Relationship between Energy Consumption (Renewable) and Economic Growth in Nigeria

Muhammad Nasir[1], Saira[2], Samra[1], Rabia[1]

ARTICLE DETAILS	ABSTRACT
History **Revised format:** Feb, 2019 **Available Online:** Mar, 2019 **Keywords** Energy Consumption; Renewable; Economic; Significant; Growth; Nigeria; Ordinary Least Square (OLS) Method.	This study aims to explore the relationship between Energy consumption (Renewable) and Economic growth of Nigeria. Using time series data over the period of 1985-2018 and implying Ordinary Least Square (OLS) method finds that there is positive and significant association between Energy Consumption and economic growth moreover the combined effect of EC*DI and EC*FDI are also positive and significant impact on Nigerian economic growth. Some previous studies also support the view that energy consumption promote the economic growth of countries that suffers from low energy consumption. These findings support that greater the energy consumption strengthen the economic growth and less energy consumption weakened the economic growth.

[1]M. Phil Scholar, National College of Business Administration & Economics Multan Campus
[2]International Islamic University, Islamabad, Pakistan

1 Introduction:

Energy is composed of atomic, electrical, mechanical, radiant and thermal sources. While energy can be transferred from one type to another, but cannot be destroyed or demolished, it can be determined by means which can be classified as main and secondary, commercial and non-commercial, conventional and non-conventional, renewable and non-renewable, traditional and non-traditional. Many researchers take interest in relationship between GDP and energy consumption for many decades. But results still remain tendentious and uncertain. When energy is consumed economic development expected to increase because economic development and energy consumption related closely. Level of economic development requires high by more and well-organized use of energy. (Kose et al., 2013) The main objective of this study is to subsidise this debate by introducing a novel approach in order to explore the relationship between economic development and energy consumption. The neoclassical growth theory originated by Solow is our point of novelty in modelling economic growth (1956, 1974)**.** By applying GDP model examine that increasing in energy consumption and pollution in 16 countries which are South Africa, Peru, Morocco, Mexico, Mauritius, Pakistan, Malaysia, Chile, Egypt, Brazil, India, Indonesia, Jordan, China, Thailand and Philippines. These mentioned countries cause of production of 40% CO2 emission by consuming more than 33% energy consumption. (Al-mulali & Che Sab, 2013). Nicholas (2008)

reveals that energy consumption activates Tanzania's economic growth. Industrial production has a positive effect on the use of hydroelectricity, biomass and wind energy and has a negative impact on the consumption of solar energy. Oguz Ocal and Alper Aslan (2013). Shyamal and Rabindra (2004) using Engle–Granger co-integration approach on Indian data and it considers that, between energy use and economic development, there is a bi-directional causality. Nicholas and James (2010) using the model of co-integration and error correction, the long-run balance among real GDP and renewable energy consumption, real gross fixed capital creation and labour force is defined with positive and statistically relevant coefficients. Asafu–Adjaye (2000) bidirectional Granger causality occurs in Thailand and the Philippines between revenue and energy use, whereas unidirectional Granger causality occurs in India and Indonesia from energy to revenue.

Literature Review:

Sehrawat, Giri and Mohapatra (2015) explored the relation between energy use, economic growth in financial development and environmental degradation in India. The analysis indicates that, including the variables, there is a long-run relationship. There is a rise in environmental degradation in India through the growth of the financial climate. Consumption of energy, economic growth and financial progress are the main elements of environmental pollution.

Shiu A and Lam P (2004) analyzed the impact of power consumption on GDP in China by applying ECM model. This study estimated results shows that the relationship between electricity use and GDP is unidirectional.

Al-mulali and Che Sab (2013) analyze the effect of the CO_2 emission and energy consumption on economic development in 16 countries. In investigated countries study indicate long run relationship among mentioned variables. This study also indicated that economic development and energy consumption both have positive relationship and high economic activity achieved by other variables with the result of higher pollution.

