

## Does the Oil Revenues affect the Macro Economic Variables' Performance In Africa? A Panel Data Analysis

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### Abstract

Oil revenues play a vital and central role in the economies of developing countries and African countries are among the countries whose macroeconomic variables are affected by oil revenues. The objective of this study is to analyze and investigate the role of oil revenues on the macroeconomic variables in most of the oil-producing African countries. The Econometric method Pooled Ols model was employed in the study and the fixed and random technique data used was time sires cross panel data in the period (2000-2018). Based on the literature review, the selected sample study was on countries such as (Nigeria, Algeria, Angola, Gabon, Egypt, Congo, Egypt, Congo, Sudan, Chad, Ghana) and we employed the Gross Domestic Product as the target variable and Oil Revenues (Oiler), inflation (CPI), Exchange rate (Ex), export (Exp), Foreign Direct Invest (FDI), money supply ( $M_2$ ), as independent variables. The study result and analysis of the data indicated that oil revenue has an impact on most the macroeconomic variables in the study except CPI and money supply. The study also indicated a strong positive correlation between oil revenue and GDP growth rate on the countries samples study. The study concluded that one of the most important macroeconomic variables is oil revenues. It also recommended that African countries need support and need to put more effort in building strong economies that are not dependent on oil revenues; to work on diversifying the revenues of the states and work to preserve the right of the next generation to exploit natural and oil resources.

**Keywords:** Gross Domestic Product, Pooled Ols, Africa, Hydrocarbon revenues.

### 1.Introduction

The discovery of oil and hydrocarbons is important in both developing and developed countries due to its impact on the economies and its direct influence on the macroeconomic variables which are considered as the basis of any economy in the world. Masami (2010). Oil plays a vital role in the energy sector and also provides revenue to other economic sectors. Greg (2013). Oil revenue also has an impact on the public sector and local development. Iddisah (2017). Since the discovery of oil in Africa, the oil produced income has become a very important factor in the economies of African countries such as Nigeria, Algeria, Libya, and Egypt. Joseph (2016). Many African countries which export natural resources, particularly oil, have been affected since their economies were built and still depend on oil. Nweze et al (2017). Revenues from the hydrocarbon sector are expected to be able to finance the oil budget in the short term, but it is not possible to rely on the oil sector in the long term spectrum due to fluctuations in oil prices. Charles et al (2019). Hydrocarbon-producing countries will face major financial and economic problems and are due to experience a continued decline in the price of oil, and a low volume of oil revenues and petroleum fiscal. Bassey et al (2016). Lower oil prices will thus affect government revenues, which then affect macroeconomic variables, including export volumes and exchange rates. Akinyemi (2017). Developing countries have worked hard to develop and promote their exports outside of hydrocarbons and have worked to create a structural balance in order to diversify their economies as well as their incomes.

This study investigates the role played by the revenue of hydrocarbons products on macroeconomic variables. It covers African countries with the most production and export of hydrocarbons, where oil, its industry, and its revenues represent a large part of the national economy of the sample countries, and the volume of returns plays an essential and pivotal role in the economies. Adewale (2018). The hydrocarbon producing countries in Africa have a lot of similarities in the characteristics of the components of its economies, especially basing on the macroeconomic level. For example, dependence on oil revenues to finance public expenditures and finance the

local and national development process, macroeconomic weakness, lack of added value and economic diversification outside the hydrocarbon sector, and also weak incomes and revenues outside the hydrocarbon sector. Margaret (2019). The hydrocarbon revenue is used across the entire economy in every country. This empirical study investigates the nexus relationship between macroeconomic variables in the global context where literature study review is relatively less. The previous studies analyses the impact of hydrocarbon revenues on macroeconomic factors in a unilateral way, where the macro represents the economy only in a single variable, such as in the study by M. Benbouzian (2018). The study investigates the oil revenues on GDP where the study result indicated a positive relationship between oil revenue and GDP in the case of Algeria, similar to the context of the study by Akinyemi et al (2017). The impact of oil revenues on the exchange rate in the case of Nigeria was also investigated, and the result indicated a positive relationship between the oil revenue and exchange rate. Any change in the exchange rate will have a direct impact on the exchange rate of Nigeria. Moayad et al (2019). It also analyses the relationship between economic growth and oil revenues based on error correction and Granger causality. Oil revenue reduced the effect on the GDP and increased oil revenue in the case of Saudi Arabia. This lack of empirical studies analyzing the relationship between hydrocarbons revenues and macroeconomic variables, especially in African countries, contributes to the clarification and analysis of the relationship between hydrocarbons revenues and macroeconomic variables in major and key hydrocarbon producing countries in Africa.

