Energy Demand and Economic Growth in Nigeria

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Submitted to the
Institute of Graduate Studies and Research
in Partial Fulfillment of the Requirements for the Degree of

Master of Science
in
Economics

Eastern Mediterranean University
July 2014
Gazimağusa, North Cyprus

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ABSTRACT

This research investigates the causal relationship among electricity consumption, fuel price and economic growth in Nigeria, using time series techniques covering the period of 1970-2012. The results of our estimation show that real gross domestic product, electricity consumption and fuel price are co-integrated. Showing a positive relationship of electricity consumption and real GDP and shows a negative relation between fuel price and real GDP. It also finds the presence of unidirectional causality from real gross domestic product to electricity consumption without any feedback effect. This shows that an improvement in economic growth in Nigeria will improve electricity consumption. And shows that fuel price granger cause consumption, which shows the impact of fuel price on electricity consumption.

To cope with the increasing electricity demand and to overcome the shortage of electricity, it is imminent that investments be encourage in the electricity supply sectors to ensure an efficiency in distribution and transmission of electricity on a large scale to bridge the gap between supply and demand of electricity in Nigeria.

Keywords: electricity consumption; fuel price; economic growth; causality; Nigeria.

ÖZ

Bu çalışmanın amacı elektrik tüketimi yakıt fiyatları ve ekonomik büyüme arasındaki nedensellik ilişkisini Nijerya örneğinde 1970 ile 2012 arası dönem için araştırmaktır. Çalışmamızın bulguları reel GSYİH elektrik tüketimi ve de yakıt fiyatları arasındaki eş bütünleşmeye dikkati çekmektedir. Elektrik tüketimi ve reel GSYİH arasında pozitif bir ilişki dikkati çekerken yakıt fiyatları ile reel GSYİH arasında negatif bir ilişki karşımıza çıkmıştır. Aynı zamanda tek yönlü nedensellik varlığı reel GSYİHdan elektrik tüketimine yönelik olarak herhangi bir geri bildirim etkisi olmaksızın karşımıza çıkmaktadır. Buradan hareketle Nijerya'nın ekonomik büyüme performansında bir iyileştirme elektrik tüketimini de iyileştirecektir sonucuna varmak mümkündür. Çalışmada aynı zamanda Granger nedensellik ilişkisi yakıt fiyatlarıyla tüketim arasında karşımıza çıkmıştır ki bu da yakıt fiyatlarının elektrik tüketimini etkilediğini göstermektedir.

Elektrik tüketim talebi ile başa çıkabilmek ve elektrik kıtlığı sorununu çözebilmek adına elektrik üretimini gerçekleştiren arz sektörlerinde etkinliğin artırılmasına yönelik yatırımların hız kazanması Nijerya için zorunludur. Aynı zamanda dağıtım ve aktarım sorunlarının çözümlenmesinde elektrik üretim sektörüne yatırımların artırılması önemlidir. Arz ve talep arasındaki uçurum da bu şekilde kapatılmış olacaktır.

Anahtarkelimeler: Elektriktüketimi, yakıtfiyatları, ekonomikbüyüme, nedensellik, Nijerya.

DEDICATION

This is dedicated to my loving parents,

Prof. and Mrs ChojiDavou.

ACKNOWLEDGMENT

I want to first, acknowledge my gratitude to God Almighty who made this journey very successful and rewarding.

My profound appreciation goes to my supervisor, Assist. Prof. Dr. KamilSertoglu for his priceless support all through the period of putting this thesis together. Also, my appreciation goes to my esteemed jury members Prof. Dr. SalihKatirciogluand Prof. Dr. Mehmet Balcilar for their constructive comments. I will like to express my gratitude to the Chair of the Economics Department, Prof. Dr. Mehmet Balcilar.

Special thanks to my parents, Prof. ChojiDavou and Mrs GarosChoji forsook the pleasure of life in order to see that I am educated. May the Lord, the best reward-giver, reward you in measures beyond your expectation.To my siblings, Vivian, Hudung, Simi and Mafeng. Thanks to all for your unconditional love. To my one and only love, Eng. Philip Abel. Thank you so much for your patience and support.

This acknowledgement will not be completed without the names of my friends, brothers and sisters in EMU: Amanda, Mercy, Paul, Alice, Kunle, Bimbo and Charlotte. They all stood by me in the course of my studies and stay in Cyprus. My gratitude to OmotolaAwojobi and IjeomaEziyi.For the assistance in my thesis.

All those whose names I did not mention here for space and time, but have helped me in one way or the other in seeing to my success of this study are equally loved, appreciated. Thank you all.

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LIST OF ABBREVIATIONS

ADF	Augmented Dickey-Fuller
CBN	Central Bank of Nigeria
ECM	Error Correction Mechanism
ECN	Energy Commission of Nigeria
ECons	Electricity consumption
EG	Electricity Generation
FP	Fuel Price
GDP	Gross Domestic Product
GHG	Green House Gas
IEA	International Energy Association
kWh	Kilowatt hour
MESSAGE	Model for Energy Supply Strategy Alternative and General Environment
MW	Megawatt
NDA	Niger Dams Authority
NEPP	National Electric Power Policy
NESCO	Nigeria Electric Supply Company
NERC	Nigerian Electricity Regulatory Commission
PHCN	Power Holding Company of Nigeria
PP	Phillips Perron
VEC	VectorErrorCorrection

Chapter1

INTRODUCTION

1.1 Backgroundof Study

Nigeria is blessed with abundant resources which if tapped and harnessed are capable of placing the country at the fore of developed countries of the world. Despite the exploitative shipment of Nigeria's resources for the development of the west (Europe) through colonization and activities of multinationals, there still remain more than adequate resources in Nigeria, waiting for exploitation and utilization. According to Anyanwuocha(1993), resources are the means or basic instruments with which human wants can be met. They include land, labour, capital, entrepreneur, time and money, all of which are used for producing goods and services. They also include commodities, services, or other assets used to produce goods and services that meet human needs and wants. Typically, resources are material or assets that are transformed to produce benefit and in the process may be consumed or made unavailable (McConnell, et. al, 2011).

The resources of a country are simply all the things the country has and can use for her peaceful economic development (Sinclair, 1992). They are the diverse natural and human factors endowments of a country, which are exploited and converted into valuable components for economic development. Natural resources are what nature has provided and can make use of such as fertile soil, rivers, lakes and mineral. Human resources on the other hand are the skills and potentials (mental and physical

abilities) embedded in man and discharged in the form of unskilled, semiskilled and skilled labour.

The available natural resources include the area of useable land, resources on the land surface, the atmosphere as well as those under the ground. Land surface resources include all sources of natural water, forest and soil. Atmospheric resources include climate, environmental conditions, wind and solar resources. Energy is an important resource for socio-economic growth in Nigeria. Energy exists in different systems like, mechanical, electrical, heat, light etc. The country has large and qualitative resources and has much growth and development potentials than countries lacking natural resources.

Nigeria is richly blessed with raw energy resources and is also blessed with the world's tenth largest reserves of crude oil. Nigeria has many natural resources which can be used for electricity generation. Nigeria's coal production of about 95 percent is consumed locally, for railway transportation, electricity supply, and in cement production used in the industry for heating. The Power Holding Company of Nigeria (PHCN) consumed the larger share of natural gas in Nigeria, used about 70percent for electricity-generating gas plants in the country. Nigerian consumption rate of petroleum product has seriously increased with motor gasoline and diesel oil taking a significant lead.

The available natural resources in Nigeria include the area of useable land, resources on the land surface, the atmosphere as well as those under the ground. Land surface resources include all sources of natural water forest and soil. Atmospheric resources include climate, environmental conditions, wind and solar resources. Underground

natural resources on the other hand include solid and liquid minerals. Nigeria is blessed with large and qualitative resources and has much growth and development potentials than countries lacking natural resources.The level of sunshine hours in the country is estimated to about 6.5 h. which can be used as solar energy to generate electricity for various consumptions. Energy sectors have to be encouraged with energy resources to supply electricity through the use of solar energy in Nigeria.

All these resources to a great extent are energy potentials to Nigeria and can be broadly categorized into renewable and non renewable energy sources. While the renewable energy resources include hydro-power, solar, biomass and wind energy, the non-renewable energy sources comprise crude oil, natural gas, fuel wood, coal, tar sands and uranium (Ajayi, et.al, 2003). These resources have turned the fortune of Nigeria. The discovery and exploitation of crude petroleum on commercial basis alone enhanced Nigeria's GDP growth rate averaging 6 percent per annum between 1958 and 1967 (Ahmad and Raju, 2003).

Since 1958, energy has steadily grown to become the mainstay of Nigeria's economy, playing a significant role in the growth and development of the country. Energy has continued to serve as the major tradable commodity for generating the national income and as a key tool of international diplomacy for the country. Energy is presently the springboard for production in all the sectors of the Nigeria's economy (industry, transport, agriculture, health, education, politics and security). In fact, any change in the energy sector could lead to over a 100 percent effect in the entire economy of not just Nigeria, but alongside her many trading partners. But despite the great importance and role of the large quantum of energy resources in Nigeria, the inadequate development and inefficient management of these potentials

have led to a continuous widening supply-demand gap in the energy sector, and this has had adverse effect on the economic development of the country.

In the past numerous studies, they conducted to examine the relationship between electricity consumption and economic growth. The most of the findings support the evidence that there is a bi-directional causality between electricity consumption and economic growth, and some from economic growth to electricity consumption. However, the causality relationship between electricity consumption, fuel price and economic growth has been rarely investigated in the literature. The relationship may very run from electricity consumption to economic growth, and/or from economic growth to electricity consumption. These causality issues, therefore, suggest the need to carry out a more in-depth investigation which aims to be the main objective of this study.