Lee (2005) use panel data for the phase of 1975 to 2001 for re-examine association among economic growth and energy consumption in 18 emerging countries. There are many test developed for heterogeneous panel co-integration, panel based error correction models and panel unit root are engaged. By using an adjusted OLS for estimating the run-long relationship. The result shows a long-run co-integration relationship. Regardless of being temporary or permanent result shows that energy consumption injurious for economic growth of developing countries.

Vafaeirad, Mohammadiha and Goodarzy (2015) give detail about association among economic growth and energy consumption can adjust and set policies on energy zone. Purpose of quality of link between mentioned two variables to explain of energy sector policies efficiently by given the close relationship between mentioned variables in preferred countries. By using panel-based error correction models and panel co-integration models wrap the phase 1980 to 2010 this paper calculated cause and effect relationship between energy consumption and GDP in preferred Asian countries. In these preferred countries study's result displays the positive and significant connection among energy consumption and economic growth.

Mehrara (2006) used panel unit-root tests and panel co-integration analysis in some preferred oil exporting 11 countries to analyze the energy consumption effect on economic growth. From economic growth to energy consumption for preferred oil exporting countries result shows a unidirectional cause and effect. In the area of

macroeconomics planning for decision makers results have applicable policy implication. Result high domestic energy consumption, below free market level domestic prices kept by government in main oil exporting countries. Result indicate that for main oil exporting countries by mean of revise energy price policies energy consumption has no adverse influence on economic growth.

Aqeel and Sabihuddin Butt (2001) analyzed the relationship in Pakistan between economic development and consumption of energy and jobs and consumption of energy. This study states that by applying co-integration and Hsiao 's version of Granger causality, the energy consumption carried out by economic development. The results of this study indicate that energy use in Pakistan does not have a negative impact on economic development.

Yoo (2006) explored the connection between the economic growth and the energy consumption in preferred 4 countries Thailand, Singapore, Malaysia and Indonesia of ASEAN countries. The research state causality between GDP and energy consumption is bidirectional in Singapore and Malaysia. Moreover, there is unidirectional causality from economic growth to electricity consumption in Thailand and Indonesia.

Zhang and Cheng (2009) apply a multivariate model to analyze causality among China's energy consumption, GDP and carbon emission. Findings propose a unidirectional causality running in long run from GDP to energy consumption and a unidirectional causality is present from energy consumption to carbon emission. Research shows that no one from carbon emission and energy consumption promote GDP of economy.

Kose, Burmaoglu and Kabak (2013) investigate that there is a well-known relationship between energy consumption and economic growth. For this purpose, investigate relationship among EC and GDP in Turkey. Research show that there is equal weight age of oil and renewable in Turkey because both are main energy sources in Turkey.

 Salahuddin, Gow and Ozturk (2015) analyzed the connection among electricity consumption, GDP, financial development and carbon dioxide emission in GCC countries. Among these econometric terms here is a healthy long run connection. But it is observed that here is no significant connection in short-run. There is positive long run connection between GDP, electricity consumption and CO_2 emission while CO_2 emission and financial development have negative but significant relationship. This show from results that in GCC countries CO_2 emission boost up by electricity consumption and GDP but shrink by financial development. Study displays that there is bidirectional causal connection between GDP and CO_2 while unidirectional relationship from electricity consumption to CO_2. But CO_2 and financial development have no links.

Asafu-Adjaye (2000) investigated causal association between the energy consumption and revenue for Indonesia, Thailand, India and Philippine. Findings shows that there is unidirectional causality present from energy consumption to revenue for Indonesia and India whilst causality exist from energy consumption for Thailand' revenue and Philippine is bidirectional. Prices, energy and income are in Thailand and Philippine equally causal. The results indicate that except Indonesia and India energy and income are not fair with each other.

 Hussain, Javaid and Drake (2012) analyzed the affiliation among energy consumption, economic growth and environmental pollution in the case of Pakistan. There is bi-directional causality between CO_2 emission and energy consumption and there is long run association among consumption, GDP and environmental pollution shows by results.

