ENERGY RESOURCES, INVESTMENT CHANNELS AND ECONOMIC GROWTH

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Abstract

The research investigated whether energy resources increase the possibility for investment promotion and how they affect economic growth. In other words, the article explored whether energy could be used to support economic growth in Nigeria through investment. The analysis utilized secondary source of data from the World Bank's Development Indicators. The variables employed in the study included; Gross Domestic Product (GDP) being the dependent variable, Gross Fixed Capital Formation (GFCF), Foreign Direct Investment (FDI), Electricity and Natural Gas Rent (ENGR) and Openness (OPEN) spanning through 1980-2021. The methodology used in this study was dependent on the type of data collected and whose analysis was econometric in nature. The study performed a pre-estimation test via Ordinary Least Squares, and it was found that the result cannot be used for policy purposes due to some of the inherent problems associated with the estimation. This problem includes auto-correlation issues, multi-collinearity and others. This further propelled the study to conduct a post estimation test using the ADF statistics and the ARDL techniques of estimation and afterwards, the results showed a short run and long run impact of explanatory variables on economic growth. The study therefore recommended that the government should provide an enabling environment that will attract foreign direct investment, stimulate trade openness and also boost economic growth in Nigeria.

Keywords; energy resources, foreign direct investments, auto-regressive distributed lag.

1. Introduction

In today's world, renewable energy is the new paradigm shift in developing nations as it has proven to reduce the effect of greenhouse gases on the environment unlike non-renewable energy sources. Non-renewable energy sources such as fossil fuels release greenhouse gases detrimental to the atmosphere. However, renewable energy resources are birthing an environmentally friendly change to todays' climate. The release of greenhouse gases such as CO_2 and methane into the atmosphere when fossil is burnt causes global warming as these greenhouse gases when trapped heat up the earth. Renewable energy sources such as solar energy when utilized reduce the amount of solar radiation heating up the earth by absorbing such radiation to produce power thereby, cooling the atmosphere instead.

The above regard has sprung further researchers the need to examine the impact of renewable energy resources, according to (Strahler and Straher, 2002), everything that exists in our universe is composed of either matter or energy. The cooperation of these two are essential, because energy is what makes matter change through time causing the shaping of our planet.

According to the ways of consumption, the energy sources can be:

a. **Primary**: (they can be used directly without modification, for ex-ample: black coal),

b. **Secondary**: (they are converted from primary sources, e.g., electricity from black coal generated by a power station. Having referred to ISO 13600, these are the so-called energy carriers).

c. **Tertiary**: (normally a "waste of energy" that comes to existence as a by-product of the secondary energy source, e.g., thermal pollution).

Energy resources have proven to be vital to human existence and functioning, they are viewed as any material that can be used as a basis or source of energy. Energy resources can be used to generate electricity and other forms of power for human use. There are two kinds of energy resources.

- Renewable Energy resources
- Non-renewable Energy resources

Renewable energy resources:

These are energy derived from natural resources that are replenished at a higher rate than they are consumed. For instance, sunlight, wind, and water are such sources that are constantly being replenished. Wind energy is utilized by wind gauges, solar energy is utilized by solar panels and the kinetic energy derived from motion in water is utilized by dams.

Nonrenewable Energy resources:

This is a natural resource that cannot be readily replaced by natural means at a pace quick enough to keep up with consumption. Example is carbon-based fossil fuels.

Natural resources in a whole and particularly energy resources on economic growth have remained an unresolve issue in macro-economic debate.

Several studies have been carried out on the relationship between the ‘resource endowment’ and the Nigeria growth experiences over the years. the bulk of these studies conclude that the resources endowment has not contributed much to the economic wellbeing of Nigeria. some even considered energy resources as a curse to Nigeria (Olusi and Olagunji,2005).Although but a few studies discovered energy resources to have the potential of promoting economic Growth (Budina and Wijnbergen2018; Odularu 2008; Salai`Martin and Subramania, 2003),but because of poor economic performance in Nigeria, it is very hard to prove such positive result .This study is a country specific, concentrating only on Nigeria. Thus, it is distinct from previous attempts at examining Natural resources impact on economic performance in so many ways. .The further address the issue of abundance and dependency as possible explanations of the confusion in the empirical evidence from previous studies.