1.2 Statement of the Problem

The importance of energy in economic development of any country, developed or developing cannot be emphasized. Energy demand and economic development can be said as the two sides of a coin; the absence of one inadvertently queries any claim in the true existence of the other. With the abundant energy resources, over half-a-century of independence and exploitation of energy resources in Nigeria, the country is supposed to be among the economically independent developed countries of the world, but the reserve is the case. Though we have celebrated the 53rd independence anniversary, Nigeria is still grossly underdeveloped; groping the path for energy supply to meet up with its energy demand. This has not only led to the slow pace of full-fledged large scale industrial (manufacturing) take-off in the country, but has led to crushing penury and much impoverishment of Nigerians. This is made manifest in

the high cost of living, inadequate supply of finished products, dependence on imported finished goods, gross contraction in the industrial and agricultural sectors because of high cost of production, increasing environmental pollution due to much usage of generators, unpleasant social cost of living due to erratic and incessant power supply. In Nigeria electricity has contributed to the total gross domestic product but still the country is facing several problems of electricity supply. The electricity subsector has not been able to meet the demand for electricity in the country and this has caused many problems which if affecting the economic growth. The Central Bank of Nigeria has identified problems associated with PHCN: maintenance of facilities, subsequent breakdowns, technical problems, vandalization of power equipment. Most of the existing plants in Nigeria are notutilized properly or they are not functioning at all. The inefficiency to boost electricity supply causes the gap between the demand and supply of power due to the poor maintenance of hydro plants, and the loss of power in transmission. On the basis of comparing Japan and Nigeria, it is observed that while Japan had a population of about 160 million people, zero natural resources, high power generation capacity of 124Giga Watts, 100% grid access, 5% carbon emission rate and 100% energy conservation compliance, Nigeria on the other hand, have a population of 170 million people, abundant natural resources (coal, petroleum & gas, bitumen, gold, diamond, etc), low power generation capacity of 0.54 Giga Watts, less than 40% grid access, 60% carbon emission rate and 2% energy conservation compliance.

The energy situation in Nigeria has not been able to produced and managed in a way to ensure sustainable energy development. Nigeria has limited technological capacity but it should be able to manage the scarce energy resources efficiently. The afore-mentioned problems caused by the low consumption of energy in the midst of

abundant energy resources are the basis of the study. Although corruption, incessant changes in government and poor national orientation have been seen as reasons that deprive Nigeria of the expected development in the energy sector, the study sought to find out the factors responsible for these and to develop strategies that can stem the deteriorating performance of the sector for an enhanced economic growth and development.

1.3 Research Questions

This will give the empirical analysis of the study to arrive at a logical conclusion. Econometrics methods will be use in analysing the empirical data to demonstrate the causal relationship between energy consumption and economic growth in Nigeria. In view of this, gross domestic product will be regress against the energy consumption and fuel price in Nigeria to find;

1.if there is any causal relationshipbetween energy consumption on economic growth in Nigeria,

2.if there is any long-run co-integration between domestic output and power sector development in Nigeria.

1.4Objectives of the Study

The main objective of this research is to establish, both theoretically and empirically, the impact of energy consumption on sustainable economic growth.

The other objectives of the study are to:

Examine the concept of energy demand,

Ascertain relationship between energy consumption and economic growth,

Analyze the impact of widened energy demand-supply gap on the welfare of the users,

Make policy recommendations on sustainable energy supply in Nigeria,

Suggestions will be noted base on the results obtained from the analysis, for efficient management and control of Nigeria's electricity supply.

1.5 Structure of the Study

The thesis is structured into five chapters. Chapter one involve the background of the research, statement of problem, research questions, objectives of study.

Chapter two analyses the review of relevant empirical literature, the conceptualization and theoretical review.

Chapter three will give the overview of energy position in Nigeria, the projected energy demand and supply, sources and factors influencing growth of energy supply in Nigeria.

Chapter four explains the methodologies that will be used in the course of the study, and the result of the analysis. It will provide econometric analyses of energy consumption in Nigeria. Using numerical values of the parameter estimates and testing the hypotheses.

Chapter 5 is the conclusion and recommendation which will help further researchers, policy makers, institutions and companies that are interested in the growth of energy supply in Nigeria.

Chapter2

LITERATURE REVIEW

This study has attracted some basic conceptual and empirical discussions, reflecting issues border on electricity productivity growth.

2.1 Conceptual Framework

This section reviews and harmonizes the different views and opinions of others on the concepts of this sustainable energy supply and economic development.

2.1.1 Energy Supply

Energy supplies are essential to sustainable development. To provide sufficient energy services in a country require extensive investments in electricity supply structure, transformationof machineries and infrastructure. Despite the Millennium Development Goals set by the United Nations to eliminate poverty, improve standards of living and to spur viable economic and general development. Presently, the population of developing countries use around half of the 470 EJ present yearly global primary energy use (International Energy Association, 2006). The desire by many governments is on how to improve energy efficiency, as part of solutions to reduce greenhouse gas (GHG)-emission. It is difficult to determine the technologies that will facilitate the improvement of energy and to set policies that will support suitable incentives. Energy access and continuous development are accord by rapidly fluctuation of oil prices. To achieve a stable power supply, governments and the global energy industry need to also use other sources of electricity production and back it up with policies.The supply of energy can be disrupted by several factors,

including higher energy prices due to action by OPEC or war, political conflict, economic disturbance, or physical damage to the energy infrastructure due to terrorism. The security of electricity supply is a major concern of national security and energy law.

Green Energy Supply Certification Scheme (GESCS) is a green electricity programme started in February 2010 in the United Kingdom, which has indeed help electricity supply to be matched by renewable energy and energy tariff to deliver additional environmental benefits, and the enforcement of rules on transparency and annual audits (GESCS, 2012).

2.1.2 Energy Demand

Energy demand is the necessity for energy input to make available for production and services (McCraken, 2005). The demand of energy is also the amount of energy consumed in a process by an organization or society" (Brown 2006). Approximately 45 percent of the final consumer energy in the world used forheating, 10 percent used in industries for high-temperature, and 15 percent for electric automobile and electronics device and 30 percent for conveyance (International Energy Association, 2006). The increase in the world population has made energy demandto continuously increase. The increase in prices and insecurity of energy supply has also compromised consumption growth.

Energy consumption in the Group of 20 developed nations of the world (G 20) rose higher than 5 percent in 2010, following the slight decrease in 2009. Industrialized economies experienced acute decrease in energy demand in 2009, redeemed actively in 2010. While China and India did not exhibits trace of reducing energy demand in 2009, but continued their extreme demand for energy sources. About 64 percent of

world electricity supply is currently from non-renewable resources, from nuclear fission 16 percent and 19 percent from hydro (California Energy Commission, 2012). There is no prospect that we can do without any of these as such the need for a strong energy supply policy mix.

2.1.3 Renewable and Non-Renewable Energy Resources

The power sources are broadly categorized into two, the renewable and the non-renewable. Renewable energy sources can be easily refilled, while the non-renewable isresources are used and cannot be renewed. According to the IEA (2007), renewable energy resources include solar, wind, geothermal, biomass,and hydropower from hydro turbines.

Non-renewable energy sources are fossil fuels produced over millions of years by the response of heat from the earth's centred and compression from rock and soil on the residue of dead plants. Nuclear power too is usually categorised separately from renewable energy sources. Although it shares many attributes with renewable, it is not a renewable energy. Renewable and non-renewable energy resources are used to generate electricity for domestic, commercial and industrial use by man.

2.1.4 Energy Conversion, Efficiency and Green Energy

Energy conversion is the process of transforming energy from one form to another. Man transformed energy from one form to another when they lit the first fire. Another example of energy conversion is seen with batteries which are used to create electricity from chemical reactions. To achieve energy sustainability, it is recommended that changes are made in the way energy is produced and used at any giving moment. Green energy is extracted, produced, and consumed without any bad effect to the environment.

2.1.5 Sustainable Energy Supply

Feasible energy is the utilization of energy produced from clean sources and technology. Appropriate energy utilization is the first step towards sustainable energy. Efficient use of energy reduces the costs of electricity; the amount of power needed and cut down energy related greenhouse pollution. Energy development deals with the two sides of energy supply and consumption. According to Sambo (2008), sustainable energy supply means transforming and usage of energy resources to meet human needs, and also preserving the environment to meet human needs both in the present and future. Sustainable energy is not just about utilizing energy resources only but also about efficient use of energy (Energylinx, 2012).

2.1.6 The Goals of Energy Policy

Policies have been set in Nigeria by the government since from 1960 on energy and other related sub-sectors but this have not complimentedwith the aim and objective of government.

National energy policy aimed at efficient development of all energy resources in the country for sustainability. The reasons for energy policies are to produceefficient energy services that enhance quality of life, like good health, life expectancy, for convenience and also production (Hall, et.al, 2004).

The objectives are to improve the production of hydro electricity to the entire energy mix, enhance electricity to rural areas by using mini macro hydro schemes, and to diversify the sources of energy (ECN, 2003).

Nurkes, 2004 said the purpose ofSweden's energy policy is to ensure that the shot and longterm productionof electricity on internationally concept of competition. The

energy program is formed to provide necessary conditions for efficient utilization of energy without affecting the health of consumers, and to also transform Sweden to a sustainable society.

2.1.7 Economic Growth and Development

The growth of an economy is expressed as the steady process which the capacity of production is increased over time to establish the level of national income. Economic development is a method of enhancing the standard of living of all human beings in a giving country (Todaro, 1987). Economic development involves the adoption of new and more advanced techniques of quantitative transformation of the economy from primary secondary and to the tertiary sectors, and improvements in the living standard of the masses. It involves fundamental changes in social and administrative systems as well as attitudes to work (Emmanuel, 2005).The objectives of ensuring sustainability and the millennial Development Goals should include; improving economic growth, meeting essential needs, lifting living standard by bettering health and education needs, ensuring that everyone participate in public life and clean environment.

In summary, we can say economic development means growth plus change. This means a complete change in the social system such that it moves away from a way of life perceived to be unsatisfactory towards a condition of life regarded as materially better. It includes improvement in material welfare of lowest income earners, eradication of mass poverty and illiteracy, diseases and early death.

2.1.8 Energy and Economic Development

Energy known as important sources of economic growth of all nations exists in different forms.The aim of an energy sectors is to provide energy services to industries, commercial, household and to ensure that different sectors of the

economyare well serviced. Nigeria is gifted with a variety of natural energy resources that can bring her to the fore of development. But despite the riches in energy sources,it still poor in the supply of electricity because of the existence of a hugegap among the demand and supply of energy use. To reduce this problem all stakeholders must ensure sufficient, economical and stable energy uses.

2.2 Empirical Review

Gbadebo and Chinedu (2009) used co-integration analysis to examine the impact of energy consumption in Nigerian economy used the period of 1970 to 2005. The dependant variable was real GDP and the independent variables were crude oil consumption, coal consumption and electricity consumption. The result shows a negative relationship between the lagged values of electricity consumption and economic growth.

The research suggested there should be an increase in electricity supply and to enhance energy infrastructure.