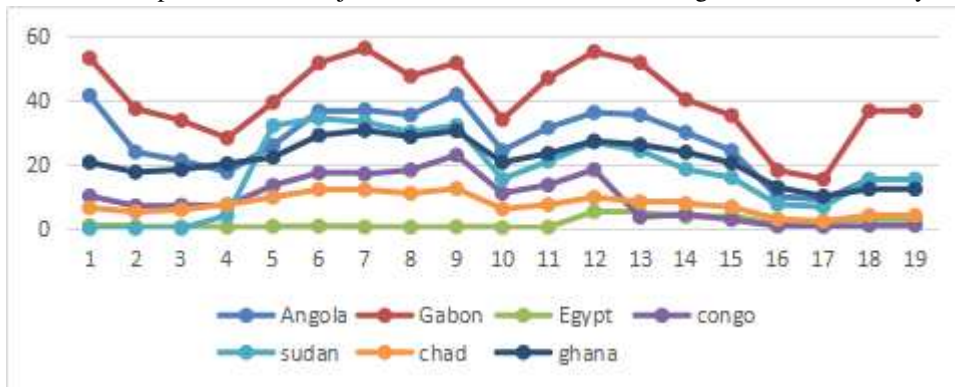
This study investigates and analyses how the hydrocarbons revenues were affected by the macroeconomic performance in each of the sample countries in the period (2000 - 2018). Second data collected from the world bank database was employed, however, it used the GDP and inflation rate as target variables and exported oil revenues, gas revenues, exchange rate as independent variables. In order to reach the objectives of the study and clarify its mechanisms, we used the Panel date method to analyze the effect of oil revenues on macroeconomic variables across the sample countries, with Pooled test technique to select the fixed and random effect. Moreover, the standard study across African countries that are producers of Petroleum and hydrocarbons in general (Algeria, Nigeria, Gabon, Libya, Congo, South Africa).

## **2 . Literature review**

Sarvar (2017). This empirical study analyzes the impact of oil revenues on Azerbaijan GDP rate, where the result indicates a positive correlation between oil revenues and GDP rate both in the long and short run. It also analyzes the relationship between oil revenues and the deficit hypothesis which includes the macroeconomic variables. Vector Auto-Regressive (VAR) method was used to analyze the causality relationship between the variables. Analysis result indicated the oil revenues price and revenues have a direct and indirect relationship between the exchange rate and GDP with the oil revenues.

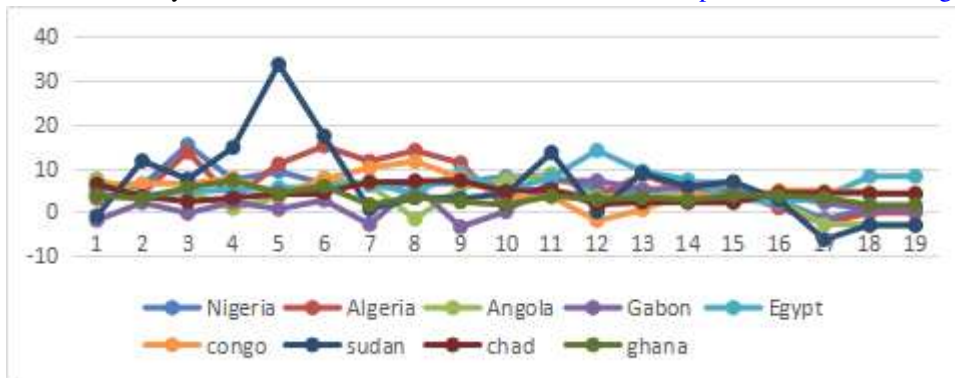
In the investigation study by Akiyemi (2017), the effect of revenues from oil on the exchange rate and economic growth in the case of Nigeria was tested. The Ordinary Least Square (OLS) technique was used. Study results indicated the exchange rate had a positive impact on the growing economy and oil revenues also have a direct effect on the employment rate and the growth and development of the economy in the oil production area, as in the econometric analysis by Aduralere (2018). The study investigates the dynamic relationship between oil growth, economic growth, and public expenditure. Study results indicated a positive relationship between the economic growth and the oil revenues, however a negative relationship between the money supply and economic growth. M. Bendouziane (2018). The co-integration Vector Auto-Regression technique was employed to investigate and analyze the impact of natural resources on economic growth, including oil abundance and oil revenues. A positive long-run relationship was found from the study between the oil revenues and economic growth; oil revenues had a negative linkage to the exchange rate in Algeria. Moses (2018). The study also investigates the relationship between the output of oil revenues and the economic growth in Nigeria. The Alima model was used to test the relationship between oil revenues and unemployment. A positive impact on employment and economic growth was indicated from the study as in the study by Isiaka (2018). Relationship between the revenue from oil and economic growth was investigated in the study for both the long and the short run. The test indicated the oil revenue's impact on the growing economy was very low compared to the oil revenues, which interpreted to the large part of the global revenues and had an impact on economic growth both in the long and short run. Eric (2018). While analyzing the economic impact of oil revenues and price on developing countries, the study used different economic variables and macroeconomic variables in particular, such as exports and exchange rates, foreign direct investment and interest rate. The Ordinary Least Square (OLS)

