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Power Generation Capacity and Economic Growth in Nigeria: A Causality Approach.

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Abstract
This study examined the impact of power generation capacity on economic growth in Nigeria from 1980 - 2015. In the model specified, Real Gross Domestic Product is a function of Power generation capacity in Kilowatt, Gross capital formation and Unemployment. With the aid of econometric techniques employed (co integration test, vector error correction mechanism and granger causality); the following results were found; a stable long run relationship exist between the dependent and explanatory variables in the model as supported by the presence of two co integrating equations. This means that the result of this finding can be relied upon in taking long run policy decision. In the VECM equation result presented , the t-statistics for PGCKWH is 0.003106 while its P-value is [0.2659]. The t-statistics for GCF is 1.109381 while its P-value is [0.5843]. The VECM result also showed a t – statistics of - 4652.801 with p value of 0.0297, indicating an insignificant relationship with RGDP. This study concludes that there is no causality between power generation capacity and economic growth in Nigeria within the study period. The study therefore, makes the following recommendations;
For the growth of the economy and improvement in power generation capacity, government must ensure transparency in the overall implementation of power sector policy and its attendant reform agenda. There is need to ensure full implementation of power sector budget through oversight function by the legislative arm of government to check the endemic corruption associated with the sector.
Keywords: Power generation capacity, Economic growth, Causality, Nigeria

1. Introduction

Power generation is one of the vital components of power delivery process to consumers. The other processes are: power transmission, power distribution, and power regulation. Power generation must be in tandem with population growth and productive capacity to drive meaningful economic growth.. Nigeria as a developing country with urgent need for increase in power generation has initiated many power generation policies in form of power sector development for the past decades. Power sector development was one of the Seven Point Agenda of President Yar'Dua in 2007. Also, the Presidential Task Force on Power (PTFP) was established by the President Goodluck Jonathan administration, in June 2010 to drive the implementation of the reform of Nigeria's power sector. The task force was meant to bring together all the agencies that have a role to play in removing legal and regulatory obstacles to private sector investment in the power industry. Its mandate was also to monitor the planning and execution of various short-term projects in generation, transmission, distribution and fuel-to-power that are critical to meeting the stated service delivery targets of the power reform roadmap (Transformation Agenda, 2011). The terms of reference of the Presidential Task Force on Power (PTFP) included close collaboration with various ministries and agencies that have specific contributions to the reform process, including the Federal Ministry of Power, the Federal Ministry of Finance, the Bureau of Public Enterprises (BPE), the Nigerian Electricity Regulatory Agency (NERC), the Nigerian National Petroleum Corporation (NNPC), the Bureau of Public Procurement, National Gas Company Limited (NGC) and the Power Holding Company of Nigeria (PHCN).

Nigerian government has also spent huge sums of money to increase power generation since returning to democratic governance in 1999. According to Daily Trust editorial of 30th December, 2014, electricity sector gulped nearly N4 trillion ($26 billion) since the beginning of the power reforms in 1999. Reiterating the importance of power sector, former President Goodluck Jonathan, in his inauguration address in 2011, introduced Transformation Agenda (TA) policy of his regime in which power sector was one of the key component. According to Dr. Shamsuddeen Usman, the former Economic Planning Minister under Jonathan Administration, Transformation Agenda (TA) was a blueprint of the key policies, programmes and projects to be implemented by Federal Government from 2011 to 2015. Usman stated further that the Agenda aimed at consolidating the achievements of previous administrations with strong emphasis on infrastructural development. The power sector roadmap was integral part of Infrastructural Masterplan (IMP) launched by former President Goodluck Jonathan in 2013, which preceded the Transformation Agenda's Mid-term Report. According to policy statement of the report, Nigeria was to invest heavily in transport, road construction, power, Information Communication Technology (ICT) and water resources in which the power sector had the largest of the expected investments. The report outlined the proposed investment in the power sector which covers investment in four major areas of power generation, transmission, distribution and alternative energy. The government's strategy, according to the report was to unbundle the sector through creating a deregulated and competitive electricity market.

The unbundling of power, has been a continuation of policy framework of subsequent governments in Nigeria towards power sector reforms. Unbundling of the power sector was thought as a strategic policy that somewhat would drive Nigeria's aspiration to become a major industrial developed nation of the world. The Transformation Agenda (TA) report posited that the reform plan of former President Jonathan was to resuscitate and deregulate the sector by investing $3.5 billion annually with the hope of moving the generation capacity from 4,000 MW in 2011 to 20,000 by the year 2020. The former Minister of Power, Prof. Chinedu Nebo said that Nigeria was capable of generating 16,000 megawatts before the end of 2014, adding that the service companies – generation, transmission and distribution networks – were to ensure that all the plants were running very well and that the ministry was partnering with investors to ensure that rural areas not connected to national grid were connected even to renewable sources of electricity. Reiterating the investment opportunity in Nigeria, the former Minister viewed Nigeria as a very strategic country to invest in Power Sector. He asserted that by investing in Nigeria's power sector, investors can capitalize on growth opportunities in the Nigerian electricity market where demand far outstrips current supply and the potential for strong economic growth is high. According to the former Minister, since Nigeria is the largest market in Economic Community of West African States (ECOWAS) region, investors can use Nigeria to establish a strong presence in West Africa and also as a platform for acquiring further assets in the region. More importantly, in his view, investors can benefit from a Multi Year Tariff Order (MYTO) which brings certainty to the Tariffs. In power regulation, Multi Year Tariff Order (MYTO) is designed to be a cost-reflective tariff that accounts for the operating cost and capital recovery, incentivizing efficient operations, based on best new entrant capabilities and technology.

Unfortunately, by the end of 2014, government policy target on power generation capability was not met despite the huge amount already invested in the sector. It is still questionable the effectiveness and efficiency of the policy and investments in increasing the power generation in Nigeria. Referring on the success of power reform in Nigeria, Dr. Sam Amadi, the former Chairman of National Electricity Regulatory Commission, stated in 2014 that for 13 years Nigeria has embarked on power sector reforms. According to him, it is arguable whether the reform has been great success or partial success. Amadi (2014) argued that the basic assumption behind the power sector reform in Nigeria was government ownership of electricity assets as a major cause of the collapse of the industry in the late 1980s. He agreed with this assumption on the need to infuse private capital into power sector in Nigeria and maintained that this tied neatly into the structure of the dominant economic narrative in the 21st Century. Amadi made passionate appeal for unbundling, privatization of the sector and enlisted seven critical disciplines for successful power sector reform in Nigeria which are the discipline of maintaining the independence of the regulator, discipline of right pricing, discipline of transparent procurement, the discipline of smart project management, the discipline of accountable public sector investment, the discipline of consistent and intelligent policymaking, and the discipline of public participation. Many experts have criticized the power policy reforms and investment effectiveness given the increasing power deficiency in Nigeria. In essence, power deficiency has been identified as major obstacle to Nigeria's economic growth.