According to Samuel and Lionel (2013), annual time series data was used taking 1970 to 2009 investigated relationships between electricity supply and economic development in Nigeria. The study employed ordinary least square estimated by using ECM which shows that PCGDP, lagged electricity supply, technology, and capital are the relevant variables that influence economic development in Nigeria.

The ECM test shows that lagged electricity supply is statistically significant at 5% level, i.e. a 1% rise in previous years electricity supply will lead to 0.3% increase in the current per capita gross domestic product.

The Adjusted R^2 shows that 73% of the per capita GDP is determined by changes in the explanatory variables. F-statistics shows that variables are jointly statistically significant at 5% level. The study recommends that efforts should be made to improve electricity generation, technology encourage capital formation in Nigeria to reduce power loss and improve electricity supply.

In the same vein, Udah (2010), investigate the relationship between electricity supply, industrialization and economic development in Nigeria from the period of 1970-2008. He used the Granger causality test and ARDL bounds test to invest their relative impact on economic performance in Nigeria. The result indicate a 1 percent rise in industrial output, capital, technology and energy supply leads to about 3.8, 1.1, 4.1 and 4.5 percent rise in real output respectively. He also conducted error correction model which shows index of the independent variables and their significant determinants of economic development. He concluded that result was highly significant.

Simon (2012) examined the impact of electricity crisis on the manufacturing productivity growth in Nigeria from 1980 to 2008, using ordinary least square multiple regression to analyze the time series data.

The result shows a positive relationship between capacity utilization, exchange rate and the index of manufacturing productivity, while electricity generation and government capital expenditure produced negative relationship with manufacturing productivity index as the dependent variable.

It shows that 67% variation in manufacturing productivity is explained by the explanatory variables. It also shows that among all the variables, electricity generation is not significant at 5% level, which identifies inadequate electricity supply as a result of low manufacturing productivity in Nigeria.

Akekere and Odokpon (2013) investigated the force of electric energy supply on industrial sector productivity in Nigeria, from the period of 1970-2010 using multiple regression analysis. The finding shows that energy supplies have no significant impact on industrial productivity in Nigeria.

Audu, Nathan and Apere (2013) empirically analysed the dynamics of demand and supply of electricity in Nigeria, using RFRM and VECM approach. The analysis revealed that electricity demand is price inelastic while income is elastic. The study shows that 1 percent increase in electricity price would lead to an average of 32.45 percent decline in the quantity of electricity demanded. And a 1percent increase in income would lead to an average of 39.57percent rise in the quantity of electricity demanded.

The researchers indicates that for electricity demand not to shrink , PHCN should not charge an average unit price that is higher than 1.3 times of the citizen per capita income.

Chibueze, Jude and Nnaji (2013) examine the causal long run relationship between electricity supply, fossil fuel consumption, carbon emissions and growth in Nigeria used 1971-2009 period. The research uses ARDL and VECM to test the relationships. The bound result indicated the long run short run estimates that

Co_2emissions is highly responsive to changes in GDP growth, fossil fuel consumption and electricity supply in Nigeria. And indicated a positive and statistical significant in the relationship between Co_2 emissions and fossil fuel consumption, also shows a positive relationship between electricity supply and Co_2 emissions showing the poor state of electricity supply in the country.The Grange causality test shows the insignificant of electricity supply on economic growth in Nigeria.The researchers indicated that government should adopt energy planning and investment in energy infrastructure.

Busanimoyo (2012), he investigated the reaction of power disruption of productivity in the production system of Nigeria. According to him, energy enhances the output of other factors inputs like labour. He used Ordinary Least Square and the Tobit models to analyse the impact of these disruptions on firm output. The variables used are periods without power per month, number of hours without power per day, percentage of productivity lost due to disruptions in power. The result shows a negative and significant effect on production. He suggested that government should create ways of enhancing energy production and supply in the country.

AlawiyeAbideen (2011), he used qualitative research method to critique the impact of electricity and industrial development in Nigeria. The findings indicate that there is a positive impact from the power sector on the industrial development of Nigeria.

Tang Qing and Liu (2012) investigated the connection of energy consumption and economic growth in China, using 1985-2009 period. The analyses revealed a long-term stable equilibrium connection between GDP and the explanatory variables.

Obas John (1996) researched on the causal directions among energy supply constraints on economic growth in Nigeria and Tanzania. He used DW statistics to test the presence of autocorrelation in the model from 1960 to 1984 for Nigeria and 1960 to 1981 for Tanzania. The finding shows the simultaneous causal relationship among energy and economic growth.

Chapter3

ENERGY AND THE NIGERIAN ECONOMY

3.1 Introduction

Nigeria has abundant material and human resources. Nigeria is the six largest world exporters of crude oil and largest oil-producing country on the African continent (Iwayemi, 2010). Nigeria and Libya, account for two-thirds of crude oil reserves in Africa. In Africa, Nigeria is position as the highest producer of natural gas. Most African bitumen and lignite reserves are found in Nigeria (Luka, 2012). The export of energy is the backbone of Nigerian economy and the economy is blessed with natural resourceswhich dictate the nation's industrial raw materials. There is a gross dependence on oil product in Nigeria, with the evident that oil revenue as a percentage of the nation's total export earnings, soared from 13.5to 96.5 percent of crude oil reserves from 1956 to 1979 respectively. The crude oil production has accounted for 30 percent of GDP and 80 percent of total government revenue (Energy Commission of Nigeria, 2003).

There are two main energy markets in Nigeria, the petroleum products and electricity. These main energy markets have two energy paradoxes. First is the petroleum products paradox. Despite the huge deposits of petroleum resources in Nigeria, until very recently, Nigeria experienced protracted crisis in meeting domestic demand for gasoline, diesel, kerosene and liquefied petroleum gas. These products paradox is evident in the persistent fuel shortages derived from the

coexistence of massive fuel imports with large excess nominal domestic refining capacity. The second is the electricity supply paradox. It is a paradox because while South Africa's electricity generating capacity is presently over 40,000 megawatts, the generation of just 6,000 megawatts (MW) of electricity remains elusive to Nigeria despite the availability of oil and gas, hydro and coal, as well as efficient human resources. This has presently made Nigeria the largest importer of generators in the world. (Iwayemi, 2010).

The inability to achieve the necessary breakthrough in the energy sector by utilizing the huge energy reserves in Nigeria has not only led to a continuous fall in the supply of energy, but has retard economic development. Without vastly improved access to affordable energy services, of which oil, gas and electricity constitute the dominant input in providing these services, sustainable development and improved living standards in Nigeria would be a mirage. The economic development of Nigeria therefore depends largely on how its energy resources are harnessed.

3.2 Electricity reform in Nigeria

3.2.1 Pre-reform Era

Energy power generation in Nigeria began in 1896, started years back in Lagos after the introduction in England. In 1929, a privately owned Nigeria electric supply company (NESCO) was established. There was no government body to control electricity generation nationwide, so the Electric Corporation of Nigeria (ECN) established in 1951 to take over assets of NESCO. It was initiated to reduce costs and improve the rate of energy production to conform to the anticipated extension of economic activities. But due to the crisis in electricity sector and the anticipated hydro consequent upon NESCO'S record on Nigerian electrification, NDA (Niger

Dams Authority) was established in 1962 developed hydroelectric power project at Kainji in River Niger. Authorities are set to govern the construction and maintenance of dams to provide hydro electricity by means of water power. And also encourage and promote fish brines and irrigation. The NDA electricity production was sold to ECN to deliver and trade at adequate voltages. Netherlands Engineering Consultants (NEDECO) and Balfour Beauty in 1961 developed a hydro electrical power for River Benue and river Niger. It was established to improve on the current power capacity in the country. From 1956 to 1961 the capacity of hydroelectric power inIjora B station was increased from 2MW to 30MW. This shows an improvement.

3.2.2 Post-Reform Era

The Niger Dam Authority (NDA) was entrenchedby 1962through thegovernment to supervise dams in Nigeria. For this reason,NDA and ECN were merged together to form National Electric Power Authority (NEPA) in 1972. The ECN was mainly createdto distribute andsales electricity in Nigeria,while NDA were responsible to build and control generating stations and maintained the transmission lines. The main aims were to improve the supply and distribution of power in the country. The actwhich created NEPA as a monopoly prevented it from pressures of competition. It operated for many years as a monopoly under the supervision of the Federal Ministry of Power. The Board of directionwere appointed by the government and agree to its obligation to the government which can repeal the board at any time. For this reasonthe organization became an object of patronage by different government in power. The bureaucratic nature and civil service like environment discouraged the direction of innovation and profit making.

The total installation of NEPA's power production capacity was over 5000MW made up of eight production stations, 28 major transmitting stations and 45 distributing

region (Okoro, 1999). The production stations wereshared in the form of three hydro-based stations at Kianji, Jebba and Shiroro with a mixed capacity of 1930MW,the five Thermal stations inAfam, Sapele, Egbin, Ughelli and Ijora with a mixed capacity of 3708MW. The demand was put between 2400 and 3000MW in 1999 (AkaraKiri, 1999; Kasali, 1999).

The Nigerian Energy division is undeveloped described by shortages and low supply of power (Ebohon, 1992). The country faced severe energy challenges due to low electricity production from domestic power plants which are basically not efficient, indicating the low maintenance culture in the country. The infrequent electric supply made residential homes, institutions and industries to run self electric power generators at high cost to them and the economy as a whole (Adurodija et al, 1998). Due to low supply, among 1991 and 1992, 7438 producing sets were imported despite been expensive (Akarakiri, 1999).

The over increasing population in Nigeria also contributed to the inefficiency in the electricity generation capacity with no visible plan to sufficiently improve theproduction capacity, cause the demand of electric power to exceed available power supply. This problem lead Nigeria into a critical situation, which made the Federal Executive council (FEC) to acknowledge the National Electric Power Policy (NEPP) in 2001. These leadto changes of ownership, management and supervision of the power sector. The NEPP 2001 set the roadmap for Nigerian's power sector privatization, which was sign into law in 2005. The signed document became the Electric Power Sector Reform Act of 2005. NEPA was incorporated into Power Holding Company of Nigeria (PHCN) plc, consist of 18 separate successor companies that took over the assets, liabilities and members of NEPA, and

areresponsible for the production, transmitting and distribution. Because of low supply, the government took a bold step to confront the problems. August 2010, the Roadmap for Power Sector Reform was drawn by the government in which target were set for increase in capacity of each sub-sector of the electricity market.

