the report, the declining oil price has a substantial and negative impact on the Nigerian economy.

Using Generalized Auto-Regressive Conditional Heteroskedasticity GARCH model to estimate effect of oil price fluctuation on economic growth in Nigeria. Ogu and Ojimadu examined the impact of oil price fluctuations on the economic growth in Nigeria [17]. The data used was Quarterly data and had coverage from the period 1984 – 2017. The findings indicate that Nigeria's economic growth is positively and significantly impacted by oil price.

Using Auto-Regressive Distributed Lag, Chen wrote a study to explain the correlation between the dwindling oil price and the Nigerian economy [18]. He carried out the study using a 35year time span (1984-2018). He used various techniques of analysis for diagnostics tests. The Pearson correlation coefficient substantially attests to a strong linear relationship between the variables, the trend analysis indicates signs of a slightly insignificant relationship between oil price and the Nigerian economy.

Olusegun and Omisakin used the VAR technique to examine the effects of oil price shocks on Nigeria's macroeconomic performance [19]. The estimation includes the cointegration, variance decomposition, and unit root tests. This model is evaluated using the following variables: money supply, consumer price index, real gross domestic product, oil revenue, government capital spending, and government recurrent expenditure. According to the investigation, the fundamental cause of the variability in oil revenue and production yield can be attributed to the shock of oil prices.

Ayadi examined how changes in oil prices affected the Nigerian economy between 1980 and 2004 with the VAR approach [20]. The unit root, variance decomposition, and variance analysis tests are included in the estimation. The variables used were the money supply, exchange rate, industrial production index, interest rate, inflation, and oil price. The findings indicate that changes in the price of oil have a substantial impact on the real exchange rate, which in turn has an impact on industrial activity.

Theoretical Framework
There have been many theories that concern the growth of an economy, this study will be using the neoclassical growth model or Solow-Swan model. In 1956, Trevor Swan and Robert Solow proposed this theory. The three main economic factors—labor, capital, and technology—are described in the neoclassical growth theory, an economic growth model. It contends that the interaction between capital and labor determines the overall productivity of an economy, this means the neoclassical growth model can be used to calculate economic growth and equilibrium of an economy.

Generally in the literature, production function is depicted as follows:
$$Y = (K,L) \text{ -- (1)}$$

Where:
Y = Income or Gross Domestic Product
K = Capital
L = Amount of unskilled Labour employed
A = Determinant of the level of technology

Methodology
Model Specification

Since this research has to do with the study of the impact of inflation and oil revenue on economic growth in Nigeria, by correctly specifying the model, Gross domestic product (GDP) is expressed as a function of Inflation rate (INF), Oil revenue (OIR), E exchange rate (EEXR) and Gross capital formation (GCFC).

Therefore, the model is given as:

$$GDP_t = f(INF_t, OIR_t, EEXR_t, GCFC_t) \text{ --------------------------- (2)}$$

Specifically,

$$GDP_t = \beta_0 + \beta_1 INF_t + \beta_2 OIR_t + \beta_3 EEXR_t + \beta_4 GCFC_t + \mu_t \text{ ---- (3)}$$

In a standard format, the ARDL estimation is shown thus;

$$
\begin{aligned}
\Delta(\ln(GDP)t) = {} & \alpha + \sum_{i=1}^{p} \beta_1 \Delta(\ln(GDP)t - i) \\
& + \sum_{i=1}^{p} \beta_2 \Delta(\ln(INF)t - i) + \sum_{i=1}^{p} \beta_3 \Delta(\ln(OIR)t - i) + \sum_{i=1}^{p} \beta_4 \Delta(\ln(EEXR)t - i) + \sum_{i=1}^{p} \beta_5 \Delta(\ln(GCFC)t - i) \\
& + \gamma_1 \ln(GDP)_{t-i} + \gamma_2 \ln(INF)_{t-i} + \gamma_3 \ln(OIR)_{t-i} + \gamma_4 \ln(EEXR)_{t-i} \\
& + \gamma_5 \ln(GCFC)_{t-i} + \mu_t
\end{aligned}
$$

The error correction model (ECM) for the study is specified as:

$$
\begin{aligned}
\Delta(\ln(GDP)t) = {} & \alpha \\
& + \sum_{i=1}^{p} \beta_1 \Delta(\ln(GDP)t - i) + \sum_{i=1}^{p} \beta_2 \Delta(\ln(INF)t - i) + \sum_{i=1}^{p} \beta_3 \Delta(\ln(OIL)t - i) + \sum_{i=1}^{p} \beta_4 \Delta(\ln(EEXR)t - i) \\
& + \sum_{i=1}^{p} \beta_5 \Delta(\ln(GCFC)t - i) + \theta ECT_{t-i} + \mu_t
\end{aligned}
$$

Where;

GDP_t = growth in gross domestic product, proxy for economic growth.

INF_t = inflation rate at time t

OIR_t = oil revenue at time t

$EEXR_t$ = effective exchange rate at time t

$GCFC_t$ = gross capital formation at time t.