Statement of the Research Problem

The real situation of power generation deficiency in Nigeria is unimaginable even as the Federal Government has initiated many policies, projects and programs to tackle energy problems in Nigeria for many decades. However, the problems of power generation deficiency persisted given that power generation capability is not meeting up to Nigeria's population growth rate and national economic aspiration as power distribution, transmission and regulation are still issues to the nation.

Nigeria is producing and consuming 4,000 mw of electricity by a population of 160 million people, which is only 2.5 per cent of what South Africa with lesser population is producing and consuming. Dr Mu'azu Babangida Aliyu, the former Governor of Niger State, at the signing of a memorandum of understanding with a German Technical Partner (GIZ) said that the country requires 35,000 megawatts of electricity to attain stable power supply in the country. According to Aliyu, as of 2014, the power supply in the country was in the neighborhood of 5,000 megawatts, which was grossly inadequate. He reiterated further that as a result of the shortfall in the supply of electricity to all parts of the country, Niger State inclusive, industrial development and other small scale businesses have not achieved the required growth (Aliyu, 2014). Bureau of Public Enterprises website enlisted some challenges facing power sector reform in Nigeria, which includes: limited access to infrastructure, low connection rates, inadequate power generation capacity, inefficient usage of capacity, lack of enough capital investment, ineffective regulation, high technical losses and vandalism. Nigeria's economic growth goal would remain a mirage unless the country explores ways to increase power generation capacity which meets up with its population and market size as the largest economy in Africa. For instance, from available data, the country has not developed a comprehensive policy in renewable energy technologies which experts agreed is best suited for the electrification of remote areas and provide ample opportunities for communities and private sector involvement and subsequently foster local economic development. More so, Nigeria has not harnessed the full potentials of energy mix and new energy technologies such as coal and natural gas-fired electricity generation. International Energy Agency (IEA,2008) projected that coal will dominate the power sector, with nearly 50 percent of the total power generation by 2050. According to IEA (2008), gas will come as second source with 23 percent projection. Other sources identified by IEA are nuclear and renewable, such as wind, hydropower and solar which will take bulk of decreases from the fossil fuel share of power generation.

Depicting power deficiency in Nigeria, it is estimated that about 70 % of rural communities do not have access to electricity in Nigeria, contributing to low rate of local economic development and increase to rural - urban migration in Nigeria (Abba, 2014). Data from NERC website depicted that an estimated 90 million Nigerians were without access to the national grid. In essence, power generation deficiency somewhat hampers industrial development, the growth of small and micro entrepreneurs, energy penetration to rural communities and to national economic growth. Even though Nigeria has potentials in energy development but the current situation of low power generation capacity depicts that the country is not well-prepared to benefit from the projected increases in power generation from coal, gas-powered and renewable sources. There have been many policy statements regarding Nigeria's willingness to increase power generation but the available generation capacity is not meeting up to the increase in population growth. It is also retarding manufacturing capacity and the growth rate of gross domestic product (GDP), resulting in increase in unemployment.

Interestingly, since 1999 when Nigeria returned to democratic government, the private investment in power sector has been massive but that did not contribute much in power generation capability which continues to dwindle year by year. According to data from Central Bank of Nigeria Statistical Bulletin (2013), power generation was around 1,800 mw in 1999 and has improved to about 4,500 mw in 2014, meaning only 2700 mw is added to the system despite the about 4 trillion Naira investment. Also, CBN (2013) depicted that government expenditure and private capital investment in power generation has skyrocketed since mid-1980s while power generation in terms of Megawatt per hour has not been measuring up to the expenditure and investments.

Indexmundi (2011) a World Bank database, depicted that the value of electricity production (kWh) in Nigeria was 27,034,000,000 as of 2011, depicting that for the past 28 years this indicator reached a maximum value of 27,034,000,000 in 2011 and a minimum value of 11,265,000,000 in 1986. World Bank database measures electricity production based on the terminals of all alternator sets in a station. Such measurement, in addition to hydropower, coal, oil, gas, and nuclear power generation, covers generation by geothermal, solar, wind, and tide and wave energy, as well as that from combustible renewable and waste. Production includes the output of electricity plants that are designed to produce electricity only as well as that of combined heat and power plants. On economic growth, measured on Real Gross Domestic Product (RGDP), the value for real GDP in Nigeria was 888,893.00 as of 2012. Indexmundi (2011) data showed that, over the past 28 years this indicator reached a maximum value of 888,893.00 in 2012 and a minimum value of 205,971.44 in 1986. The time-series data depicts that real Gross Domestic Product (GDP) and power generation capacity have been increasing since 1980 but the degree of increment has not been properly analyzed, hence this study. In 2014 after Gross Domestic Product (GDP) rebasing, Nigerian economy became the largest in Africa notwithstanding the slow pace in growth of power generation capacity. The trend of recorded value of electricity production (kwh) in Nigeria is shown in the table below.

Table 1: Electricity Production (Kwh) in Nigeria

S/N	Energy Production	1990	2000	Rate of Change %
01	Energy production (kt of oil equivalent) in Nigeria	150452.0	201717.4	34
02	Electricity production from coal sources (kWh) in Nigeria	13000000.0	0.0	0.0
03	Electricity production from coal sources (% of total) in Nigeria	**0.1**	**0.0**	**1**
04	Electricity production from hydroelectric sources (kWh) in Nigeria	4387000000.0	5628000000.0	**28**
05	Electricity production from hydroelectric sources (% of total) in Nigeria	**32.6**	**38.2**	**17**
06	Electric power transmission and distribution losses (kWh) in Nigeria	5172000000.0	5618000000.0	**8**
07	Electric power transmission and distribution losses (% of output) in Nigeria	**38.4**	**38.2**	**0.005**
08	Electricity production from natural gas sources (kWh) in Nigeria	7223000000.0	8879000000.0	**23**
09	Electricity production from natural gas sources (% of total) in Nigeria	**53.7**	**60.3**	**12**
10	Electricity production from nuclear sources (kWh) in Nigeria	**0.0**	**0.0**	**0.0**

Source: Tradingeconomics.com

Also, CBN data depicted that private capital investment in power generation increased from 175 billion Naira in 1999 to 549 billion Naira in 2013. Given the trends of key variables, this study will investigate power generation and real Gross Domestic Product (RGDP), used as proxy for economic growth in Nigeria, employing gross capital formation and unemployment as control variables within the period under review .

2. THEORETICAL LITERATURE REVIEW

The Solow Growth Theory

Solow growth theory developed by R.M. Solow in 1957 estimated the contributions of technical change to overall growth rate of US economy. The basic assumption of Solow theory is the law of diminishing returns to labor and capital and constant returns to scale as well as competitive market equilibrium and constant savings. An important assumption of the theory is that a long run per capita growth can be explained by technology progress which comes from outside the model. Solow treated technical changes as disembodied where capital is assumed as homogenous and technical changes as exogenous. Solow theory is an exogenous theory because it opined that technology is exogenous factor which determines growth. In essence, Solow growth theory is very strategic approach to study power generation with its technical progress ideology. It can be assumed that power generation capacity can drive economic growth with this Solow's theory explanation that long run per capita growth is a function of technological progress.