Nigeria plans to enhance the efficient of hydroelectricity generation capacity by 2020 to 5,690MW.Nigeria is privatizing the state-owned PHCN hopping it will improve the level of investment and increased power generation in the country. The regulatory body in Nigeria are;

1.The Federal ministry of power: is a government agency aim at dealing with policy formulation and provide direction to other agencies involved in power sector in Nigeria. They promote and in the progress of implementation of schemes for the provision of adequate and reliable electricity supply in the country.

2. Nigerian Electricity Regulatory Commission (NERC): they regulate the production, transmission, distribution and marketing of electricity.

3. Energy Commission of Nigeria (ECN): they coordinate and supervise all energy functions and activities.

4.Rural Electrification Agency: they promote, support and provide availability of electricity access to rural areas in Nigeria.

3.3 Major Energy Resources in Nigeria

Nigeria is well endowed with huge reserves of various types of both renewable energy resources and non-renewable energy resources. The renewable energy sources are the ones which when tapped, can easily be replaced within a relative short time by nature or man-made processes (Ajayi, 2003:103). They include hydro,

solar, fuel-wood. They are non-depletable on consumption. Apart from large hydropower and some form of biomass, renewable energy utilization relative little negative effects on the environment (Sambo, 2009). They are therefore energy resources suitable for sustainable development.

Non-renewable energy resources (also called fossil fuels) on the other hand include fuel, gas, tar sands and coal in Nigeria.

3.3.1 Renewable Energy Resources

Hydropower sources are renewable energy gotten from water or rivers. Hydropower energy is the most used type of renewable energy, and there are much small and big potential for hydropower development in Nigeria. The small hydropower sites are seen in almost all parts of the country with capacity of 3500MW.A large hydropower potential was equivalent to about 32% of the entire installed, grid-connected production capacity of electricity in Nigeria by early 1999, and the potential for hydropower development in the country was estimated to be 20,000 to 30,000MW (Stern, 2000). The large hydropower potential of Nigeria is concentrated on the River Niger and River Benue, both having important distributaries which drain large catchment areas such as the Kaduna River in the north and Cross River in the east (Ajayi and Enendu, 2003). This source of power does not affect the environment and the water can be put to use for several purposes.

Wind energy is produced as a result of the differentiated heating of the earth's surface by solar radiation. Wind speed can be converted into wind energy for use in many parts of Nigeria (Adegbulugbe, 1993 and Ajayi, 2003). Wind speed is weak in the southern parts, but strong in the coastal areas and the hilly regions in the northern parts of Nigeria. Wind energy conversion systems produces electricity by means of wind turbines. This does not harm the environment but is costly to manage.

Solar energy is received on the earth as electromagnetic radiation. Solar energy is the type of energy that is produce from the sun and can be attracted through the solar panels. This source of energy is free and does not affect the environment. It is costly because we do not see the sun for twenty four hours.

Biomass energy is a type of energy derived from biological sources like wood, aquatic animals, forage grasses, shrubs, residues and wastes from forest products, agricultural products, industrial effluents (such as sugar cane molasses) and municipal solid wastes especially from the high-density urban centres. More than 40 million tonnes of sawdust, wood shavings, wood barks, waste timber and wood chips are estimated to be generated annually in Nigeria. Husks from rice and other grains, animal dungs and poultry droppings are all sources of biomass in Nigeria.

3.3.2 Non-Renewable Energy Resources

Nigeria is gifted with different forms of fossil energy type. Burning fossil fuels contribute to global warming and green house effect by upsetting the natural balance of carbon dioxide ($Co_{2)}$. These are resources which can run out sooner or later and cannot be replaced.

Crude Oil

The first search for oil in Nigeria started in 1908 by a German company called the Nigerian Bitumen Corporation. Its operations were disrupted by World War 1. The second exploration was by the Shell BP Company of Nigeria in 1937, but this was again disrupted by the Second World War which ended in 1945. The company continued exploration after the war until commercial oil was discovered in 1956. Other companies later joined Shell in the search for oil. Seven oil companies popularly known as the “Seven Majors” in oil exploration were involved (Anyawuocha, 1993).

Oil is the most widely use of fossil fuel. It consists of many different organic compounds which are transferred to products in a refining process.

Natural gas

Nigeria is gifted with high natural gas reserve in Africa, but has low infrastructure to expand the sector which leads to the flaring of the gas. Most of the natural gas reserves are situated in the Niger Delta. Nigeria generates about 820 billion cubic feet natural gas, consumed about 255 cubic feet mostly for electricity production where natural gas accounted for 60 percent of electricity production in 2009, because of low or inefficient equipment to produce and supplynatural gas. Nigeria flared 536 billion cubic feet gas in 2010, that is about a third of gross natural gas produced in 2010 (International Energy Agency, 2011). Natural gas is use for cooking, lighting and operation of electrical appliances.

Coal

This is the first commercial fuel used in Nigeria when 24 000tons were produced. In 1959, production was close to one million tons, before reducing to the present insignificant level, due to the reduction in demand for coal to the demand for gas and petrol for thermal power generation. Coals are of different types: Lignite, Sub bituminous, and Bituminous Anthracite.

Table 1.Energy Resources in Nigeria
Sources: (1) Nigerian National Petroleum Corporation (2007)
(2) Ministry of Mines and Steel Development (2008)

S/N	Types of Resources	Natural Unit of Reserves
1	Large hydropower	11,250 Mega Watts
2	Small hydropower	3,500 MW
3	Wind	2-4 metre per second at 10 metre height
4	Biomass:Fuel Wood	11 million hectares of forest and woodland
5	Biomass: Animal wastes	245 million assorted
6	Crude oil	36.22 billion barrels
7	Natural gas	187 trillion cubic feet
8	Coal and lignite	2.734 billion tonnes
11	Tar sands	31 billion barrels of oil equivalent

Nigeria has enough resources to satisfy her domestic energy requirements. But despite the enormous energy resources, only four, namely: hydro, crude oil, gas and coal are currently been processed and utilized on large scale. Solar and fuelwood are used in their raw forms. Only hydro and thermal are heavily responsible for the production of electricity in Nigeria. Wind, biomass and solar energy sources are grossly under-tapped in the country. Only an all encompassing strategic planning and effective implementation of the plans for the energy sector can overcome the challenges of sustainable energy supply in the country.

3.4 Demand and Supply of Energy in Nigeria

3.4.1 The Demand for energy in Nigeria

The need for energy is increasing in Nigeria, due to the result of increase in population, growth in industrial base of the nation and the pursuit of development on

the part of the citizenry. In an attempt to find out the current demand for energy in Nigeria and to project energy demand, model was analysis of energy demand which is used to model the demand structure of Nigeria energy sector.

It is obvious that increased energy demand will serve as the springboard for the transformation of Nigeria from an agrarian society to an industrialized nation. This means that for a 13% growth in Nigeria by the year 2020, there will be need for at least 312.61 metric tons of oil equivalent (Mtoes) energy in the country.The component of electricity from the total energy demand is presented below;

Table 2.Total Projected Electricity Demand in megawatts (MW)
Source: Energy Commission of Nigeria, (2006)

Scenario/year	2005	2010	2015	2020	2025	2030
Reference (7%)	5,746	15,730	28,360	50,820	77,450	119,200
HighGrowth (10%)	5,746	15,920	30,210	58,180	107,220	192,000
Optimistic (11.5%)	5,746	16,000	31,240	70,760	137,370	250,000
Optimistic (13%)	5,746	33,250	64,200	107,600	172,900	297,900

3.4.2 The Supply of Energy in Nigeria

The IAEA develop Model for Energy Supply Strategy Alternative and General Environment Impacts (MESSAGE) to find the output (to estimate the supply strategy for meeting energy demand in Nigeria). The results of the projected electricity supply by fuel mix, thermal and the contributions of biofuels in energy supply in Nigeria are presented below,

Table 3.Power Supply (in megawatts), 7 percent Growth Rate in Nigeria by fuel mix. Source: Energy Commission of Nigeria, 2008.

Scenario/year	2010	2015	2020	2025	2030
Large Hydropower	3,702	4,962	6,479	9,479	11,479
Small Hydropower	40	90	140	227	701
Wind	0	126	1,471	3,019	5,369
Solar	5	10	34	75	302
Nuclear	0	0	3,530	7,005	11,872
Coal/Lignite	0	2,393	6,515	9,305	15,815
Natural Gas	13,555	23,617	37,733	56,086	85,585
Total	17,303	31,197	55,903	85,196	131,122

This shows that using the productionplan and general environmental impacts (MESSAGE) model, projected electricity supply a 7 percent growth rate in Nigeria by 2015 will be 31,197 MW. This will be the supply from all electricity supply mix. If this can be achieved then Nigeria will have leverage over her projected electricity demand of 28,360MW for a 7 percent growth rate. The MESSAGE model suggests that there must be renewed vigour in the level of investment in energy infrastructure in the country. An achievement of this will be consistent with the millennium development goal of reducing poverty by half by 2015.It is obvious from the fore-going therefore, that all the energy supply policies of Nigeria derived from MEND and MESSAGE model can be considered as over ambitious policies and projections.

Policies that can yield the desired energy supply in Nigeria must first be targeted at tackling corruption and mismanagement in the energy sector. It must not be ambitious as time must be given for maturity of projects. There must be room for change in the orientation of the human resource of the country, especially as it affects attitude at work. There is therefore the need for an over haulage of the present policies for a more realistic policy that will yield result.

3.5 Energy Utilization in Nigeria

Energy utilization is the total units of energy consumed or used by households and firms. Efficient utilization of energy is the judicious consumption and use of energy in the nation. Efficient energy access and use is the key to growth and development of a nation.

Nigerians are living in the midst of enormous energy resources, but yet there exists gross energy poverty and poor energy access. The per capita access and the utilization of energy in Nigeria show an inverse relationship between the standard of living and the share of energy consumption. There is the dominance of traditional energy (biomass) in energy consumption. While Nigeria ranked first in the number of highest consumers of biomass energy (percentage of total energy) in 1970 and had 28.99 kilowatt-hours per capita in electric power consumption, South Africa was ranked 5^{th} lowest consumer of biomass energy; consuming only 10.4 percent of her total energy as biomass but had 2,062.04 kilowatt-hours per capita in electricity power consumption. By the year 2000, biomass formed 79.8 percent of total energy consumption in Nigeria with only 69.47 kilowatt-hours per capita as electric power consumption. South Africa on the other hand consumed only 11.5 percent of her total energy as biomass and hand 3,774.51 kilowatt-hours per capita in electric power

consumption. Ghana enjoyed 307.67 kilowatt-hours per capita of electric power consumption in 1970, 403.43 kilowatt-hour by 1980 and not less than 340 kilowatt-hour per capita in year 2000.