μ_t = the error term at time t

β_0 = the intercept and β_1, β_2, β_3, β_4, β_5 = estimated coefficients of variables.

Results and Interpretation
Descriptive Statistics

Table 1: Descriptive Statistics of the Data Employed

	EEXR	GCFC	GDP	INF	OIR
Mean	19.99241	20.70150	21.95995	22.95337	25.69051
Median	6.431141	15.02781	15.22171	6.403509	11.02805
Maximum	323.4354	57.67560	75.27462	382.8167	123.3734
Minimum	-5.769689	-11.95880	5.592333	-85.41708	-51.12394
Std. Dev.	55.58008	16.44202	14.92771	89.08230	47.76525
Skewness	4.871578	0.533121	1.600524	2.426387	0.497741
Kurtosis	26.94803	2.632557	5.961193	9.633786	2.202621
Jarque-Bera	974.8041	1.854835	27.73075	98.51994	2.372413
Probability	0.000000	0.395574	0.000001	0.000000	0.305378
Sum	699.7345	724.5525	768.5982	803.3678	899.1680
Sum Sq. Dev.	105031.0	9191.556	7576.442	269812.3	77571.66
Observations	35	35	35	35	35

Source: Computed by Authors, 2024

Descriptive statistics analysis was carried out to help understand the nature of the distribution. The results indicate that; the mean values are 19.99241, 20.70150, 21.95995, 22.95337, 25.69051 for EEXR, GCFC, GDP, INF and OIR respectively. The median values are estimated as 6.431141, 15.02781, 15.22171, 6.403509 and 11.02805 for EEXR, GCFC, GDP, INF and OIR. The maximum values are 323.4354, 57.67560, 75.27462, 382.8167 and 123.3734 for EEXR, GCFC, GDP, INF and OIR respectively.

It is also observed that the standard deviation for the variables EEXR, GCFC, GDP, INF and OIR are 55.58008, 16.44202, 14.92771, 89.08230 and 47.76525. The degree of asymmetry of the distribution is represented by the skewness and all the variables employed in this study are positively skewed as presented in Table 1.

Stationarity Test
Table 2: Unit root Test Augmented Dickey Fuller (ADF)

Varaiable	ADF Test	Critical Value	Interpretation	Remark
	LEVEL	5%		
GDP	-3.383671	-2.951125	I (0)	Stationary
OIR	-5.167494	-2.951125	I (0)	Stationary
INF	-7.941841	-2.951125	I (0)	Stationary
EEXR	-5.851397	-2.951125	I (0)	Stationary
GCFC	-4.568581	-2.951125	I (0)	Stationary

Source: Authors' Computation, 2024

Table 2 above shows a summary of the Unit Root Test results for the series at levels. It is confirmed from the table that all the employed research variables are stationary at levels (1(0)) since the critical values of all the variables are greater than the ADF statistical values as presented in the Table 2. The result

justifies the applicability of Auto-Regressive Distributed Lags (ARDL) method. The next step therefore is to test for the long-run coefficients of the research model.

ARDL Bounds Test for Cointegration
Table 3: ARDL Bounds Test Results
H_0: Long-run relationship does not exist
H_1: Long-run relationship exists

Significance Level	Critical Bounds		F Stat Value	Kmax	Hypothesis Testing
	I(0)	I(1)			
AT 10 PERCENT	2.2	3.09	7.514849	4	Cointegration exists
AT 5 PERCENT	2.56	3.49	7.514849	4	Cointegration exists
AT 2.5 PERCENT	2.88	3.87	7.514849	4	Cointegration exists
AT 1 PERCENT	3.29	4.37	7.514849	4	Cointegration exists

Source: Authors' Computation using E-views 9.

Table 3 shows the ARDL bounds test result using GDP as the dependent variable. From the table the F-stat is 7.514849, this is greater than the upper bounds 3.09, 3.49, 3.87 and 4.37 at 10%, 5%, 2.5% and 1% significance levels respectively; this means that there is a long run relationship between the variables and cointegration exists at all levels of existence.

Cointegrating ARDL Model Estimate
After establishing the stationarity of the variables and that they are cointegrated, the Auto-Regressive Distributed Lag (ARDL) was then applied to examine the long run relationship among all the variables. The outcome is given as:

Table 4: Estimated Long Run Coefficients

Dependent Variable: GDP				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
INF	0.093221	0.051110	1.823922	0.0789***
EEXR	-0.037768	0.054196	-0.696879	0.4916
GCFC	0.527402	0.183819	2.869146	0.0077*
OIR	0.163676	0.068506	2.389222	0.0239**
C	5.797443	5.198243	1.115270	0.2742

Note: *, **, *** denote rejection of null hypothesis at 1%, 5% and 10% levels respectively.

The result of the co-integrating form of the ARDL model estimate is presented in Table 4. The result is important for the analysis since the series of the economic growth model are co-integrated. From the result, it is found that oil revenue exerts a significant positive effect on economic growth. Here, a unit increase in oil revenue (OIR) leads to 0.163676 increase in economic growth during the period under observation, and significant at 10% level. The relationship conformed with the a priori expectation of positive correlation between the variables. From the table, it is confirmed that INF behaved contrary to the

a priori theoretical expectation. The reason could be that the research coverage starts from 1987 when the inflation rate in the country was relatively low.