method was used to analyze the long and short run relationship between the target and independent variables. It indicated a linear relationship between oil revenue and the macroeconomic factor in the case of Nigeria and also its relationship with oil revenue in the case of Uganda comparatively. Shabbir (2018). Analysis of the impact of oil and non-oil revenue in Oman and UAE indicates that oil revenues in Oman have more impact on GDP rate and macroeconomic than in UAE. This interprets that UAE uses the non-oil revenue in the growth of its economy more than Oman, as in the study by Margareta (2019). The study indicated that oil revenue in Uganda has a direct effect on the investment of the FDI. Tarek (2017). It also analyzed the relationship between the oil revenue and well being included in the GDP level, which shows that the oil revenue has a long and short-run impact on GDP and well being. As in the same context of the analysis study by C. I. Ezeanyej (2019), the empirical study showed the economic recession and growth in Nigeria. It also included analysis on the nexus between the macroeconomic variables such as exports, exchange rate, economic growth, employment and the price of oil and oil revenues. The Johansen co-integration and the error correction mechanism result showed that the oil revenue impacted all the major macroeconomic factors driving the macro-economy of Nigeria.



**Fig. 1:** Oil revenues % for sample countries

Source: Made by the author based on the world bank database <https://data.worldbank.org/>



**Fig. 2:** GDP% Sample Countries

Source: Made by the author based on the world bank data <https://data.worldbank.org/>

The figures above interpret two important variables, GDP and oil revenues. GDP was selected as the principal macroeconomic variable for the global economy of any of the countries. The figures also show that the variables are high in African countries due to oil production in the period 2000-2018. However, based on the figures it can be observed that the oil revenues have a partial effect and in some countries, it is not absolutely inevitable for all the countries under study such as in the case of Algeria, Angola, Chad, Nigeria, Gabon. In the period between the 2000-2017, oil revenue's percentage was very high except for the GDP level. In Congo and Sudan, it can be noticed that the oil revenues are not very high but the GDP rate is higher for the other countries that have recorded the highest level of oil revenues in the same period of time as in the case of Chad and Angola. Ghana has a balanced oil revenue rate and GDP rate. The study shows that the sample countries experienced a decrease in the rate of oil revenues and the level of growth rate, with the GDP of an approximate zero or even less except Angola and Congo.

### 3. Research Methodology

#### 3.1 Data resource and the variables

In this panel of the investigation, we highlight the relationship between oil revenues and the performance of the macroeconomic variable in African countries. In this study, African countries with the most oil production and high oil revenues were selected (Nigeria, Algeria, Angola, Gabon, Egypt, Congo, Sudan, Chad, Ghana). In this study analysis, the macroeconomic variables used as secondary data were selected from the world bank data between 2000-2018 (GDP, exports, exchange rate, FDI, inflation rate). Variables such as (Oilre) which indicates the Oil revenues (% of GDP), (FDI) Foreign direct investment, inflows (% of GDP), (Ex) exchange rate, (CPI) consumer prices (annual %), (M2) money supply (% of GDP), (Exp) export (USD), (GDP) (annual %) were used in the study analysis.