The domestic consumption of crude oil rose from 12,234,000 barrels in 1970 to 134,857,000 barrels in 1980. This declined to 49,345,000 barrels in 1986 before rising to 118,746,000 barrels in 1994, a high of 11,235,323 tonnes in 2002 and 10,434,146 tonnes in 2006. In terms of oil exports, the volume rose from 1,820,000 barrels in 1958 to 383,455,000 barrels in 1970. It reached a peak of 807,685,000 barrels in 1979 before falling to a low of 390,514,000 barrels in 1987. In 1994, export volume stood at 578,044,000 barrels, 780,094,000 barrels in 2001, and 823,655,000 barrels in 2005 (CBN 2005).

Electricity which was introduced into Nigeria in 1898 (Motor-Columbus, 1980) via a small generating plant in Lagos is the best representation of energy available to end users in the country. Electricity is supplied through an electricity supply mix, generated from all the energy sources in Nigeria-coal, gas, hydro, solar, and wind. Electricity consumption and transmission data reveal the low level of energy consumption in Nigeria, evident in the low level of electricity consumption per capita. This is an indicator of energy and income poverty. Very low generation of electricity has led to poor access to electricity by all sectors users' energy in Nigeria. According to the United Nation World Energy Access Report (2009), only 46.8 percent of Nigeria's population had access to electricity in 2009 and only 26 percent of the accessed population is from the rural population of Nigeria. The remaining 74 percent are urban dwellers who have access to energy. The consumers of power in

Nigeria are divided into 3 main categories, namely, residential, commercial and the industrial.

3.5.1 Industrial Utilization of Energy in Nigeria

Industrial utilization of energy refers to the consumption of energy by the industrial sector of the economy. It shows that energy consumed by all industrial sub-sectors, like mining and quarrying, iron and steel, construction, etc. Constant reliable electricity supply has become a serious problem to industries in Nigeria, and it affected the prices of goods and services. In an attempt to overcome this and introduce an energy efficient technology, differentiated prices and supply methods are used in the supply of energy to the three main user groups (industries, commercial outfits and households). Unfortunately this difference has not solved the power problem in Nigeria. Nigeria's power sectors are bedevilled by rotating blackouts, which at times is indicated by total grid failure. Attention giving to power efficiency investments in industries is very low and strongly influenced by the priorities of those responsible for the company or building management.

The total energy used in Nigeria required more than two-thirds of it to meet the demand of industries. Only 26 percent of total electricity output was distributed to the industrial sector in 1990. This percentage continued to fall, that only 18 percent of total output was transmitted for industrial utilization in 1994 and about 20 percent of the total energy output in 2008 (CBN, 2008).

3.5.2 Commercial Utilization of energy in Nigeria

Commercial utilization of energy is the energy consumed by wholesale and retail trade, street lighting and public sector operations such as public administration and defence, education and other community, health and social and economic service activities. Commercial utility such as the services of hotels and restaurants, post and

telecommunications, financial intermediation, computer are all classified under the commercial class of energy utilization. Petroleum constitutes over 80 percent of the energy consumed by commercial users in Nigeria (Sambo, 2009).

Between 2002 and 2010, coal constituted an average total of 0.04 percent of the total commercial primary energy commercial primary energy consumption in Nigeria. Petroleum products on the other hand accounted for an average of 78.71 percent. While hydro accounted for about 16.08 percent, natural gas accounted for just 5.17 percent of the total share of commercial consumption within the same period (CBN, 2011). In 2008, commercial and street lighting accounted for about 24.7 percentages consumed inNigeria (CBN, 2008).

3.5.3 Residential Utilization of Energy in Nigeria

Residential utilization is the used of power supply by households. It is easily supplied, cheap and very efficient for use by households especially those in the rural areas. In Nigeria about 0.120 million tonnes of fuel wood is utilized daily. The utilization of electricity in the country is highest by residents. Households alone consume an average of fifty percent of the total electricity consumption in the nation. About fifty percent of total power output was used by residents in 1990, 51 percent in 1998 and not less than 55.3 percent by 2008 (CBN, 2008). The share of residential consumers for energy is about 60% of the total power output in Nigeria.

The revenue collection however is the proportion of residential consumers is consequently high for some reasons. The residential consumers offer lower tariff structure. Secondly, a large portion of residential consumer is unmetered, and is only billed on average consumption. Registered number of consumer population is higher than the number of metered used by consumers. These figures reveal that more than

30 percent of the residential consumers are unmetered. Unpaid bills have been accumulated and there are currently no effective policies for handling bad debts in the sector.

3.6 Issues in Optimal Energy Pricing in Nigeria

Optimal pricing and availability of energy are of great concern to all dwellers in Nigeria. A number of industrial actions in the country are concerned with the hike in the price of energy resources especially petroleum products. Any change in the pricing of energy products in Nigeria at any point in time affects the welfare of the people. The issue of energy pricing is very sensitive in Nigeria. In the early part of 2012, economic activities were literally paralyzed for over one week in Nigeria because of energy resource pricing (petroleum products). There were serious disagreements between the government of Nigeria, labour, trade unions and civil society organization.

3.6.1 Petroleum Product Pricing and the issue of Subsidy

The pricing of crude oil and refined petroleum product as well as the issue of subsidy removal on domestic petroleum products have served as topical debates in Nigeria. While the successive administrations of the federal government have advocated for complete removal of subsidy on the products and questioned the rational for uniform pricing across the country, many Nigerians argue against the liberalization of the petroleum sector. Those on the part of the government often argue that the interplay of the invisible hand in the domestic energy market will reduce the burden borne by the government in paying for subsidy and afford government more resources for other developmental projects in the country. The advocates of liberalization believe that optimal petroleum pricing can only be achieved when subsidy is completely removed. This would also lead to supply adequacy, efficiency in product distribution,

an end to hoarding, smuggling and black market and the institution of an ideal petroleum product pricing policy which would reflect location and local costs considerations.Revenue from the oil sector is not judiciously utilized on major sectors of the economy, but siphoned by corrupt leaders into private accounts for personal use. This shows the insensitivity to the plight of over 80 percent of the country's population who are already leaving below the poverty line (2 US dollars per day).

3.6.2 The Optimal Pricing of Electricity

The Nigerian powertariff is currently the lowest in the world. There is a notification for an upward review of the electricity price from June 1, 2012, but labour unions and the Nigerian people are ready raging and calling for a reversal in the policy or the government will experience a complete shutdown of the economy. Most Nigerians expect public utilities to be provided for free or at a cheaper rate. Corrupt practices by previous governments failed to invest more in electricity infrastructures or even pay debts on previous investments in the sector. With a 2.3 percent population growth rate in the country and the sensitivity of the role of electricity in national development, the present leadership in the country is faced with the challenge of facilitating an appropriate electricity pricing policy (optimal price) that would encourage private sector investment in the sector without any undesired breakdown of law and order or distortion in macroeconomic aggregates in the country.

3.7 Effects of Underutilized Capacity and Inadequate Energy Supply in Nigeria

The inability to utilize the available energy resource base in Nigeria has some effects. The immediate effect is the mounting demand for energy without a

corresponding supply in the country. Inadequate investment in the sector has led to inadequate infrastructures for full utilization of available capacity. Other effects are discussed below;

3.7.1 Impacts of Energy Supply on Nigeria's Economy

While adequate energy supply triggers expansion in all productive sectors of an economy and an increase in growth rates, an underdeveloped (underutilized) energy sector leads to inadequate energy supply and contraction in economic activities in a nation. Because of limited investment in the energy sector of Nigeria, energy supply is limited. Industrialists and businessmen have decided to seek alternative means of power supply through generators to their firms. This has led to increase in cost of transportation, cost of production and high prices of products in Nigeria. The result is the distortion of the macroeconomic aggregates of the nation such as increase in the rate of unemployment, inflation and low investment in Nigeria. Others include loss of external reserves to the government. This is evident in the huge scare foreign exchange expended on energy products such as generators, refined petroleum products and bitumen for road construction.

3.7.2 Energy Supply and Sectoral Outputs in Nigeria

Inadequate supply of energy creates an un-conducive work environment. It worsens the performance of socio-economic infrastructures such as telecommunication, water supply and the use of modern gadgets that ease work. This reduces the aggregate output of workers from the various sectors of the Nigerian economy. A government official who is meant to work for at least 8 hours per day may spend 4 out of 8 hours waiting for power supply. The same thing befalls those without an option of alternative power supply in the private sector. The end is low productivity and revenue loses to firms and government establishments.

Energy supply has affected large scale modern of agricultural operation in Nigeria because large scale mechanized agriculture requires adequate energy supply. Nigeria therefore, cannot ensure food security for her population if she depends on her sectoral output. Inadequate supply of energy products such as cooking gas and kerosene has accelerated the exploitation and consumption of fuelwood in Nigeria. The effect is an increase in the rate of depletion of forest reserves, with its serious implications for soil conservation and a negation of the afforestation and desertification policies of the government.

3.7.3 Energy Supply and Poverty in Nigeria

The word poverty was first used in AD 1075 (Cox, 2004). It means a wide range of issues ranging from income by households, access to social services, inability to participate in society economically, culturally and politically. It is the state of having little or no resources at one's disposal, being materially destitute and being involved in different forms of deprivations, including vulnerability and exclusion from society (Cox and Healey, 1999). With the abundant energy resources in Nigeria, it is expected that, poverty should be unheard of in Nigeria, but the reserves is the case.

Inadequate energy supply has increased the poverty trend in Nigeria. Money meant for other economic issues in households and firms is spent in providing alternative power sources such as generators and petroleum products to power up generating plants. In some cases the economic heads of the families have died due to power surge in houses and offices or in attempts to provide alternative power supply. Sudden power outages in hospitals especially in the processes of surgeries have claimed many lives and worsened the incidence of poverty in the country. Although, there has been tremendous growth in Nigeria, it has not translated into improvements

in the living conditions for the generality of the people, and consequently, it is not a sufficient condition for poverty reduction.

Many attempts have been and are still being made to reduce poverty in Nigeria, but these attempts only succeed in wasting Nigeria's resources enriching the few rich who parade themselves as poverty alleviators. Nigerians were core poor unlike the 13 million in 1985, an indication of rising poverty level. Over 80 percent of rural dwellers in the country are living in crushing poverty (CBN, 2005).