Table 5: ECM Regression Analysis

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CointEq(-1)*	-0.656761	0.090094	-7.289768	0.0000
R-squared	0.616625	Mean dependent var		-0.413592
Adjusted R-squared	0.616625	S.D. dependent var		15.50376
S.E. of regression	9.599506	Akaike info criterion		7.390271
Sum squared resid	3040.967	Schwarz criterion		7.435164
Log likelihood	124.6346	Hannan-Quinn criter.		7.405581
Durbin-Watson stat	2.234102			

* p-value incompatible with t-Bounds distribution.

Table 5 reflects the result of the regression of the Error Correction Model (ECM) of the study. The negative value of the ECM coefficient (-0.656761) implies that previous year's shock, identified in the short-run, converge back to the long run equilibrium in the current year. This position confirms the presence of a long run equilibrium nexus in the research model as indicated in Table 3 above.
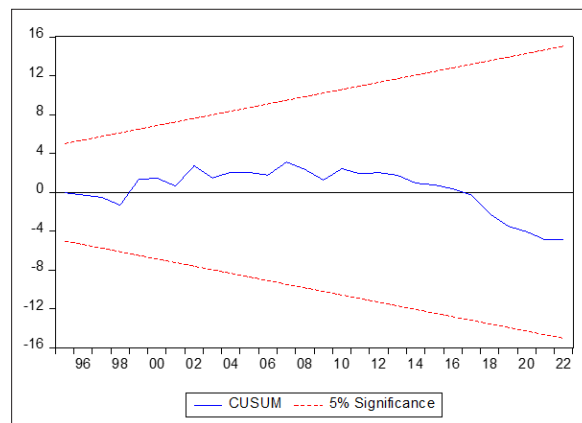
Stability Test

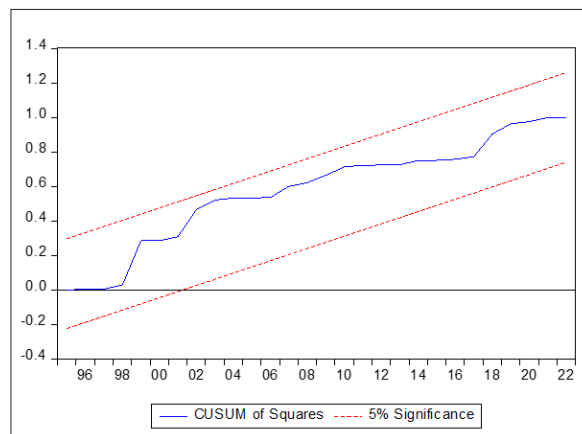**Figure 1:** Cummulative Sum (CUSUM)

Figure 2: Cumulative Sum of Square (CUSUM-q)

As Shown in Figure 1, the mean line starts from figure zero (0). The continuous line (cumulative sum line) trends toward the mean line within the two broken lines as presented in the figure confirms the stability of the estimated model in both the short and long runs in the study. As the cumulative outcome trends from the lag time to the current period and forecasting to the future period, the result displays stability throughout the study period.

Figure 2 indicates the cumulative sum of square (CUSUM-q) where the stability in the research model was determined and was found to be stable both in short and long runs in the study.

Policy Implications of Findings

The studies concludes that oil revenue has a long-term positive effect on economic growth in Nigeria, this is consistent with the a priori expectation, which states that as oil production and sales revenue increase, so does long-term economic growth.

Contrary to a priori expectations, inflation has a long-term positive impact on Nigeria's economic growth. The reason may be traced back to the low rate of inflation during the 1980s, the period that was included in the coverage of the study. The result is in conformity with Anidiobu, Okolie and Oleka who demonstrated positive relationship between inflation rate and economic growth in Nigeria between 1986 and 2015 [13].

Both the effective exchange rate and gross fixed capital formation variables behaved well. They were consistent with the theoretical a priori expectation. The gross fixed capital formation contributed positively at 1% significant level to the economic growth in the country.

Recommendations

The maximum annual spending amount should be limited by the government in order to prevent the high rise in spending that fuels inflation. To end the long-standing practice of exporting crude oil at a low price and buying refined oil at a high price, the government should build new refineries and renovate the existing ones. Refinery reconstruction is of importance for oil revenue to be maximized, hence the export and import of crude and processed oil will reduce. The over-reliance of the Nigerian economy on the oil sector has resulted in significant macroeconomic oscillations, such as diminishing growth and unemployment, and the government ought to invest in other economic areas. Not only may the development and operation of non-oil sectors accelerate the rate of growth, but they can also boost overall production, which can lessen economic volatility.

It is imperative to establish and assiduously implement a number of procedures and regulations to guarantee that the revenue diverted from a dominant industry such as the oil business is appropriately managed in order to achieve Nigeria's macroeconomic goals.

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