Solow theory has been criticized for his method of measuring the residual and for his estimates which undermine the role of investment in contrast to technical change in the growth process. Critics argued that the result of this approach produces a wave of investment pessimism. His assumptions of perfect competition, returns to scale and complete homogeneity of the capital stock are criticized for been unrealistic.

The Olduvai Theory of Energy Production and Population

The Olduvai theory is defined by the ratio of world energy production and population. The theory stated that life expectancy of industrial civilization is less than or equal to 100 years: 1930-2030. The theory further explained the 1979 peak and the subsequent decline. Moreover, it asserted that energy production per capita will fall to its 1930 value by 2030, thus giving industrial civilization a lifetime of less than or equal to 100 years. This analysis predicted that the collapse of energy production will be strongly correlated with an 'epidemic' of permanent blackouts of high-voltage electric power networks — worldwide. According to Duncan (2001), the Olduvai theory, of course, may be proved wrong. But at the present time, it cannot be rejected by the historic world energy production and population data.

Endogenous Growth Theory

Main ideas on endogenous theory focused on active and knowledge creation. According to Romar (1982), endogenous theorists created models which depicted how economic growth is based on research and development (R&D) and the production of new technologies of crucial importance. Most of the models assumed that inventors and innovators have negligible success at appropriating the benefits of their efforts. Romar stated further that other models link the adoption of technologies to the role of institutions, financial markets, and policies.

Important implication of endogenous theories is related to the role of policy measures like subsidies to R&D and investments in education as keys to long term economic growth. On technology in power sector, the theory assumed that each technology has its own costs and benefits. More so, there is no technology which can be seen as ideal answer to power crisis. For instance, Green Gas Emissions(GHG) technologies cannot pay for the damage to climate change. Some major assumption of the theory are that; increasing returns to scale because of positive externalities; human capital and the production of new technologies are essential for long run economic growth; private investment in R&D is the most important source technology progress; and finally that knowledge or technical advances are non-rival good.

David Stern Model

Stern (2004), is a neoclassical model on the linkage between energy and growth. Stern asserted that there has been extensive debate concerning the trend in energy efficiency in developed economies, especially since the two oil price shocks of the 1970s. He argued that in the United States of America (U.SA) economy, energy consumption hardly changed in the period 1973 to 1991, despite a significant increase in gross domestic product (GDP). According to Stern, these facts were indisputable and the break in the trend have been the subject of argument. He referred to Neoclassical perspective of the production function to examine the factors that could reduce or strengthen the linkage between energy use and economic activity over time and depicted that there has been a decoupling of economic output and resources, which implies that the limits to growth are no longer as restricting as in the past. A general production function of Stern can be represented as follows:

$$(Q_i,\ldots, Q_m) = f(A, X_i, \ldots, X_n, E_k, \ldots, E_p) \qquad (2.1)$$

where the Qi are various outputs (such as manufactured goods and services), the Xi are various inputs (such as capital, labor, etc.), the Ek are different energy inputs (such as coal, oil, etc.), and A is the state of technology as defined by the total factor productivity indicator. In simple term, Stern model can be translated to become the output (GDP) if a function of capital, labour, holding energy inputs and technological change constant).

The relationship between energy and an aggregate of output such as gross domestic product can then be affected by substitution between energy and other inputs, technological change (a change in A), shifts in the composition of the energy input, and shifts in the composition of output. Also, shifts in the mix of the other inputs— for example, to a more capital-intensive economy from a more labor-intensive economy—can affect the relationship between energy and output. It is also possible for the input variables to affect total factor productivity, though in models that invoke exogenous technological change, this is assumed not to occur (Stern, 2004).

Empirical Literature Review

Empirical review analyzes how previous results and methodologies on power generation and economic growth were employed and how they fit into this research. This research work depicts the scale of historical debate on the topic.

Bayar and Ozel (2014) in their study, "economic growth and electricity consumption in emerging economies," investigated the relationship between economic growth and electricity consumption in emerging economies during the period 1970-2011 by using Pedroni, Kao and Johansen co-integration tests and Granger causality tests. Their study found that electricity consumption had a positive impact on the economic growth and there was bidirectional causality between economic growth and electricity consumption.

Stern and Cleveland (2004) study analyzed the impact of energy and economic production and growth. They posited that physical theory shows that energy is necessary for economic production and growth but the mainstream theory of economic growth, except for specialized resource economics models, pays no attention to the role of energy. Their study reviewed the relevant biophysical theory, mainstream and resource economics models of growth, the critiques of mainstream models, and the various mechanisms that can weaken the links between energy and growth. Also they reviewed the empirical literature that found that energy used per unit of economic output has declined, but that this is to a large extent due to a shift from poorer quality fuels such as coal to the use of higher quality fuels, and especially electricity. Furthermore, their time series analysis showed that energy and GDP co integrated and energy use Granger caused GDP when additional variables such as energy prices or other production inputs are included. As a result, they argued that prospects for further large reductions in energy intensity seem limited.

Altintas and Kum (2013) employed annual data for Turkey from 1970 to 2010 to examine the short and long-run causal relationship between economic growth, electricity generation, exports and prices in a multivariate model. According to the bounds test results by their study, when electricity generation and economic growth are the dependent variable there are two co integrating relationships. The results, also depicted that long-run equilibrium relationship and long-term causality are found between economic growth, electricity generation, export and price. The study argued that, in the short-run, there are bi-directional causalities between economic growth- electricity generation, economic growth-export and electricity generation-export with feedback effect.

Sarker and Alam (2010) study employed Granger-causality test on the nexus between economic growth and electricity generation using Bangladesh data covering the period 1973-2006. The test results indicated that only unidirectional causal relationship exists between electricity generation and economic growth. The short run causal relationship was found from electricity generation to economic growth. Policies and strategies for increasing electricity generation can therefore be implemented for speeding up of economic growth in the country

Onwuka (2006) in his paper, "the impact of Nigeria's growing population on the country's development," posited that with a population that already exceeds 130 million people and growing at roughly 3 per cent annually, a considerable proportion of the nation's resources are consumed instead of accumulated for development purposes. In effect, his study empirically tests the association between population growth and economic development in Nigeria between 1980 and 2003 and found that growth in population outweighs that of output and this has hindered the capacity of successive governments to efficiently provide social services to the people, thereby negatively affecting development. The study recommended that government should curb population growth through appropriate policies that would integrate the country's population programmers into the mainstream development efforts. That way, according to the study, higher per capita consumption of social services by the citizens would be facilitated and which ultimately would boost their access to the benefits of development.