#### 3.2 Methodology

The next step is to estimate the study model and to employ the model needed to apply the technique.

Pooled ordinal least square (OLS): This method uses the data variables (T) observation Number <sub>(it)</sub> and the (OLS) parameter model as follow :

In this study, there are 9 African countries which produce oil the most in the period (2000-2018) and 5 macroeconomic variables. To investigate, the following method was employed:

Pooled (OLS) method: (18\*9) 179 observation and we apply the estimation following the model :

$$\gamma_{it} = \alpha_1 + \alpha_2 X_{1it} + \alpha_3 X_{2it} + \alpha_4 X_{3it} + \varphi \dots \dots \dots (1).$$

Where the countries names = 1.2.3.4.5....9, the t is the time = 0.....18, the  $\gamma$  is the GDP rate, and the  $X_1$  = oil revenues  $X_2$ =GDP rate  $X_3$ =FDI  $X_4$ =EX  $X_5$ = CPI  $X_6$ =M2  $X_7$ =EXP.

In this estimation model, the assumption is that it is not stochastic, however, if it is stochastic then it does not have a correlation with the error terms.

The effect fixed model: This model gives the intercept of the value of random drawing out by the study population. The study indicates 9 countries drawing out but African countries continue the same with no difference between the countries and the intercept value, which is ( $\alpha_1$ ). The intercept of each country was reflected by the term errors and this drew out the model :

$$\gamma_{it} = a_1 + a_2 x_{1it} + a_3 x_{2it} + a_4 x_{3it} + a_5 x_{4it} + a_6 x_{5it} + a_7 x_{6it} + \varphi_{it} + \mu_i \dots \dots \dots (2)$$

$$\gamma_{it} = a_1 + a_2 x_{1it} + a_3 x_{2it} + a_4 x_{3it} + a_5 x_{4it} + a_6 x_{5it} + a_7 x_{6it} + \phi_i \dots \dots \dots (3)$$

Where  $\phi_x = \varphi_{it} + \varepsilon_i$  however the  $\varepsilon_i$  is the error specific on the time series individual or cross panel and based on the model 1.2.3.4, it is seen that the variance model is  $\phi_{it} = \sigma_\mu^2 + \sigma_\eta^2 \dots \dots \dots (5)$

$\forall \sigma_\mu^2 = 0$  no different can be noticed between the models employed above, the Pooled Ols as per the first estimation.

#### 3.3 Result analysis

Cross panel data was used in this study and in order to analyze this cross panel data, the Pooled OLS is employed and GLS as the fixed effect. It also contributes to the description of the statistics and characteristics of the variables.

**Fig. 1: Description of the statistics**

	Oiler	GD P	FDI	Ex	CPI	M2	export
max	56.28	33.62	50.01	733.03	7145	98.136	94.03
min	0	-6	-6.05	0.54	-8.975	7.21	1.6
mean	19.17	4.92	4.47	221.53	56.55	30	35.88

median	16.03	4.34	2.43	94.70	7.18	33.21	31.749
variance	223.610	20.2 72	54.049 31	60490.	314941	623.352	533.60
obs	162	162	162	162	162	162	162

Source: Calculated by the author based on the Stata2014 software

**Tab. 2: Pooled OLS test**

<b>GDP</b>	Coe f.	St.err	t	P>t	Lower bound	Upper bound
Oilre	0.1 057	0.0441	2.39	0.01 8	0.018 5	0.1929
FDI	0.1 288	0.4942	2.61	0.01 0	0.312 2	0.2265
Ex	- 0.005	0.0017	-3.32	0.00 1	- 0.0094	-0.0023
CPI	- 0.0002	0.0060	-3.35	0.72 8	- 0.0013	0.00097
M2	- 0.0502	0.0152	-3.14	0.00 2	- 0.07781	-0.0177
Exp	- 0.0502	0.0322	-1.56	0.12 1	- 0.11384	0.01342
cons	7.2 11	0.989	7.29	0.00 0	5.257 1	9.1658
source	AF	Sum Squares	Mean Squares	F	P>F	
Model	6	437.233	72.872	4	0.000 1	
Residual	155	2826.66	18.236			
total	161	3.363.91	20.272			