Asma and Leila (2014) examined relationship among energy consumption, GDP and sustainable development. The research focuses on a panel of 38 Mediterranean Unions and data is in between 1980 and 2010.using production model and econometric techniques (ECM) Error correction model. Find out the bidirectional correlation between the consumption of energy and economic development. The consequence of our findings is that energy policies may take into account not only the causal path between economic growth and energy consumption, and also if policy action must be established either by temporary or permanent additional authorities in order to increase renewable energy consumption by 20 percent in 2020.

Shyamal and Rabindra (2004) showed the various directions of the casual relationship between the report on energy use and GDP carried out in India. We define bi-directional causality present between energy use & economic growth by applying the Engle Granger cointegration method. Additional Johanson multivariate co-integration methodology for various variable sets. The long-term casual relationship varies from GDP to energy consumption then from energy consumption to GDP for short periods.

Xi et al (2020) studied the first goal is to decouple the position of 89 countries between energy use and economic development in the agriculture sector. Data was gathered from 2000 to 2016. Only 18 countries have achieved effective decoupling, most of them nations at the UMI and HI stage.

3. Data and Methodology:

In this research (GDP) Gross Domestic Product used as depended variable. There are four explanatory variables (EC) energy consumption, (ELF) Employed Labor Force, (FDI) Foreign Direct Investment (DI) Domestic investment. (EC) Energy consumption is consist of fossil fuel comprises coal, oil, petroleum, and natural gas products. (ELF) employed labor force involves individuals aged 15 years and older who are involved in the provision of labour for the manufacture of products. It affects people who are currently working, unpaid employees, family staff and students are frequently excluded and armed forces personnel are not counted in some countries. (DI) comprises land improvements, the procurement of plants, machinery and equipment and the construction of railway routes, including schools, offices , hospitals including private residential, commercial or industrial buildings. Annual time series date over the period of 1985 to 2018 sourced World Bank is used to estimate the model. We choose this period because of availability of data on (EC) in Nigeria. Following model is adopted to explore the association between (EC) Energy consumption and GDP in Nigeria.

$$\log(Y_t) = \beta_0 + \beta_1 \log EC_t + \beta_2 \log FDI_t + \beta_3 \log DI_t + \beta_4 \log ELF_t + \mu_t$$

In this model Y_t is (DGP) Gross domestic product in Nigeria. EC_t, FDI_t, DI_t and ELF_t are explained above. Goal of the study to analyze the causal connection between (EC) and economic growth in Nigeria. For this purpose, we use econometric test (OLS) to see the relationship between variables. (OLS) ordinary least square is a process in which the unknown parameters in the regression model are calculated. It takes the parameters of linear function. When the repressors are exogenous, the OLS estimator is consistent and, when the errors are homoscedastic and serially uncorrelated, optimal in the class of linear unbiased estimators.

4. Results & Discussions

Table 1: Descriptive Statistics Results

	GDP	EC	DI	FDI	LF
Mean	192256.2	727.9281	40377.43	2978.187	41.04784
Median	84708.09	722.1081	29939.66	1879.16	39.42136
Maximum	568498.9	798.6302	85749.73	8841.113	60.69849
Minimum	27752.2	671.9069	12343.17	193.2149	29.28695
Std. Dev.	174091.4	38.34996	21763.18	2582.421	9.79352
Skewness	0.75173	0.155735	0.489091	0.945776	0.472705
Kurtosis	2.035162	1.65461	1.760577	2.645814	1.974438

The mean, median, maximum, minimum and standard deviation values of all selected variables are shown in Descriptive Statistics Table 1. The skewness value of all the variables are positive it means that GDP, EC, DI, FDI and LF positive skewed. The standard value of kurtosis is 3 and values of all the variables GDP, EC, DI, FDI & LF are less than 3 its means all the variables are Platykurtic.

Table 2: Variance Inflation Factor (VIF)

Variable	Centered VIF
EC	6.00412
DI	3.694639
FDI	2.923098
LF	7.352669

Table 2 shows that there is no multicollinearity because the value of centered variance inflation factor is less than 10 of all variables.