Babatunde, Afees, and Olasunkanni (2012) investigated the impact of infrastructure on economic growth in Nigeria. A multivariate model of simultaneous equations was deployed. The paper also utilized three-stage least squares technique to capture the transmission channels through which infrastructure promotes growth. The research covered 40 years (1970 to 2010). The finding showed that infrastructural investment had a significant impact on output of the economy directly through its industrial output and indirectly through the output of other sectors such as manufacturing, oil and other services. The agricultural sector was however not affected by infrastructure. The results also showed a bi-directional causal relationship between infrastructure and economic growth. The paper recommended increased investment in infrastructure. Also, the financing options for closing Nigeria's infrastructure gaps should focus on broadening the sources of finance and a better allocation of public resources. Moreso, government should intensify the utilization of the public-private-partnership (PPP) framework.

Maku (2014) examined the link between government spending and economic growth in Nigeria over the last three decades (1977-2006) using time series data to analyze the Ram (1986) model. Three variants of Ram (1986) model were developed-regressing real GDP on private investment, human capital investment, government investment and consumption spending at absolute levels, regressing it as a share of real output and regressing the growth rate real output to the explanatory variable as share of real GDP, in other to capture the precise link between public investment spending and economic growth in Nigeria based on different levels. Empirical result showed that private and public investments have insignificant effect on economic growth during the period under review. The paper tested for presence of stationarity by using Augmented Dickey Fuller (ADF) unit root test. The result revealed that all variables incorporated in the model were non-stationary at their levels. In an attempt to establish long-run relationship between public expenditure and economic growth, the result revealed that the variables are cointegrated at 5% and 10% critical level. With the use of error correction model to detect short run behavior of the variables, the result showed that for any distortion in the short-run, the error term restored the relationship back to its original equilibrium by a unit. The paper's main policy recommendation was that government spending should be channeled in such a way as to influence economic growth significantly and positively in Nigeria especially on education and infrastructural facilities.

Nedozi, Obasanmi and Ighata (2014) evaluated infrastructural development and economic growth of Nigeria, using simultaneous equation analysis. In the study, two models were specified, and after applying the substitution method (reduce form equation), the two models collapsed to one which enabled researchers to use OLS to run the regression. From the result, it was clear that infrastructure was an integral part of Nigeria economic growth. They argued that undermining infrastructure is undermining the growth and development of Nigerian economy. The study showed that infrastructure was an intermediate good and service for the real sector and a finished good and service for consumers. The study recommended that if the real sector which is the engine of growth is to propel Nigerian growth and development, infrastructure should be given qualitative and adequate attention.

Edame and Fontaz (2014) investigated the impact of Government expenditure on infrastructure in Nigeria, using the cointegration and error correction specifications. They opined that development economists have long acknowledged the centrality of public expenditure, particularly on infrastructure as an important instrument in the development process. The result of the error correction mechanism (ECM) of their study indicated a feedback of about 99. 38 percent of previous year's disequilibrium from long-run elasticity of rate of urbanization, openness, government revenue, external reserves, population density and type of government. The results of the Chow test revealed that public expenditure on infrastructure were stable and did not change over time as evidenced by F* value of 1.8214 against F-critical value of 2.580 at the 5% level .

Ogundipe and Apata (2013) examined the relationship between electricity consumption and economic growth in Nigeria using the Johansen and Juselius Co-integration technique based on the Cobb-Douglas growth model covering the period 1980-2008. The study adopted and conducted the Vector Error Correction Modeling and the Pairwise Granger Causality test in order to empirically ascertain the error correction adjustment and direction of causality between electricity consumption and economic growth. The study found the existence of a unique co-integrating relationship among the variables in the model with the indicator of electricity consumption impacting significantly on growth. Also, the study showed an evidence of bi-directional causal relationship between electricity consumption and economic growth. The study recommended the need to strengthen the effectiveness of energy generating agencies by ensuring periodic replacement of worn-out equipment in order to drastically curtail transmission power losses.

Babatunde and Shuaibu (2007) in their paper, "The Demand for Residential Electricity in Nigeria: A Bound Testing Approach examined the residential demand for electricity in Nigeria as a function of real gross domestic product per capita, and the price of electricity, the price of substitute and population between 1970 and 2006. The study used the bounds testing approach to cointegration within an autoregressive distributed framework. They stated that bounds testing approaches is the analysis of level relationships which they found that, in the long run, income, the price of substitute and population emerges as the main determinant of electricity demand in Nigeria, while electricity price is insignificant, the relationship among variables is more stable. In essence, the result of their study showed that population variable is significant in the long and short run, meaning that the higher the population , the higher the demand for electricity in Nigeria.

Ubi and Effiom (2013) explored the relationship between electricity supply and economic development in Nigeria using annual time series data. The study emphasized the need for the correct specification of the model on the basis of which estimation would be valid. They carried out stationarity, cointegration tests and estimation of the model using ordinary least squares in the context of error correction mechanism (ECM). The results showed that per capita gross domestic product (GDP), lagged electricity supply, technology and capital are the significant variables that influence economic development in Nigeria. One strong outcome of the study was that despite the poor state of electricity supply, it influenced economic development in Nigerian but its impact was relatively very low. They recommended that efforts should be geared towards the improvement of technology and that the various power projects should be completed with state of the art technology as this will ultimately reduce power loss and boost electricity supply vis-à-vis

Nwankwo and Njogo (2013) investigated the links between a sustained economic growth and electricity in an economy. Their study employed a multiple regression model to examine the effect of electricity supply on economic development and likewise the effect of electricity supply on industrial development. The result of the regression showed that, electricity (ELEC), gross fixed capital formation (GFCF), industrial production (INDU) variables and population have positive signs. That is, they are positively related to RGDP per capita. On industrial production expenditure model, the result indicated that electricity generation expenditure, gross fixed capital formation and population variables are positively related to GDP per capita. Their study recommended that issues relating to electricity production and industrial development should be given priorities particularly in the budget scheme and because of this, substantial amount should be allocated to the electricity sector to be able to fix the state of electricity permanently in a good shape.

Abdulwahed (2014) conducted a study to determine the factors affecting Capacity Utilization (CU) in Nigeria. The study depended on SWOT analysis for the Nigerian manufacturing sector and then followed by applying the Vector Auto Regressive Model (VAR) to determine the most influential factors affecting Nigerian manufacturing sector's ability to benefit from Local Content Development Bill. The results showed that the most influential factors are Electricity Generation (ELEC), Capital Goods Imports (IM) and Interest Rates (IR). The study recommended that Nigerian government should focus on modernizing the efficiency of existing power stations and establishing new power stations, It recommended also that there is need to decrease the applied tariffs and apply drawback regimes on capital goods imports to support the Nigerian manufacturing sector to modernize production equipment so as to be able to produce competitive goods complying with the high technology specifications of oil and gas sector. In addition, the sum of one percent of every contract awarded to any operator in the oil and gas sector is inadequate for the Nigerian content development fund, therefore, the government must support the fund with annual sufficient budget.