Source: Calculated by the author based on the Stata2014 software

**Tab. 3: Random GLS test**

<b>GDP</b>	Coef.	St.err	Z	P>Z	Lower bound	Upper bound
Oiler	0.141 5	0.056 0	2.53	0.012	0.03167	0.2513
FDI	0.131 8	0.048 8	2.70	0.007	0.03613	0.2275
Ex	- 0.0075	0.002 8	-2.61	0.009	-0.0131	-0.0018
CPI	- 0.0026	0.000 5	-0.45	0.652	-0.0014	0.0069
M2	-	0.026	-2.23	0.026	-0.1091	-0.0069

	0.0426	0				
Exp	- 0.0426	0.046 04	-0.93	0.354	-0.1329	0.04756
cons	6.921 3	1.746 4	3.96	0.00	3.4983	10.3443
sigma	1.7706	R-sq Between =0.35 Overall=0.24				
sigma E	4.0949					
Rho	0.1575					

Source: Calculated by the author based on the Stata2014 software

**Tab. 4: Fixed effect test**

GDP	Coef	Std	t	P> T		
Oil re	0.1558	0.67418	2.31	0.022	0.022 62	0.28 90
FDI	0.1426	0.0500318	2.85	0.0005	0.043 73	0.24 148
ex	-0.0030	0.0070132	-0.43	0.665	- 0.1689	0.01 082
Cpi	-0.00032	0.0005957	-0.55	0.581	- 0.0150	0.00 081
M2	-0.07629	0.0468881	-1.63	0.106	- 0.16895	0.01 63
Exp	-0.06393	0.0616098	-0.10	0.917	0.128 1	0.11 53
C	4.779769	3.377931	1.41	0.159	- 1.89581	11.4 55
Sigma-U	3.02432					
Sigma-e	4.0919					
rho	0.3529	Pro>F=0.0 08				

Source: Calculated by the author based on the Stata2014 software

**Tab. 5: Husman test**

GDP	(b) FIXED	(B) RAND OM	(b-B) Difference	sqrt(diag(V_b- V_B))
Oilre	0.1558	0.1415	0.01435	0.037496
FDI	0.1426	0.1318	0.01076	0.010976
Ex	-0.0030	-0.0075	0.00449	0.006393
CPI	-0.0003	-0.0002	-0.0006	0.006393
M2	-0.0762	- 0.05806	-0.0182	0.000104
Exp	-0.0063	- 0.04268	0.03629	0.040931
$hi2(6) = (b-B)[(V_b-V_B)^{-1}](b-B) = 5.05$ Prob>chi2 = 0.5378				

Source: Calculated by author based on the Stata2014 software

Based on the tables above, it can be noticed that the descriptive statistics of the variables indicate that the



dependent variables resulted in the following: min=-6, max=33.62, median=4.34 and mean=4.92. The descriptive statistics of independent variables indicated the following results: min=0, max=56.28 for the oil revenues; median=16.03 for the FDI; mean=4.47, median=2.34. A min of -6.05 and max of 50 was also indicated for the independent variable exchange rate; median=94.70, mean=221.53. A min of 0.5 and a max of 7.33 for CPI, mean=56.55, median=7.18; min=-8.975, max=7145. M2 statistics' characteristics indicated: min=7.21, max=98.136; mean=30 and median=33.21. The Export variable indicated a median=31.749, min=1.6, max=94.03 and mean=35.88. The statistical descriptive test includes 162 global observation.