Nigeria is the 27th poorest country in the world and ranked 140 out of 182 countries of the world. Ranked 146 out of 174 in Human Development Index (HDI) in 2010, Nigeria has 94 per 1000 live birth infant mortality, less than fifty percent of Nigerian population has access to clean water because of the inadequate power supply to power water works, and effectively distribute drinkable water to end users (Ujah, 2004 and CIA World Factbook Demographic Statistics, 2010).

Chapter 4

METHODOLOGY AND FINDINGS

This chapter gives the empirical analysis of the study to arrive at a logical conclusion. Econometric methods have been used in analyzing the empirical data to demonstrate the impacts of energy demand on economic growth in Nigeria. The aim of this study is to examine the causality between electricity consumption, fuel price and economic growth, and to find out the policy implications from the results.

4.1 Model Specification

This paper makes use of annual time series data for Nigeria, using period between 1970 and 2012. The sources of data were from WorldBank statistical database and CBN statistical bulletin. Weused econometric methods of co-integration and Granger causality for this study. The variables used in this study are electricity consumption, fuel price and economic growth. The analysis is designed to show the presence of regression equation, economic growth as a dependent variable, on electricity consumption and fuel price. First we examinedif the variables contain a unit root to confirm the stationarity of each variable, we usedthe Augmented Dickey–Fuller tests (ADF) (Choi, 2001) and Philips–Perron (PP) tests (1998). Then we estimate whether a long-run co-integrating relationship existamong the variables by using the Johansen and Juselius (1990) approach. And if the variables integrated at order one and co-integrated, then the short-run elasticity can be estimated using the vector error correction model (VECM) by Engle and Granger (1987).

4.2 Test for Unit Root

Time series econometrics by assumption should be stationary (Gujarati, 2009). Hence, before deciding on a model, atest for each variable on stationarity should be carried out. This will help to describeif the variables are explanatory, also identify regressand in the explanatory and to show the order of integration.A model in it level form thatdo not reject hypothesisstating a presence of unit root, and at first difference conforms no unit root, this may be problematic. ADF and PP (1988) is used for testing presence of stationarity. **Augmented Dickey Fuller test** is a test for stationarity which has been used to correct unit root test.The equation below is an example of ADF test:

$$\Delta Yn = \beta_1 + \beta_2 t + \delta^* Y_t + \sum_{i=1}^{h-1} \alpha_i \Delta Y_t + \in_t$$

$$\alpha_i = -\sum_{k=i+1}^{h} \delta k \qquad\qquad \delta^* = \left(\sum_{i=1}^{h} \delta_i \right) - 1$$

Placed $\in_t$ as the structure of errors which assumed absence autocorrelation, ΔY_nshows represent regressand series; n = trend; βstand for intercept; h = lag level, it usedAkaike Information Criteria (AIC) model to assure that errors are white noise. The unit root equation aboveshows general modelcomprises of intercept and trend. **Phillips-Perron test** is a non-parametric method that eliminates high order serial correlation in a series. Both ADF and PP tests are tailored towards establishing possible presence of unit roots; i.e. non stationary variable. Any variable found to be non-stationary at level form, will be test using the first difference and then apply the causality test.

4.3 Cointegration Test

Thistest by exploringavailablecointegrationas well as the long run equilibrium between selected economic variables. Granger (1981) pointed out that a non stationary time series regressed on another non stationary time series can indicate a false regression. Also, to take regression of a time series with other integrating order can lead to a problematic result in the model. For example**,** provided that X and Y are both non-stationary, one would expect that a linear combination of X and Y would be a random walk. Notwithstanding, the two variables may have a particular combination of Y = X-bZ is stationary. However, if this is true, then it means X and Y are co-integrated. If X and Y are non-stationary and co-integrated, it means any standard Granger-causal inferences will be unreasonable. Accordingly, more extensive estimation of causality based on an error-correction estimate, should be conducted. And also when, X and Y are both non-stationary the linear combination of the series of two variables is non-stationary, it will be necessary to test for the Granger-causality. Hence, it will be necessary to test the co-integration property of the series from electricity consumption, fuel price and economic growth prior to operating the Granger-causality test. If the series are integrated of the same order, then we can continue to test for the presence of co-integration. Long run relationship exists when variables co-integrate at level form. However, short run equilibrium exist when they co-integrated by first difference.

4.4 The Error Correction Model

At level form when variables co-integrate, they are seen to have long run connection, but where they co-integrate at first difference, short run stability is established. This short run equilibrium will most likely with time converge in the long run. This adjustment process is tested with the ECM, assume X_t~I(1), Y_t~I(1) is entrenched,

then ΔY_t, ΔX_t and (Y_t - θX_t) are I(0). The error correction model can then be expressed as:

$$\Delta Y_t = \delta(\Delta X_t) + \tau(Y_t - \theta X_t) + \varepsilon_t$$

The mathematical work defines the alternative of Y_t near the long run flow caused by or associated to the variation in X_t around the long run trend.

4.5 Granger Causality Test

Katircioglu (2009) stated that with the absence of stationarityin the time series, the result might be false and as such avert the end based on causality model. Toda and Phillips (1993) developed a method used to handle granger causality: the Block Exogeneity Wald acces under the vector error correction mechanism (VECM).

$$\Delta \ln Y_t = C_o + \sum_{i=1}^{m} \beta_i \Delta \ln Y_t + \sum_{i=1}^{n} \alpha_i \Delta \ln X_t + p_i ECT_t + \varepsilon_t \qquad (X \rightarrow Y)$$

$$\Delta \ln X_t = C_o + \sum_{i=1}^{m} \omega_i \Delta \ln X_t + \sum_{i=1}^{n} \theta_i \Delta \ln Y_t + \eta_i ECT_t + u_t \qquad (Y \rightarrow X)$$

u_t and ε_t are serially uncorrelated stochastic disturbances with zero mean respectively. In each case the block exogeneity test for causality under a restricted model is associated with test on the significance of α*'s* and θ *'s* conditionality with optimal lag lengths *m* and *n*. Also, we test to see if *Y* granger causes *X* in short-run by using a multiple rank F-test and t-test under a null hypothesis (H_0): Y does not granger cause X. when null is rejected, then we accept an alternative hypothesis (H_1): Y granger cause X. The mathematical computation of F-statistic can be derived from the equation below:

$$F = \frac{(\mathrm{RSS_r} - RSS_u)df_u}{RSS_u(df_{r-}df_u)}$$

This pointRSS_r and $RSS_u$to represent the residual sums of squares within restricted and unrestricted models, respectively; shows thatdf_r and df_u are the degrees of freedom within restricted and unrestricted models.

4.6 Empirical Results and Findings

As mentioned earlier, the research examines the causal relationship between electricity consumption, fuel price and economic growth for Nigeria. The data used are from the period of 1970–2012. The nominal GDP series are transformed into real GDP in constant 2010 US dollar. The variables used in this research are: electricity consumption (LEC), real GDP, Fuel price. The reason for including fuel price in this research is because Nigeria totally depends on fuel (natural gas) for power.

The diagram below shows the relationships of the variables in this study. Real GDP and electricity consumption shows a positive relationship, as growth in the country increase, electricity consumption also increase. The fuel price diagram shows how it fluctuates.

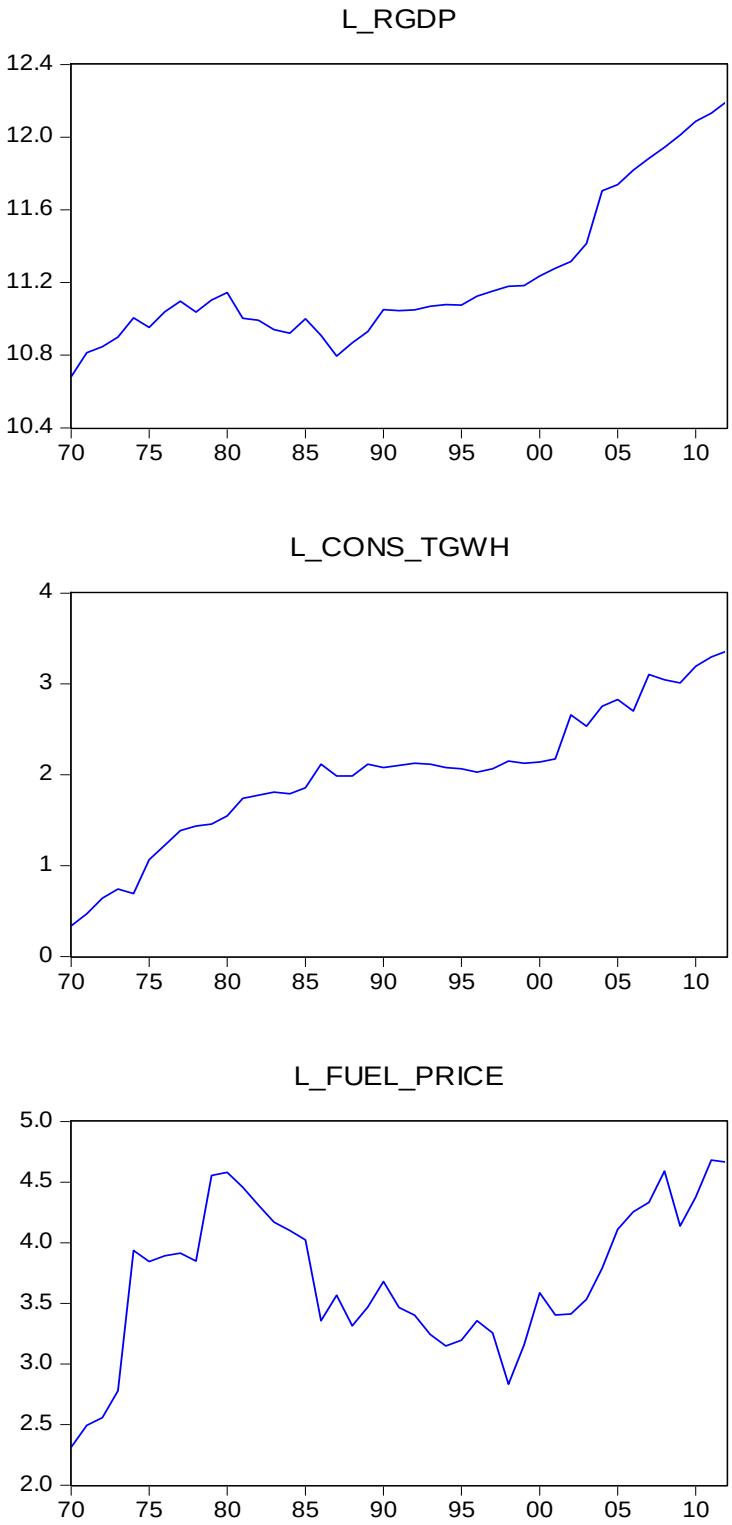

Figure 1. The relationships of the variables

4.6.1 Empirical Results

Prior to the estimation of a term relationship among economic variables, the stationarity property was defined employing the Augmented Dickey Fuller (ADF) and Phillip Perron (PP) methodology. Phillip Perron test is included to integrate residual variance that eliminates auto-correlation in the process of unit roots test. The unit root test result of LRGDP, LCONS, LGEN, LFP, LCOMM, LRES and LIND variables are presented in Table 4. It has two sections, the first shows the level form and the second section shows the test result after taking first difference. After taking the level form of each series we realize that all the variables are not stationary except in industrial consumption, but after taking the first difference they all conform to the stationarity property. This means the variables integrated at first order ≈ I(1). This shows that estimating a longrun relationship for the variables may be problematic because they are not stationary. So we rely on a shortrun relationship with an inclusion of the ECM, which will tell us the speed of adjustment from the shortrun to the longrun.