Samuel and Lionel (2013) in their study explored the relationship between electricity supply and economic development in Nigeria using annual time series data. The study emphasized the need for the correct specification of the model on the basis of which estimation would be valid. They carried out stationarity, cointegration tests and estimation of the model using ordinary least squares in the context of error correction mechanism (ECM). The results of their study showed that per capita gross domestic product (GDP), lagged electricity supply, technology and capital are the significant variables that influence economic development in Nigeria. A visible outcome of their study depicted that despite the poor state of electricity supply, it influences economic development in Nigerian but its impact is relatively very low. They recommended that efforts should be geared towards the improvement of technology and that the various power projects should be completed with state of the art technology as this will ultimately reduce power loss and boost electricity supply vis-à-vis.

Odularu and Okonkwo (2009) investigated the relationship between energy consumption and the Nigerian economy from the period of 1970 to 2005. They used energy sources, such as coal, electricity and crude oil to test for this relationship. Their study applied co-integration technique, and the results derived inferred that there exists a positive relationship between current period energy consumption and economic growth. According to their study, with the exception of coal which was positive, a negative relationship was noted for lagged values of energy consumption and economic growth. The implication of the study is that increased energy consumption is a strong determinant of economic growth having an implicit effect in lagged periods and both an implicit and explicit effect on the present period in Nigeria. They recommended that this sector should be given more relevance even by exploiting the opportunities laden in the sector to increase economic

Summary of the Review of Related Empirical Literature

Author/ Year	Location or country	Topic	Methodology	Result Finding	Limitations/Gap in literature
Bayar& Ozel (2014)	Emerging Economies	The Relationship between Economic Growth and Electricity Consumption	Petroni, Kao & Johnasen Co-integration and Granger Causality Tests	Electricity Consumption had a positive impact on Economic Growth. There was bidirectional causality	The study was based on emerging economics. The present studies is on Nigeria economy
Stern & Cleveland (2004)	Global Economy	Energy Production and Gross Domestic Product	Co-integration and causality Tests	Energy Production and GDP co-integrated. Energy Use Granger caused GDP	The study was conducted in 2004. The present study's timeframe ended 2015.
Altlinas & Kum (2013)	Turkey	Short and Long run Causal Relationship between Economic Growth, Electricity Generation, Export and Prices in Multivariate Model	Bound Testing	Depicted a long run equilibrium relationship and long term causality between economic growth, electricity generation, export and price. In the short run depicted bidirectional causality between the variables.	Over-stressed topic. The present study focuses on Power generation Capacity and Economic growth in Nigeria
Sarker & Alam (2010)	Bangladesh	Nexus between Economic Growth and Electricity generation	Granger causality Test	The result indicated only unidirectional relationship	The application of only Granger causality Test without other tests was not enough. The present study applies Stationarity, co-integration and Granger Causality test.
Onwuka (2006)	Nigeria	The Impact of Nigeria's Growing Population on the Country's Development	Empirical Test	Found that population outweighs economic development.	There was no specific empirical test and 2006 timeframe was far from the present study with 2015 timeframe
Babatunde , et al (2012)	Nigeria	The Impact of Infrastructure on Economic growth in Nigeria	Three-Stage Least Square Technique	Showed that infrastructural investment had a significant impact on industrial output but insignificant on other sectorial output	Did not specify other tests before three-stage least.The present study conducts stationarity, co-integration, vector error correction mechanism and Granger Casuality tests.
Maku (2014)	Nigeria	Links between Government Spending and Economic growth	Three-Variants of Ram (1986) Regressing Model	Showed that private and public investments have insignificant effects on economic growth	The study did not specify public expenditure in infrastructure or power generation. The present study looks at Power generation and economic growth.
Nedozi, et al. (2014)	Nigeria	Infrasructural Development and Economic growth of Nigeria	Ordinary Least Square (OLS)	Showed that infrastructure was an intermediate good and service to the real sector and a finished good and service to consumers	Did not show other tests conducted before employing OLS. This study conducted stationarity, co-integration, VECM and Granger tests
Edame & Fontaz (2014)	Nigeria	Impact of Government Expenditure on Infrastructure in Nigeria	Co-integration and Error Correction Mechanism (ECM)	ECM indicated a feedback of about 99.38 % of previous year on specified independent variables.	Government expenditure in infrastructure is vast. The present study focus is on power generation.
Ogundipe and Apata (2013)	Nigeria	Electricity Consumption and Economic growth in Nigeria	Johnasen an Juselius Co-integration based on Cobb-Douglass growth Model.	Electricity consumption impacted significantly on Economic growth within the period under review	Did not specify the employment of diagnostic test such as stationarity test. The present study employs ADF Unit Root test.
Babatunde and Shuaibu (2007)	Nigeria	The Demand for Residential Electricity in Nigeria: A bound Testing Approach	Bound testing Approach	Showed that in the long run, income and population were determinants of electricity demand in Nigeria. Price was insignificant	The timeframe of 2007 is long period to present study's timeframe of 2015. The variables for this study are power generation, capital formation, and unemployment.
Nwankwo and Njogo (2013)	Global	The Links between Sustained Economic Growth and Electricity in an Economy	Multiple Regression Model	Electricity generation, Gross Fixed capital formation, Industrial Production and Population were positively related with RGDP per capita	The study was not country's specific. The present study is on Nigeria economy.
Abdulwah ed (2014)	Nigeria	Factors Affecting Capacity Utilization in Nigeria	SWOT analysis and VAR	Showed that the most influential factors were electricity generation,	The study was based on Nigerian's manufacturing sector, while this study was on Nigeria's

				capital goods import and interest rate.	economic growth.
Samuel and Lionel (2013)	Nigeria	The Relationship Between Electricity Supply And Economic Development	Stationarity, co-integration and OLS	Showed that per capita GDP, Lagged electricity supply, technology and capital influenced economic development in Nigeria.	It was strange estimation procedure to use stationarity, co-integration and OLS. The present study employs stationarity, Co-integration and Vector Error Correction Mechanism
Oduaru & Okonkwo (2009)	Nigeria	The Relationship Between Energy Consumption and Nigerian Economy	Co-Integration Technique	Depicted that there was positive relationship between current period energy consumption and economic growth	The 2009 period was very long time period to the present study of 2015.
Ubi & Effiom (2013)	Nigeria	The Relationship Between Electricity Supply and Economic Development in Nigeria	Stationarity, Co-integration and OLS	Showed that per capita GDP, lagged electricity supply, technology and capital are significant variables that influenced economic development in Nigeria	It is questionable the use of stationarity, co-integration and OLS. The present study employs as estimation procedure, stationarity, co-integration and vector error correction mechanism.