2. Selected Existing literature

Many studies have investigated and empirically established findings on the significance of natural resources (resource endowment) like oil and others on growth over the years. One such study is Sachs and Warner's (1997) analysis of 95 developing nations, which found a glaringly negative relationship between growth in the 1970s and 1990s and exports of natural resources. From 1970 to 1980, only two of the list's resource-rich nations maintained annual growth rates of 2 percent. Mehlum, Moene, and Torvik (2002) used a sample of 87 nations from 1965 to 1990 to examine if institutional arrangements differed between countries that had economic growth and those that did not. They distinguished between "grabber friendly" institutions, where rent seeking and productivity were incompatible pursuits, and "producer friendly" organizations (where rent seeking, and production were complementary activities). They discovered that more natural resources reduce aggregate revenue when institutions are pro-grabbers, whereas more resources increase income when institutions are pro-producer.

According to a different study by Sachs and Warner (2001), nations with abundant natural resources expand more slowly than nations with few resources. They demonstrate that there was little concrete evidence that the negative association could be explained by omitting geographical or climate characteristics or that there was a bias brought on by some other unrecognized development inhibitor. They contend that nations with plenty of resources typically have high prices and, maybe as a result, miss out on export-led prosperity. Gylfason and Zoega (2019) have also demonstrated that a country's long-term output per capita will decline if it depends too much on natural resources in terms of growth, savings, and investment. They concluded that natural resources are essentially exogenous elements that might obstruct economic growth through macro-economic channels as well as through institutions after looking at 85 countries, including the resource wealthy and poor.

The relationship between resource availability and a number of metrics of human welfare was explored by Blute, Damania, and Deacon (2015) In line with existing research on the link between resource availability and economic growth, they discovered that, given a starting income level, resource-intensive countries typically have lower levels of human development. Furthermore, they discovered relatively scant evidence for an indirect relationship operating through institutional quality, despite finding strong evidence for a direct relationship between resources and welfare.

Olomola (2007) used data for 60 nations from the years 1970 to 2000 to examine the impact of oil rents on economic growth in African nations that export oil. He discovered that oil rent has failed to spur economic growth in oil-exporting African nations, and that the Dutch disease, rather than the absence of democracy in oil-exporting nations, explains why economic growth is sluggish in such nations. Olomola and Adejumo (2006) investigated how the 34-year oil price shock affected Nigeria's output inflation, real exchange rate, and money supply while maintaining that the Dutch disease exists in Nigeria.

3. Methodology

3.1 Theoretical framework

The theoretical modeling for the relationship between energy resources and economic growth follows directly from the standard Solow theoretical model. However, to include non-`renewable resources in the standard Solow model, it is assumed that fixed amount of energy resources (E) is available to the economy in each production period and is exhaustible when they are used in production and that output is produced according to:

$$\mathbf{Y= AK^{\alpha}E^{\beta}L^{1-\alpha-\beta}} \qquad \textbf{(1)}$$

Where β is between zero and one $+\beta < 1$, L and K represent human and physical capital inputs. A represents the index of exogenous technology and multiplies the whole production function rather than the augmenting labour inputs as the Solow model suggests. The production function exhibits constant returns to scale in L, K and E, so output doubles only when all the inputs are doubled. In a similar manner, with the standard Solow model, the economy is assured further to exhibit exogenous technological progress and exogenous population growth, and capital accumulates in the standard fashion

$$\frac{\Delta A}{A} = g_A \qquad (2)$$

$$\frac{\Delta L}{LA} = n \qquad (3)$$

$\Delta K = sY - \partial K$ (4)