It is essential to see if the variables converge in the long run since they all integrate at first difference suggest there is possible relationship among variables. To identify the number of co-integrating vector, we test for co-integration of variables using the Johansen and Juselius (1990) approach. We can see the co-integration result in Table 5. According to this result, it shows that there is a Co-integration equation which shows a long run equilibrium relationship between Real Gross Domestic Product, Electricity consumption (EC), Fuel price (FP). The implication here reveals that electricity consumption has a long run relationship with economic growth in Nigeria and vice versa. The result gives cointegration results indicating the number of cointegrating vector in this model; *lngdp = f(lnEC, lnFP).*

According to the results, it shows that at least there is one cointegrating vector in the specified model. Therefore, lngdp = f(lnec, lnfp,) is a cointegration model.The variables rgdp, cons, fuel price, shows that there is atleast two cointegrating vector indicates a strong longrun connection between the three variables. This creates some strong argument for a long run relationship existing among domestic output, electricity consumption, fuel price. Reasons for including fuel price in this research is because most of the power plants in Nigeria depend on fuel (natural gas), and so if the price of fuel goes up, cost of production will be high and this will cause consumption to decrease, then GDP in Nigeria will go down.

Table 4. ADF and PP unit root test

Statistics (Level)	**Rgdp**	**lag**	**Comm.**	**Lag**	**Cons**	**lag**	**Fp**	**lag**	**Gen**	**lag**	**ind**	**lag**	**res**	**lag**
τ_T (ADF)	-0.126	(0)	-2.652	(1)	-2.500	(0)	-2.094	(0)	-2.653	(1)	-3.892**	(0)	-2.529	(1)
τ_μ (ADF)	1.286	(0)	-0.457	(1)	-1.306	(1)	-2.140	(0)	-3.172**	(1)	-4.027*	(0)	-2.198	(1)
τ (ADF)	3.304	(0)	1.572	(1)	1.791	(3)	0.851	(0)	2.652	(0)	-0.180	(2)	3.014	(1)
τ_T (PP)	-0.328	(3)	-3.873**	(2)	-2.434	(4)	-2.109	(2)	-3.098	(5)	-3.843**	(2)	-2.761	(3)
τ_μ (PP)	1.070	(3)	-0.627	(5)	-1.382	(3)	-2.147	(2)	-4.517*	(10)	-3.994*	(2)	-2.481	(6)
τ (PP)	2.677	(4)	2.599	(16)	2.808	(4)	0.894	(2)	2.355	(3)	0.137	(27)	2.723	(0)
Statistics (First Difference)	**∆lnrgdp**	**lag**	**∆lncomm**	**Lag**	**∆lncons**	**lag**	**∆lnfp**	**lag**	**∆lngen**	**lag**	**∆lnind**	**lag**	**∆lnres**	
τ_T (ADF)	-6.024*	(0)	-10.122*	(0)	-8.380*	(0)	-6.349*	(0)	-8.263*	(0)	-5.461*	(2)	-8.445*	(0)
τ_μ (ADF)	-5.516*	(0)	-10.227*	(0)	-8.409*	(0)	-6.419*	(0)	-7.554*	(0)	-6.103*	(1)	-8.220*	(0)
τ (ADF)	-1.884***	(2)	-9.870*	(0)	-2.018**	(2)	-6.305*	(0)	-1.205	(3)	-6.185*	(1)	-3.382*	(1)
τ_T (PP)	-6.027*	(2)	-11.259*	(7)	-8.347*	(3)	-6.349*	(1)	-8.292*	(1)	-24.206*	(40)	-8.439*	(1)
τ_μ (PP)	-5.605*	(4)	-11.249*	(6)	-8.357*	(3)	-6.419*	(1)	-7.483*	(3)	-11.149*	(15)	-8.206*	(1)
τ (PP)	-4.902*	(4)	-9.8967*	(1)	-6.644*	(5)	-6.305*	(1)	-5.876*	(4)	-11.371*	(16)	-6.655*	(3)

Note:RGDP represents Real GDP; GEN is the electricity generation gwh; CONS is the electricity consumption gwh, COMM is the commercial consumption mw, IND is the industrial consumption mw, RES is the residential consumption mw and FP is fuel price. All the series are at their natural logarithms. τ_T represents the most general model with a drift and trend; τ_μ is the model with a drift and without trend; τ is the most restricted model without a drift and trend. Numbers in brackets are lag lengths used in the ADF test (as determined by AIC set to maximum 3) to remove serial correlation in the residuals. When using the PP test, numbers in brackets represent the Newey–Westbandwidth(asdeterminedbytheBartlettkernel)(Katircioglu,2009).

Table 5. Co-integration results for overall model

Variables	Trace statistics	5% Critical value	1% Critical value
Rgdp,l-cons-gwh and l-fuel-price (VAR lag=3)			
$H_{0:}$ r=0	43.98	29.68	35.65
$H_{0:}$ r≤1	15.98	15.41	20.04
$H_{0:}$ r≤2	2.12	3.76	6.65

Error Correction Model

This is the short run equilibrium model that incorporates with the long run transmission mechanism. Since the unit root at level order exist at first difference for all policy targets and they cointegrated at same order, a possible long run relationship is investigated among rGDP, electricity consumption and fuel price. The normalized coefficients are estimates of possible long run relationship under an unrestricted model. However, because the variables are stationary at first difference (short run feature), we computed a regression equation under the error correction framework to include a transmission mechanism from short run to long run equilibrium. From table 6, it shows that a 1% increase in previous years energy consumption will lead to 0.9% increase in the current real gross domestic product respectively. And for fuel price 1% increase will lead to an average of 0.03% decrease in the current real GDP. Error Correction Model (ECM) is -0.107. This implies that short run values of real gross domestic product converged toa long run equilibrium level by 11% speed of adjustment every year, taking about ten years structural adjustment to desired state of equilibrium as defined under the unrestricted model. The declining rate of disequilibrium of electricity consumption and fuel price signifies a long run transmitting mechanism for economic growth in Nigeria.

After estimating error correction model for growth in GDP, growth in consumption and growth in fuel price, it shows a positive relationship between electricity consumption and real output, and is very significant. But rGDP and fuel price shows that there is a negative relationship which follows the apriori expectation, because output will increase when more is supply. If the price of fuel increase real GDP will decrease because of the negative relationship. When the price of fuel is high it will affect consumption by reducing the amount of electricity that will be consumed. In this case the consumption of electricity in the three major part of electricity consumption (industrial, commercial and residential consumption) in Nigeria will be affected negatively due to the increase in price of electricity. This will lead to a decrease in the growth of the country. This will be in the interest of policy makers to make case for investment in the energy sector to keep the pace with the growth in GDP. If the price of fuel increase real GDP will decrease because of the negative relationship. Since the gap between consumption and generation in Nigeria is affected by the lost in transmission and distribution. In addition, the error correction model shows that both electricity consumption and fuel price have elastic impact on growth showing a positive and negative impact respectively. The VECM results support this argument. Then what type of causality exists among the variables? This question is resolved using the Granger causality test under the VEC framework (block exogeneity test).

Table 6. Error Correction Model

Cointeg Eq:	LRGDP	C	LCONSGWh	LFUEL	ECT
CointEq 1	-1.000	-9.436	0.918 (0.113) (8.103)	-0.029 (0.112) (-0.260)	-0.107 (0.055) (-1.941)

Granger Causality

This test was performed to explain the accurate transmission lines among economic variables and growth(lnrGDP, lnEC and lnFP); the block exogeneity test for 1(1) condition was also carried out. The result is shown on Table 4, shows that electricity consumption does not affect economic growth in Nigeria. But it indicated that real GDP causes electricity consumption. That is, economic growth affects electricity consumption for Nigeria. The result shows a unidirectional causality between consumption and GDP. It supports the story that rich countries consume more. Because when the country's output increase, they have more money to invest and produce more power. Relationship between fuel price and GDP shows that fuel price has a unidirectional causality on GDP but only in the long run. Under the aggregate supply and demand model, if fuel price increase the cost of production will increase. This will cause the real output to drop. Empirically, the Granger causality shows that fuel price has a unidirectional causality on GDP but only in the long run. And also shows that fuel price granger cause consumption in the short run and long run. The result shows that fuel price have effect on electricity demand. Higher price lower demand and lower price higher demand. This shows that since Nigerians electricity supply depend on oil, higher price of fuel will make electricity to be costly.

Considering causality among energy consumption and economic growth, result in table 7 promotes an assertion that economic growth in Nigeria has a unidirectional causality on electricity consumption in a short run and long run instance. In this case, an improvement in economic growth in Nigeria will improve electricity consumption.