3.0 Model Specification

Having considered various theories on power generation, economic growth, gross capital formation and unemployment, this work is anchored on David Stern Model. In his model on factors affecting linkage between energy and growth, Stern (2004) asserted that there has been extensive debate concerning the trend in energy efficiency in the developed economies, especially since the two oil price shocks of the 1970s. He argued that in the United States of America (USA) economy, energy consumption hardly changed in the period 1973 to 1991, despite a significant increase in gross domestic product (GDP). According to Stern, these facts were indisputable and the break in the trend have been the subject of argument. He referred to Neoclassical perspective of the production function to examine the factors that could reduce or strengthen the linkage between energy use and economic activity over time and depicted that there has been a decoupling of economic output and resources, which implies that the limits to growth are no longer as restricting as in the past. A general production function of Stern can be represented as follows:

$$(Q_i,\ldots, Q_m) = f(A, X_i, \ldots, X_n, E_k, \ldots, E_p) \quad (1)$$

Where:

Qi are various outputs (such as manufactured goods and services), the Xi are various inputs (such as capital, labor, etc.), the Ek are different energy inputs (such as coal, oil, etc.), and A is the state of technology as defined by the total factor productivity indicator. Specifically, this study uses the following model:

RGDP=f(PGCKWH,GCF,UNEM) (2)

The linear form of the model becomes,

$$RGDP = \lambda_0 + \beta_1 PGCKWH_1 + \pi_2 GCF + \emptyset_3 UNEM + \mu \quad (3)$$

Where:

RGDP is economic growth variable, PGCKWH is power generation capacity in kilowatts hours, GCF is gross capital formation, UNEM is unemployment , λ = Model Constant, β, π, ϕ = Model Parameters, and μ = Error term.

Estimation Procedure

The first process in estimation procedure will be to perform a unit root test on the variable in this model. This is because most macroeconomic time-series have unit root and the regression of a non-stationary time series on another non-stationary time series is bound to produce a spurious regression. In order to produce a meaningful estimate, a unit root test will be conducted. Thus, this study first tested the nature of the time series to determine whether they are stationary or not and if stationary what is their order of integration. The order of integration assist researcher in determining the long-run relationship among the variables. To do this, the Augmented Dickey Fuller test is employed.

After performing the unit root test, next is to test for co-integration among the variables. Co-integration indicates the presence of a linear combination of non-stationary variables that are stationary. In a case where co-integration does not exist, it means the linear combination is not stationary and the variable does not have a mean to which it returns. The presence of co-integration however, implies that a stationary long run relationship among the series is present. The Mackinnon (1991) critical value or residual procedure is adopted in this study.

A non-stationary series which can be transformed to a stationary series by difference d time is said to be integrated of the order d. A series X_t integrated of order d is conventionally denoted as:

X_{t-1} (d) --- (i)

If X_t is stationary, then no difference is necessary; that is integration order of zero denoted as:

X_{t-1} (0) - - -(ii)

These series with time variant mean and co-variance function is said to be integrated of order zero. While series that need to be differenced once to achieve stationarity, is said to be integrated of order one, that is

X_{t-1} (1) - - - (iii)

The Augmented Dickey-fuller (ADF) and the Saragn-Bahrgv Dub-Watson (SBDW) test which is used is in this general format

$X_t = a + \beta x_{t-1} + \beta T + \sum t$ - - - (iv) (4)

and $X_t = a + \beta x_{t-1} + \sum Ci\ p\ X_{t-1} + \beta T$ - - - (v) (5)

Where the n's are large enough to ensure white noise residuals and T is trend.

The relevant test statistics for DF and ADF test is the ratio of β over its OLS standard error. The Null hypothesis is

$H_0 : X_{t-1}(1)$

The test statistic does not have a t-distribution under the null hypothesis because of the theoretical variance of X_t. However, Fuller (1976) reports tables and critical values for those t- ratios.

The next step would be to evaluate the order of integration of the residual generated from the static model. If the series of the model is co-integrated, that is the residuals is stationary, we are guided towards error correction specification regression are non-stationary. Otherwise, we can apply the Unit root to check their stationarity.

The unit root test of the ADF as follows:

$pU_t = \Phi U_{t-1} + \sum \eth i\ pU_t + dT$ (6)

In a case where co integration does not exist, it means the linear combination is not stationary and the variable does not have a mean to which it returns. The presence of co integration however implies that a stationary long-run relationship among the series is present. The study will then employ the error correction mechanism based on Engle-Granger (1987) error correction model (ECM) approach. This procedure involves the estimation of long-run relationship using the Johansen cointegration test. A statistically significant ECM indicates the speed of adjustment in the short-run GDP growth when disequilibrium occurs.

The method of data analysis for the Model is Ordinary Least Square (OLS) because the parameter estimates obtained by the Ordinary Least Squares have some optimal properties, its computational procedure is fairly simple and the data requirement are not excessive. The multi-regression obtain by OLS will be applied to identify parameter estimates of the model. In order to carry out the test to determine the causal relationship between economic growth and power generation capacity in Nigeria, the study formulated pairwise correlation analysis with Granger causality methodology. The Causality Model was stated in two ways to identify bilateral or unilateral relationship using Granger causality methodology.

4.0 PRESENTATION OF RESULT

Unit Root Test

The study began with the test of unit root to determine the stationarity of all the employed variables using Augmented Dickey Fuller (ADF) test. The tests were conducted to avoid spurious regression. The results of the test are presented in table 1 below.

Table 1: ADF Test

Variables	At levels T– Statistics	Pv	5% crit. Value	10%crit. Value	Remarks
RGDP	-1.675185	0.7410	-3.544284	-3.204699	Not stationary
PGCKWH	-2.100396	0.5277	-3.544284	-3.204699	Not stationary
GCF	-2.034979	0.5625	-3.544284	-3.204699	Not stationary
UNEM	-2.592739	0.2857	-3.544284	-3.204699	Not stationary
At 1st Diff.					
RGDP	-5.802657	0.0002	-3.548490	-3.207094	Stationary
PGCKWH	-6.524297	0.0000	-3.548490	-3.207094	Stationary
GCF	-6.650799	0.0000	-3.548490	-3.207094	Stationary
UNEM	-5.573528	0.0003	-3.548490	-3.207094	Stationary

From the table above, the null hypothesis of unit root is accepted if the calculated T statistics is much less than the critical value at 5 percent level of significance. Since these variables are much less than their respective values as indicated in the table 1 above, the study accept the null hypotheses and conclude that all the variables have unit root or non – stationary at levels. However, at first difference the variables RGDP, PGCKWH, GCF and UNEM were stationary. This is because their calculated T statistics were much more in negative than their critical values as shown in the ADF table above. This implies that all the variables were integrated to order one, 1(1). Having established that the variables are integrated of the same order after first difference, the study proceeds to determine the evidence of co integration among the variables.