Where s is the constant rate of investment and ∂ is the constant rate of depreciation. If R_0 stands for the initial stock of the energy resources, when the economy uses amount E of energy in production, the resources stock is depleted and the resources stock obeys a differential equation similar o the capital accumulation equation, only it dissipates rather than accumulates

R= –E (5)

In the long run, just like the saving rate assumption of the Solow model, a constant fraction (S_E=E/R) of the remaining stock of energy resources is used in the production in each period (Jones 2002). By dividing Equation % by R, the remaining stock of energy in the economy is observed to decline over time at the rate (S_E):

$\frac{R}{R} = \quad S_E$ (6)

And, therefore, the behavior of stock of energy resource over time can be described by;

R (t) = $R_0 e^{-s} E^t$ (7)

The stocks of energy resources decline exponentially and since E= S_ER, then the amount of energy in used in the production in each period is given as:

R (t) = $S_E R_0 e^{-s} E^t$ (8)

Substituting Equation 8 to Equation 1and expressing the production function terms of capital output ratio, the Equation 1 becomes:

$Y - \frac{1}{A^{1-\alpha}}((\frac{K}{Y})^{\frac{1}{1-\alpha}} (S_E R_0 e^{-SE^t})^{\frac{\beta}{1-\alpha}} L^{1\frac{\beta}{1-\alpha}}$ (9)

Taking the log and derivatives of Equation 9, the growth rate of total output along a balanced growth pat is:

$g_{y=}$ g $- \varphi_{S_E} + (1- \varphi)n$ (10)

Where g= g_α / 1-α and $\varphi = \beta_\alpha$/ 1$-\alpha$ and given the assumption of constants population growth, the final growth rate of output can be given as:

g_y= g $- \varphi(S_E$ + n) (11)

This expression in Equation (11) gives rise to three significant policy implications. First, if *B=0*, energy resources play no role in the model and g_y, = g just like the basic Solow model with technology progress suggests. Second, the long-run, growth rate of the economy with energy resources depends on more than just the rate of technology change, energy resources' abundance (á) and dependence in production (S_E) as well as the population growth rate mow plays significant roles. Third, the growth rate of the €economy depends on the tug of war between technological progress (g) and the Combined effects of energy dependence φ (S_E) and the diminishing returns introduced by energy resources as nonrenewable factor φn

Lastly, the more dependence on energy resources (that is, (β and S_E)), the lower the long-run growth will be. This will be so because the more important the energy resources is, the sharper the diminishing returns to capital and labour in the economy ($-\varphi$ (S_E +0).

Equation 11 also implies that investment either in human development or capital accumulation is an important channel energy resource that could affect the economic growth in the long run. According to the investment channel, energy resource abundance may reduce private and public incentive to accumulate human capital due to a high level of non-wage income, e.g,, dividends social spending and low taxes. Energy resource rich nations may underestimate the log-run value of education, thereby crowding out human capital, which leads to low productivity and , in turn , low economics growth. Also, abundant energy resources may cause private and public incentives to save and invest, thereby retarding economic growth.

3.2 Model Specification

The model for this study specified functionally as

GDP= f (GFCF, FDI, ENGR, OPEN) ------------------------------------(1)

$GDP_t = \beta_0 + \beta_1 GFCF_t + \beta_2 FDI_t + \beta_3 ENGR_t + \beta_4 OPEN_t + U_t$ ----------------- (2)

Where, GDP represents; gross domestic product, GFCF represents gross fixed capital formation , FDI represents foreign direct investment and ENGR represents electricity natural gas rent, OPEN represents Openness which is the sum of imports and exports normalized by GDP. (Fujii, 2017).