Table 3: Serial Correlation LM Test

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.374024	**Prob. F(2,28)**	0.6913
Obs*R-squared	0.884594	**Prob. Chi-Square(2)**	0.6426

Table 3 shows that there is no auto correlation in the data because probability value of data is greater than 5 percent and insignificant.

Table 4: Heteroskedasticity Test

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.920626	**Prob. F(4,29)**	0.4653
Obs*R-squared	3.830953	**Prob. Chi-Square(4)**	0.4294
Scaled explained SS	2.992508	**Prob. Chi-Square(4)**	0.5591

Table 4 shows that there is no heteroskedasticity in the data because the value of probability in insignificant and greater than 5 percent.

Regression Results

To checked the independent variable impact on dependent variable by using ordinary least square (OLS) method.

Table 5: Ordinary Least Square (OLS) Method Results

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EC	-0.692171	0.148826	-4.650866	0.0001
DI	0.784845	0.121801	6.443681	0.0000
FDI	0.104143	0.025773	4.040744	0.0004
LF	1.131284	0.281819	4.014225	0.0004
EC*DI	0.519587	0.127537	4.074013	0.0003
EC*FDI	0.773357	0.161863	4.777837	0.0000
R-squared	0.99113	Adjusted R-squared		0.989863
Durbin-Watson stat			1.907628	

The results of OLS shows that coefficient value of Energy consumption (EC) is negative but significant impact on economic growth, if 1 percent change in energy consumption it will (-0.692171) percent change in development of the economy. If 1 percent change in domestic investment, it will (0.784845) percent change in GDP. Domestic investment has positive and significant impact on GDP. Foreign direct investment has positive impact and significant impact on economic growth if 1 percent change in foreign direct investment it will (0.104143) percent change GDP. Labor force also positive and significant impact on GDP if 1 percent variation in labor force means (1.131284) percent change in GDP in Nigeria. We also see the combine effect of energy consumption & domestic investment and energy consumption & foreign direct investment shows that there is positive and significant impact on GDP means 1 percent change in EC*DI it will (0.519587) percent variation in GDP and 1 percent change in EC*FDI means (0.773357) change in economic growth of Nigeria.

5 Conclusion

The main goal of the study is to explore the relationship between Energy consumption (Renewable) and Economic growth of Nigeria applying time series data of 1985-2018 and implying Ordinary Least Square (OLS) method finds that there is negative but significant impact of Energy Consumption on GDP, Domestic investment, foreign direct investment and labor force have positive & significant impact on GDP. Moreover, the combined effect of EC*DI and EC*FDI are also positive and significant impact on Economic growth of Nigeria. Some prior studies have also endorsed the view that energy consumption is supporting the economic growth of low-energy countries. These findings support that greater the energy consumption strengthen the economic growth and less energy consumption weakened the economic growth.

REFERENCES

Al-mulali, U., & Sab, C. N. C. (2013). Energy consumption, pollution and economic development in 16 emerging countries. *Journal of Economic Studies*.

Aqeel, A., & Butt, M. S. (2001). The relationship between energy consumption and economic growth in Pakistan. *Asia-Pacific Development Journal*, *8*(2), 101-110.

Lee, C. C., & Chang, C. P. (2005). Structural breaks, energy consumption, and economic growth revisited: evidence from Taiwan. *Energy Economics*, *27*(6), 857-872.

Mehrara, M. (2007). Energy consumption and economic growth: the case of oil exporting countries. *Energy policy*, *35*(5), 2939-2945.

Sehrawat, M., Giri, A. K., & Mohapatra, G. (2015). The impact of financial development, economic growth and energy consumption on environmental degradation. *Management of Environmental Quality: An International Journal*.

Shiu, A., & Lam, P. L. (2004). Electricity consumption and economic growth in China. *Energy policy*, *32*(1), 47-54.

Yoo, S. H. (2006). The causal relationship between electricity consumption and economic growth in the ASEAN countries. *Energy policy*, *34*(18), 3573-3582.