Co-integration Test

This technique is employed to testing for the presence of co integration between the series of the same order of integration through forming a co integration equation. The basic idea behind co integration is that if, in the long-run, two or more series move closely together, it is possible to regard these series as defining a long-run equilibrium relationship, as the difference between them is stationary. Lack of co integration implies that such variables have no long-run relationship.

Table 2: Johansen co-integration test for the series; RGDP, PGCKWH, GCF and UNEM

Date: 07/10/16 Time: 10:55
Sample (adjusted): 3 36
Included observations: 34 after adjustments
Trend assumption: Linear deterministic trend
Series: RGDP PGCKWH GCF UNEM
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.606732	70.04226	47.85613	0.0001
At most 1 *	0.496991	38.31125	29.79707	0.0041
At most 2	0.323869	14.94826	15.49471	0.0603
At most 3	0.047139	1.641736	3.841466	0.2001

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.606732	31.73101	27.58434	0.0138
At most 1 *	0.496991	23.36299	21.13162	0.0239
At most 2	0.323869	13.30652	14.26460	0.0704
At most 3	0.047139	1.641736	3.841466	0.2001

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

RGDP	PGCKWH	GCF	UNEM
9.09E-06	2.61E-07	-0.000351	-0.098955
1.73E-06	3.50E-08	9.25E-05	-0.293787
9.09E-07	4.20E-07	-0.000109	0.067899
7.83E-06	1.33E-07	1.33E-05	-0.095899

Unrestricted Adjustment Coefficients (alpha):

D(RGDP)	-2864.652	-22872.39	-3489.041	3481.631
D(PGCKWH)	-609374.4	37560.38	-849792.7	-62715.26
D(GCF)	1637.289	-407.1872	-600.7600	70.22787
D(UNEM)	0.370206	0.961821	-0.460411	0.507630

1 Cointegrating Equation(s): Log likelihood -1320.853

Normalized cointegrating coefficients (standard error in parentheses)

RGDP	PGCKWH	GCF	UNEM
1.000000	0.028721	-38.60111	-10890.81
	(0.00676)	(4.79201)	(4739.61)

The result of the co integration test shown in table 2 above indicates two (2) co integrating vectors. This means that the explanatory variables (PGCKWH, GCF and UNEM) have long run relationship with the depended variable (RGDP). This implies that, vector error correction model is the best option for further analysis. It captures both the long run equilibrium and short run dynamic relationships associated with the above results.

Vector Error Correction Mechanism

The presence of long run equilibrium relationship among the variables as found from the Johansen cointegration led to the application of VECM. With this approach, both the long run equilibrium and short run dynamic relationships associated with variables under study is established.

Table 3: VECM 1

Vector Error Correction Estimates
Date: 07/10/16 Time: 10:59
Sample (adjusted): 4 36
Included observations: 33 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
RGDP(-1)	1.000000
PGCKWH(-1)	0.015346
	(0.00557)
	[2.75569]
GCF(-1)	-23.68649
	(4.09300)
	[-5.78707]
UNEM(-1)	-21012.38
	(4992.67)

	[-4.20864]			
C	-24811.68			

Error Correction:	D(RGDP)	D(PGCKWH)	D(GCF)	D(UNEM)
CointEq1	-0.182625	-0.182137	0.012433	1.35E-05
	(0.06827)	(5.17900)	(0.00591)	(7.9E-06)
	[-2.67491]	[-0.03517]	[2.10234]	[1.71148]
D(RGDP(-1))	-0.827486	10.28640	0.003071	-6.46E-06
	(0.21350)	(16.1953)	(0.01849)	(2.5E-05)
	[-3.87585]	[0.63515]	[0.16608]	[-0.26242]
D(RGDP(-2))	1.430572	1.654079	0.012710	-1.64E-05
	(0.25126)	(19.0598)	(0.02176)	(2.9E-05)
	[5.69360]	[0.08678]	[0.58398]	[-0.56709]
D(PGCKWH(-1))	0.003106	-0.166582	3.26E-05	-1.66E-07
	(0.00272)	(0.20661)	(0.00024)	(3.1E-07)
	[1.14030]	[-0.80627]	[0.13835]	[-0.52758]
D(PGCKWH(-2))	0.000384	-0.059866	-7.28E-05	2.81E-07
	(0.00267)	(0.20237)	(0.00023)	(3.1E-07)
	[0.14381]	[-0.29582]	[-0.31498]	[0.91274]
D(GCF(-1))	1.109381	-109.2405	0.186897	-0.000109
	(1.99899)	(151.637)	(0.17315)	(0.00023)
	[0.55497]	[-0.72041]	[1.07938]	[-0.47454]
D(GCF(-2))	-1.139161	127.1433	-0.141978	0.000358
	(1.82514)	(138.450)	(0.15809)	(0.00021)
	[-0.62415]	[0.91833]	[-0.89806]	[1.70345]
D(UNEM(-1))	-4652.801	66026.72	174.6741	0.283249
	(2007.81)	(152306.)	(173.917)	(0.23145)
	[-2.31736]	[0.43351]	[1.00436]	[1.22381]
D(UNEM(-2))	-19.86398	17802.84	11.65387	-0.120832
	(1890.71)	(143423.)	(163.773)	(0.21795)
	[-0.01051]	[0.12413]	[0.07116]	[-0.55440]
C	12775.77	-649048.5	-316.7905	0.869647
	(7991.11)	(606181.)	(692.192)	(0.92117)
	[1.59875]	[-1.07072]	[-0.45766]	[0.94406]
R-squared	0.670526	0.102951	0.353452	0.255535
Adj. R-squared	0.541601	-0.248068	0.100455	-0.035777
Sum sq. resids	1.59E+10	9.13E+13	1.19E+08	210.9141
S.E. equation	26269.66	1992737.	2275.483	3.028230
F-statistic	5.200906	0.293292	1.397060	0.877186
Log likelihood	-376.6819	-519.5339	-295.9565	-77.43154
Akaike AIC	23.43526	32.09296	18.54282	5.298881
Schwarz SC	23.88875	32.54645	18.99631	5.752368
Mean dependent	20391.57	-252318.7	99.21182	0.454356

S.D. dependent	38800.07	1783737.	2399.177	2.975471

Determinant resid covariance (dof adj.)	7.37E+28
Determinant resid covariance	1.74E+28
Log likelihood	-1260.216
Akaike information criterion	79.04338
Schwarz criterion	81.03872

Table 4: VECM 2

Dependent Variable: D(RGDP)
Method: Least Squares
Date: 07/10/16 Time: 11:05
Sample (adjusted): 4 36
Included observations: 33 after adjustments
D(RGDP) = C(1)*(RGDP(-1) + 0.015345544254*PGCKWH(-1) - 23.6864887936*GCF(-1) - 21012.3838118*UNEM(-1) - 24811.6810439) + C(2)*D(RGDP(-1)) + C(3)*D(RGDP(-2)) + C(4) *D(PGCKWH(-1)) + C(5)*D(PGCKWH(-2)) + C(6)*D(GCF(-1)) + C(7) *D(GCF(-2)) + C(8)*D(UNEM(-1)) + C(9)*D(UNEM(-2)) + C(10)