3.3 Empirical Results and Interpretation.

Table 3.1 Ordinary Least Square Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GFCF	0.069335	0.058822	1.178741	0.2484
FDI	-0.182997	0.631843	-0.289624	0.7742
ENGR	1.307076	1.632973	0.800427	0.4302
OPEN	0.417072	1.662973	0.810428	0.0262
C	3.730901	1.684520	2.214815	0.0351

R-squared	0.091385	Mean dependent var	4.320114
Adjusted R-squared	-0.081103	S.D. dependent var	4.017196
S.E. of regression	4.073266	Akaike info criterion	5.763236
Sum squared resid	464.5619	Schwarz criterion	5.946453
Log likelihood	-88.21177	Hannan-Quinn criter.	5.823967
F-statistic	0.717474	Durbin-Watson stat	1.049236
Prob(F-statistic)	0.549900		

After running the Ordinary Least Square estimation, the study discovers that the model was not significant from apriori-expectation, where the model displayed R-SQUAREDis less than 0.50 explaining the model is not fit.

- T TEST, that explains the individual significant of the variables, where the individual variables were not significant at5% (0.05) .
- The F- statistic, that measures the joint significant of the variables, in other words the F statistics, that measures the overall significance of the model is not significant because of the probability value is greater than 5% (0.05) .
- The Durbin-Watson stat, that shows if there is presence of autocorrelation, has a negative autocorrelation at 1.049236

On this basis, the study goes further to individually check the stationarity of the variables to attain what Test method to adopt.

Table 3.2. AUGUMENTED DICKEY FULLER. TEST RESULT (UNIT ROOT TEST)

Variable	ADF test statistics	5% critical value	Probability	Remark
Electricity and natural gas rent	-4.10849	-2.963972	0.0034	Stationary
Foreign Direct Investment	-3.098322	-2.960411	0.0025	Stationary
Gross fixed capital formation	-10.31679	-2.963972	0.0042	Stationary
Gross Domestic product	-3.625627	-2.960411	0.00136	Stationary

The study was only concerned with the negative values of our test statistic DFr if the calculated test statistics is less (more negative) than the critical value, the null hypothesis of $\gamma=0$ is rejected and no unit root is present. Where the process has no unit root, it is stationary and henceforth it exhibits diversion to the mean; so the legged level will provide relevant information in predicting the change of the series and the null hypothesis of the unit root will be rejected. Example: DF statistics of -4.10849 which is more than the tabulated critical value of -2.963972, so all the 95% level of the null hypothesis of a unit root was rejected.

Table 3.3

Dependent Variable: GROSS_DOMESTIC_PRODUCT
Method: ARDL
Date: 10/24/22 Time: 16:37
Sample (adjusted): 1994 2021
Included observations: 28 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): GROSS_FIXED_CAPITAL_FORM
FOREIGN_DIRECT_INVESTMENT
ELECTRICITY_NATURAL_GAS_
Fixed regressors: C
Number of models evalulated: 500
Selected Model: ARDL(2, 4, 2, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*

GROSS_DOMESTIC_PRODUCT(-1)	0.529282	0.204994	2.581942	0.0240
GROSS_DOMESTIC_PRODUCT(-2)	0.277519	0.216085	1.284305	0.2233
GROSS_FIXED_CAPITAL_FORM	-0.011766	0.066532	-0.176848	0.8626
GROSS_FIXED_CAPITAL_FORM(-1)	-0.115602	0.086248	-1.340350	0.2050
GROSS_FIXED_CAPITAL_FORM(-2)	0.070105	0.121079	0.579007	0.5733
GROSS_FIXED_CAPITAL_FORM(-3)	0.053518	0.098865	0.541325	0.5982
GROSS_FIXED_CAPITAL_FORM(-4)	0.178138	0.078220	2.277413	0.0419
FOREIGN_DIRECT_INVESTMEN	-0.336537	0.687397	-0.489582	0.6333
FOREIGN_DIRECT_INVESTMEN(-1)	-0.831542	0.622154	-1.336554	0.2062
FOREIGN_DIRECT_INVESTMEN(-2)	0.714875	0.521678	1.370337	0.1957
ELECTRICITY_NATURAL_GAS_	0.246044	2.131642	0.115424	0.9100
ELECTRICITY_NATURAL_GAS_(-1)	5.935338	3.221380	1.842483	0.0902
ELECTRICITY_NATURAL_GAS_(-2)	-6.574801	3.344519	-1.965843	0.0729
ELECTRICITY_NATURAL_GAS_(-3)	6.112765	3.412207	1.791440	0.0985
ELECTRICITY_NATURAL_GAS_(-4)	-7.938360	3.273918	-2.424728	0.0320
C	1.943452	1.798349	1.080687	0.3011