Based on **Tab. 2**, the Pooled OLS test estimation indicated the test variables were not random and also that they have a correlation with the errors terms. The test  $R^2$  indicates only 13% of the independent variables (Oilre, FDI, Ex, CPI, M2, Exp) can affect the dependent variable (GDP). In the same context, the study also indicates that only four variables are statistically significant and indicate  $p < 5\%$  (Oilre=0.018, FDI=0.010, Ex=0.001, M2=0.002). This is similar to the study by Mohammed (2017) which showed significant results between GDP and Money supply. It also showed the impact of money supply on Bangladesh's economic growth. The study by Iwed (2019) found a strong positive correlation between money supply and GDP in the case of Nigeria. The same empirical investigation about the study of the macroeconomic variables was by Anthony (2018). The study investigation showed a long run relationship between the macroeconomic variables (GDP, Exchange Rate, inflation, and export) and the total income in general and the hydrocarbon revenues in the case of Ghana. The study by Yugang (2017) also analyzed the relationship between the macroeconomic variables (M2, inflation, interest rate) and GDP in the case of China, where the study results indicated a strong correlation in both long and short run. However, the study result indicated the oil revenues to be  $0.018 < 5\%$ , which is statistically significant and has a positive impact on the GDP where the coefficient result was (0.1057). The FDI coefficient also indicated a positive effect on the GDP (0.1288), where the Exchange rate indicated a negative coefficient (-0.0058). The money supply indicated a negative impact on the GDP with the coefficient result of (-0.0477). Globally, the result follows the economic theory, and in primary the Pooled OLS estimation model can't be accepted because it cannot take the differences between the countries as important. Based on the Pooled OLS model, we need to analyze the **Tab. 3** where the random effect model test result indicates the (P-value = 0.0003 < 5%) and this result interpret the model coefficient is not equal to zero. The P value of oil revenue is statistically significant; when P value = 0.012 < 5% it can affect the GDP. The FDI have significant P value = 0.007 < 5%, which means the factor of FDI can have an impact on the GDP. The same goes with the exchange rate P-value = 0.009 with negative coefficient; Money supply P value = 0.026 < 5% with a negative effect on the GDP. In the same context, from the table above, the LM statistics shows (6)=25.06 which interpret it is significant. However the  $H_0$  is not accepted but the Random test will be accepted, there is need to run the fixed effect model in the same context and in other important technique fixed-effect test where we observe the LSDV Model test results in **Tab. 4**. When the test ( $P > F = 0.0003$ ), that means the coefficient of the model can't equal zero. The variables (when oil revenues' oil P value was fatalistically tested, it also showed that the LM Test result was statistically significant when it indicated P value = 0.02 < 0.05) interpret a positive impact of the Oil revenues on the GDP. The FDI also had a positive impact on the GDP with significant P value = 0.00d < 5%. And according to the technique test, we need to follow the methodology we observed in **Tab. 5** which shows the Husman test. According to the Husman test, the appropriate model can be tested between the GLS or LSDV test. The Prob > Chi2 = 0.5378 is larger than 5% and according to the Husman test result, the null hypotheses will be accepted, which means the random effect model is the appropriate model to explain the outcome. There is a positive relationship between the oil revenues and the GDP and it follows the economic theory. However, the study result opposes a few literature studies such as the study by Moayad H (2019) where the study indicates growth on GDP from non-oil revenues.

## Conclusions

Based on the analysis of the empirical study, there is a relationship between the oil revenues and macroeconomic variables in oil-producing African countries (Nigeria, Algeria, Angola, Gabon, Egypt, Congo, Egypt, Sudan, Chad, Ghana) in the period (2000-2018). The study applied the short panel data pooled OLS method to investigate the variables and oil revenues and used the GDP growth rate as the target variable. The study result indicated the Pooled test the oil revenues have a strong positive impact and correlation with the GDP growth rate, the FDI, exchange rate and money supply. The study also indicated no correlation or relationship between the CPI and export rate and the growth rate of GDP. It also indicated a negative relationship between the Money

supply and exchange rate and the GDP in the countries of study. Also, the second technique, the random test showed a positive correlation between oil revenues, FDI exchange rate and the GDP accepted the variables money supply and the export. The third estimation fixed effect model result indicated that the oil revenues and the FDI have a positive effect on the GDP growth rate and other variables are not statistically significant. Based on the technique applied Husman test was used where the test result indicated acceptance of the null hypothesis and indicated the impact of the oil revenues on the macroeconomic variables Including the GDP.

This empirical study's conclusion is to recommend the African governments to develop the macroeconomics tools and support to develop a macro-economic policy and its variables that improve its performance and work to create policies and instruments of the economy to keep abreast of the developments of the modern economy; and also to move away from the oil revenues that finance the economy and create a modern economical wealth such as agriculture and light industries that create added value and are not associated with oil. These are threatened with disappearing with the care of the rights of future generations in the exploitation of oil resources, as the study data and drawings have shown that once the oil revenues have decreased the total variables of the study countries will decrease where the oil place improves the macroeconomic performance of the African countries.

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