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.182625	0.068273	-2.674909	0.0135
C(2)	-0.827486	0.213498	-3.875849	0.0008
C(3)	1.430572	0.251260	5.693600	0.0000
C(4)	0.003106	0.002724	1.140300	0.2659
C(5)	0.000384	0.002668	0.143807	0.8869
C(6)	1.109381	1.998987	0.554971	0.5843
C(7)	-1.139161	1.825144	-0.624148	0.5387
C(8)	-4652.801	2007.805	-2.317357	0.0297
C(9)	-19.86398	1890.708	-0.010506	0.9917
C(10)	12775.77	7991.110	1.598748	0.1235

R-squared	0.670526	Mean dependent var	20391.57
Adjusted R-squared	0.541601	S.D. dependent var	38800.07
S.E. of regression	26269.66	Akaike info criterion	23.43526
Sum squared resid	1.59E+10	Schwarz criterion	23.88875
Log likelihood	-376.6819	Hannan-Quinn criter.	23.58785
F-statistic	5.200906	Durbin-Watson stat	2.030066
Prob(F-statistic)	0.000665		

Granger Causality Test

Table 5: Granger Causality Test

With this test, the pair-wise relationships between the estimated variables are ascertained. Thus the table is presented below:

Pairwise Granger Causality Tests
Date: 07/10/16 Time: 11:10
Sample: 1 36
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
PGCKWH does not Granger Cause RGDP	34	0.42535	0.6576
RGDP does not Granger Cause PGCKWH		0.01552	0.9846
GCF does not Granger Cause RGDP	34	0.25059	0.7800
RGDP does not Granger Cause GCF		12.6363	0.0001
UNEM does not Granger Cause RGDP	34	5.44709	0.0098
RGDP does not Granger Cause UNEM		2.36301	0.1120
GCF does not Granger Cause PGCKWH	34	1.44219	0.2529
PGCKWH does not Granger Cause GCF		3.27647	0.0521
UNEM does not Granger Cause PGCKWH	34	0.00870	0.9913
PGCKWH does not Granger Cause UNEM		0.22187	0.8024
UNEM does not Granger Cause GCF	34	3.35576	0.0489
GCF does not Granger Cause UNEM		0.47847	0.6245

DISCUSSION OF RESULTS

This section deals with the discussion of the results. In the discussion, effort was made to develop the story found in the data, making connections between the results of the analysis, existing theory and research.

From the ADF result at levels, all the variables respectively were much less than the 5 percent critical values. The study concludes that all the variables have unit root or non – stationary at levels. At first difference, all the variables were much more in negative than their respective critical values at 5 percent level; the study concludes that all the variables were stationary at first difference. This indicated that all the variables were non – stationary at levels but turned to be stationary after first difference.

Based on the results of the estimation above, it was found that a stable long run relationship exist between the dependent and explanatory variables in the model as supported by the presence of two co integrating equations. This means that the result of this finding can be relied upon in taking long run policy decision. The nature of the long run equilibrium relationship is found from the normalized co-integrating coefficients and also from the upper chamber of the Vector Error Correction Mechanism (VECM). Thus, the equation is stated as follows;

RGDP = -24811.68 + 0.026029PGCKWH – 38.60111GCF – 10890.81UNEM

Where RGDP is the dependent variable, -24811.68 is the constant term, 0.026029 is the coefficient of PGCKWH, -38.60111 is the coefficient of GCF, and 10890.81 is the coefficient of UNEM. The signs borne by the coefficient estimate of the variables: GCF and UNEM have negative relationship with RGDP while that of PGCKWH have positive relationship with RGDP.

The ECT has the expected negative sign with the coefficient of -0.182625, this implies that power generation capacity add 18.26 percent per year to economic growth for equilibrium to be restored in the long run. This result is supported by the ECT p value of 0.0135 indicating that it is statistically significant.

The R- square is 0.670526 showing that 67.05 percent variation in the dependent variable is explained by the independent variables while the remaining 32.95 percent is explained by other variables not captured by the model which is represented by error term (et)

The F – statistics of 5.200906 with p value of 0.000665 which is less than 0.05 shows that the influence of explanatory variables on the dependent variables is statistically significant. The DW has the value of 2.030066 which is above 2. This indicates the absence of auto correlation among the residuals.

The pair wise granger causality test indicated no causal relationship between PGCKWT and RGDP. It was also found that a unidirectional causality runs from RGDP to GCF as supported by its p value of 0.0001and a unidirectional causality from UNEM to RGDP and GCF.

IMPLICATIONS OF RESULT

The policy implication of the long run relationship between the dependent and explanatory variable is that power generation capacity if improved has the tendency to stimulate economic growth in the long run, considering that the nature of relationship in the long run is positive and statistically significant. This also means that for the growth of the economy, government must ensure transparency in the overall implementation of power sector policy and its attendant reform agenda. There is also need to ensure full implementation of power sector budget through oversight function by the legislative arm of government to check the endemic corruption associated with the sector. However, GCF and UNEM had a negative significant relationship with RGDP, meaning that government should engage proactive policy decisions that will encourage the growth of the economy and improve domestic investment that will consequently reduce unemployment in the long run.

In the short run, a positive insignificant correlation exists between power generation capacity and economic growth. This means that all the huge financial commitment by the government on the power sector has not translated to the improvement of power generation capacity, probably due to poor budgetary implementation and corruption within the sector.

The pair wise granger causality result showed no causality between RGDP and power generation capacity and vice versa. This means that power generation capacity has not caused increase in economic growth, contrary to appriori expectation which assumes that activities in the power sector should lead to increase in RGDP. However, the findings from the result are understandable knowing that the power sector has been characterized by obvious inefficiency which has affected all strata of businesses in Nigeria negatively.

5. Conclusion

This study examined the impact of power generation capacity on economic growth in Nigeria from 1980 - 2015. In the model specified, Real Gross Domestic Product is a function of Power generation capacity in Kilowatt, Gross capital formation and Unemployment. With the aid of econometric techniques employed (co integration test, vector error correction mechanism and granger causality); the following results were found that a stable long run relationship exist between the dependent and explanatory variables in the model as supported by the presence of two co integrating equations. This means that the result of this finding can be relied upon in taking long run policy decision.

In the VECM equation result presented above, the t-statistics for PGCKWH is 0.003106 while its P-value is [0.2659]. The t-statistics for GCF is 1.109381 while its P-value is [0.5843]. The VECM result also showed the t – statistics of - 4652.801 with p value of 0.0297, indicating an insignificant relationship with RGDP.

This study concluded that there is no causality between power generation capacity and economic growth in Nigeria within the study period.

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