R-squared	0.780429	Mean dependent var	4.411155
Adjusted R-squared	0.505965	S.D. dependent var	3.792082
S.E. of regression	2.665364	Akaike info criterion	5.094117
Sum squared resid	85.24997	Schwarz criterion	5.855377
Log likelihood	-55.31764	Hannan-Quinn criter.	5.326842
NF-statistic	2.843468	Durbin-Watson stat	2.814698
Prob(F-statistic)	0.037475		

*Note: p-values and any subsequent tests do not account for model selection.

The coefficient for gross fixed capital formation is negatively related to gross domestic product, this shows that a unit change in gross fixed capital formation leads to a decrease in gross domestic product by 1 percent. Also, the corresponding probability reveals to be insignificant at 0.86 greater than 5 percent level of significant.

The coefficient for foreign direct investment is negatively related to gross domestic product, this shows that a unit change in gross fixed capital formation leads to a decrease in gross domestic product by 33 percent. Also, the corresponding probability reveals to be insignificant at 0.91 greater than 5 percent level of significant

The coefficient for electricity natural gas rents is positively related to gross domestic product, this shows that a unit change in gross fixed capital formation leads to an increase in gross domestic product by 24 percent. Also, the corresponding probability reveals to be insignificant at 0.24 greater than 5 percent level of significant.

The coefficient of openness is positively related to Gross Domestic Product. This shows that a unit change in trade openness leads to an increase in Gross Domestic Product by 41%. Also, the corresponding probability revealed to be significant at 5% level.

The R squared shows that the model is fit after it conducted the ARDL TEST due to the fact that the value obtained is more than 50 percent at 78 percent while the remaining 22 percent is explained by the variables not included in the model, this shows that the variables are actually fit for the model, and as such the explanatory variables used for the model is fit to explain the model , and again other unexplained variables are in the error term.
The F statistics probability value 0.03 (5%) implies that the model is jointly significant at 5 percent level.

Conclusion

The study examined the interconnectivity between energy resources, investments channels and economic growth in Nigeria between 1980-2021 and also estimation was conducted and the result shows that some of the variables in the study were not significant at 5% level. after observing this result, a transformation was conducted using Augumented Dickey Fuller test statistics to ascertain the stationarity of the data and the study observed variation in order of integration and thereby was motivated to conduct an autoregressive distributed lag model and the study found out there is a short run and long run impact of independent variable (gross fixed capital formation, foreign direct investment, electricity natural gas rent on economic growth (GDP). It can therefore be deduced that all the explanatory variables are jointly significant at 5% percent which simply suggest, that increase in foreign direct investment, accompanied with trade openness and energy resources will stimulate economic growth.
The policy implication of this result is that the government needs to reformulate energy policies in order to be investment friendly. The lack of adequate supply of the bulk of energy used in the country from domestic sources had added significantly to the cost of production in Nigeria, Thus, serving as a deterrent to potential investors. The aftermath of such disincentive is low productivity and low economic activity and growth. The existing growth rate might be transient and unsustainable if adequate attention is not paid to the link between energy policy and overall investment overhead cost arising from the energy product market inadequacy.

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