Table 7. Granger causality test for energy consumption, fuel price and economic growth

Null hypothesis	lag 1		lag 2		lag 3		Remark
	F-stat	t-stat (ECT)	F-stat	t-stat (ECT)	F-stat	t-stat (ECT)	
L_CONS_TGWH does not Granger Cause L_RGDP	0.038	0.009	0.285	5.652*	1.811	3.541	GDP→CONS
L_RGDP does not Granger Cause L_CONS_TGWH	6.957**	5.790**	5.743***	5.289*	4.550***	5.689	
L_FUEL_PRICE does not Granger Cause L_RGDP	7.311***	1.613	3.700**	1.043	2.782*	1.274	FP→GDP
L_RGDP does not Granger Cause L_FUEL_PRICE	3.361*	0.259	1.715	3.109	1.148	9.443**	
FUEL_PRICE does not Granger Cause L_CONS	2.313	2.157	1.376	6.560**	4.080**	13.436***	FP→CONS
L_CONS does not Granger Cause FUEL_PRICE	0.087	1.302	1.263	0.687	0.995	3.653	

Impulse Response Function

The estimated impulse response functions and variance decomposition are estimated to show the innovations in one standard deviation changes in the variables. Since our main scope of the research is ascertain the impacts of the listed independent variables on output, we shall rather lay more emphasis on how the output reacts to a given change in any of the variables of interest. From figure 2 shows the response of RGDP to a one standard deviation innovation on itself is persistent but positive. Also a given one standard deviation change in electricity consumption will leave a positive impact on RGDP. As expected, higher electricity consumption will drive upwards domestic production and a higher expected output. However, we have seen that a negative downward trend to a one standard deviation shocks in oil prices. Equally shocks to the prices of oil will leave a negative effect to real output for the economy. It is also not a surprising revelation since oil has been the main revenue generation in the economy, any shock associated with oil prices is indeed a bad omen for the economy.

Variance Decomposition

Variance decomposition is used to help in the interpretation of a vector autoregression model. It shows the level of information each variable contributes to other variables. Table 8 indicates that own shocks accounts for the highest impact on itself. This means about 70% forecast of GDP the expectation of a shock on output, which is positive within the forecast of ten years. A given shock in electricity consumption will also signal a raise in output from 0.8% in the first year to a more than unity in the 10^{th} year. This is also consistent with the findings using the impulse responses. A shock in oil prices will lead to a 2% change in output within the first year and continues to increase to more than unity.

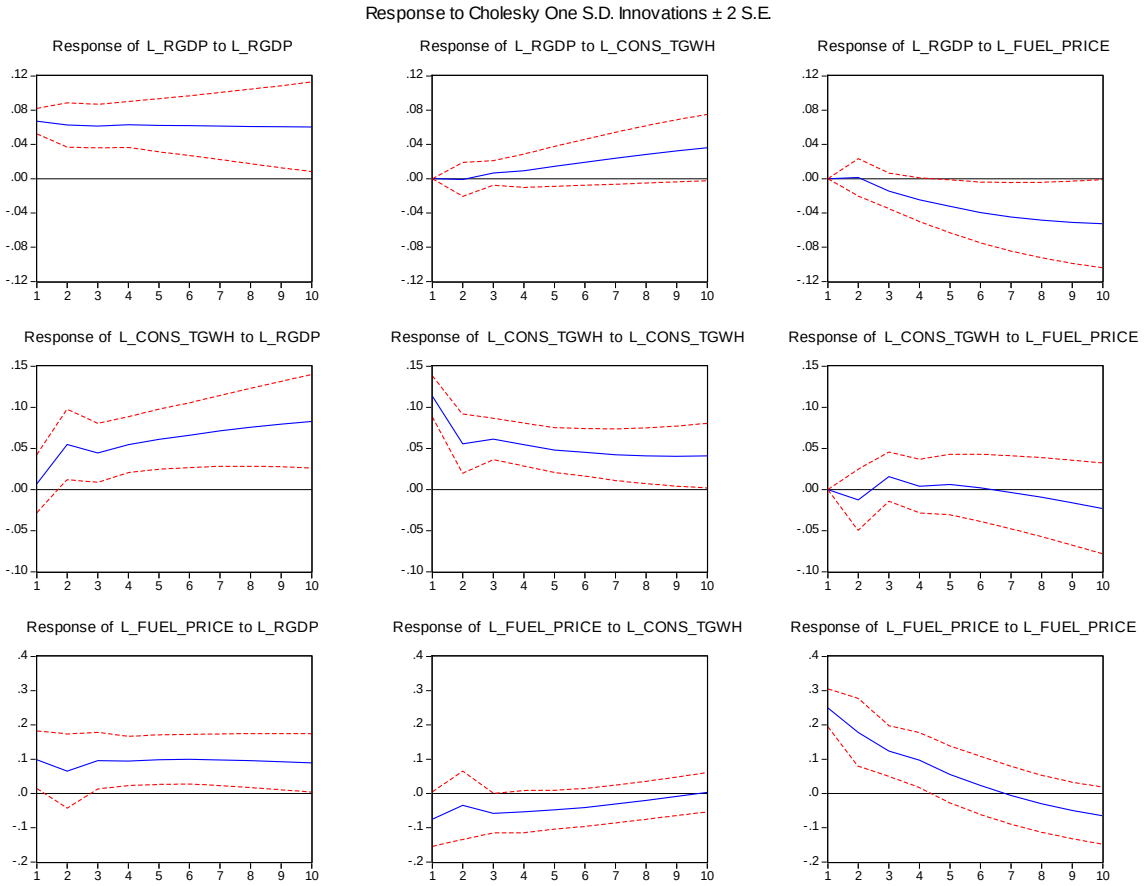

Figure 2. Impulse Response

Table 8. Variance Decomposition

Variance Decomposition of L_RGDP:				
Period	S.E.	L_RGDP	L_CONS	L_FP
1	0.067	100.00	0.00	0.000
2	0.091	99.969	0.008	0.022
3	0.115	97.957	0.362	1.679
4	0.130	94.44	0.760	4.794
5	0.149	90.097	1.517	8.385
6	0.167	85.244	2.510	12.244
7	0.185	80.521	3.690	15.788
8	0.202	76.124	5.014	18.861
9	0.220	72.195	6.419	21.384
10	0.237	68.772	7.864	23.3629

Chapter 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Nigeria is recently named as the biggest economy in Africa. Its power generation level remains a big challenge to the country. The period between mid 1980's towards the end of 1990's, data in this study shows evidences that there was no investment in the power sector. For a country with such an increasing trend in real activities, it is believed that energy supply is paramount for sustainable real sector operations. This study has further identified that there is a huge gap between the energy generated for on-grid supply and the end user consumed energy. In the case of Nigeria, this gap is as a result of the weak/old transmission and distribution facilities, and also caused by theft, i.e. Illegal connections which often do not reflect in the official information of what is sold to the market. Over the past few years the situation of power supply in Nigeria has deteriorated. Industries and commercial enterprises now rely more on self captive generators to run their daily businesses. These captive generations increase the marginal cost of operating in such power deficient environment like Nigeria. Those firms that could not afford further inclination in their marginal cost are strategically conditioned to move to neighbouring nations.

The major goal of the research was to examine the causal relationship of electricity consumption, fuel price and real economic output, and also to empirically examine if there is any long-run convergence among the real economic output with power sector

development. Taking from this research, real Gross Domestic Product was modelled as a function of electricity consumption and fuel price. According to the analysis, the following are the result to the study: Annual time series data were employed using 1970 to 2012 periods. The ADF and PP Unit root tests and Johansen co-integration tests were applied. The ADF outcomeshows a non-stationarity at level for the variables other than industrial consumption. But they all become stationary after first difference. From the analysis; it shows a longrun relationship exists among real gross domestic product and Electricity. Because Rgdp, electricity consumption and fuel price co-integrate at 1% and 5% levels, this shows that long run co-integration relationship exist between variables that were used.

The estimation of Vector Error Correction model shows an adjustment towards the long-run equilibrium. It indicates that any short-run disruption of the economic conduct in the long-run equilibrium will adjust in some years as implied by the indication. The test of Error correction mechanism shows that; a positive relationship exist among real gross domestic product and electricity consumption, but for fuel price it shows a negative relationship among the real gross domestic product and fuel price. Models were estimated to test the direction of Granger-causality. The outcome show that uni-directional causality runs from economic growth to electricity consumption with no any feedback result. Hence, a growth in real GDP is responsible for the great level of electricity consumption in Nigeria. In conclusion economic growth results in a relative amount of real GDP spent on electricity consumption, to stimulate future electricity consumption.

The result shows that electricity consumption and fuel price affirmed to the apprior expectation because electricity consumption is positively related to economic growth while fuel price is negatively related to economic growth.

5.2 Recommendation

To resolve the bad situation of inefficient consumption of electricity in Nigeria, policies should be appointed to govern the supply of power by ensuring a good maintenance of distribution facilities to boost the supply and enable increase in consumption especially to the industries, households and health sectors. Laws should be established by the government to stipulate power projects with efficient supply, transmission, distribution structure to meet the energy demand of Nigeria.

Total population in Nigeria consume both Petroleum and Electricity and consume few of other resources. From the outcome of this work, it shows that real growth in domestic output affect power consumption in Nigeria. We can recommend that Nigerian government should efficiently improve the supply of power since it has been found that economic growth influence energy demand. And also encourage optimal production and utilization of energy resources to boost the supply of power in order to bridge the gap between demand and supply of electricity in Nigeria. Policies should be set to ensure efficient installation of facilities. This may help to improve the supply of electricity to the consumers.

Research should be encouraged to improve development in the energy sectors to encourage innovation and provide reliable information on power distribution. Petroleum product has the majority share in energy generation and consumption in Nigeria. It is advisable to diversify the source of energy to avoid over dependant on

fuel. The machinery should be upgraded to ensure efficient used in the country. However, when energy prices are too high, it affect consumption to avoid this cost of production should be made affordable especially to the low income class. Government should increased funding in energy sector because it is certain that the energy sector is capital intensive and would require large amount of investments. It is necessary to encourage improving industrial and agricultural productivity. And also increase the budgetary allocation to the energy sectors. The public and private sector can form a partnership agreement to. The private, public partnership project could be carried out to encourage increase in the provision of power and tackle the investment problem. The old and weak transmission lines should be replaced with new ones to eliminate the inequality in the energy supply to the residential users, the commercial customers and to industrial consumers.

Anyone caught in vandalising and theft of energy resources should be punished. Security should be ensured to safeguard the energy equipments.

To bring to fruition Nigeria's quest of becoming one of the developed nations in the year 2020, it is recommended for Nigeria to increase its power generation capacity from the existing Watts to atleast 30Giga Watts in the first instance, increase access to electricity to about 80%, and enact laws to increase energy conservation rate to about 90% as obtained in developed nations of the world.

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