National Development and Unemployment Reduction in the Power and Energy Sector: 2050 Nigeria population in Focus

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Abstract

This paper attempts to examine the relationship between electricity transmission and distribution on Gross Domestic and National Development in Nigeria; Also population access to electricity consumption against the background of unemployment reduction in Nigeria using co-integration technique of estimation, descriptive statistics for the period covering 1990-2014. The study used the electricity transmission and distribution and consumption data readily available from WDI as against that provided by the Central Bank of Nigeria Statistical Bulletin, since the latter exhibited some form of inconsistencies from time to time. The study conducted a unit root testing to ascertain the stationery status of the data series; as theories as proofed the non-stationary of most economic data in level state. The series were found to contain unit root, hereby necessitating the incorporation of the differencing mechanism at first-order integration. The study found the existence of a unique co-integrating relationship among the variables in the model, as well the VECM estimates indicates a possibility of a long run convergence with high speed of error correction. The indicator of electricity transmission, distribution and consumption was found to exert a very significant impact on growth and employment creation. In line with the obtained result, there exist a bi-directional causal relationship between electricity transmission, distribution, consumption and economic growth. The inelastic impact of electricity transmission, distribution, consumption on growth, as obtained in the analysis; therefore call for the need to strengthen the effectiveness of energy generating agencies by ensuring periodic replacement of worn-out equipment and necessary tools in order to drastically reduce power losses as well as seek alternative sources of power considering comparative advantage.

***Keywords**:* National Development, Unemployment Reduction, Power and Energy, Sector & Population

Introduction

Energy plays the most vital role in the economic growth, progress, and development, as well as poverty eradication and security of any nation. Uninterrupted energy supply is a vital issue for all countries today. Future economic growth crucially depends on the long-term availability of energy from sources that are affordable, accessible, and environmentally friendly. Security, climate change, and public health are closely interrelated with energy. Energy is an important factor in all the sectors of any country's economy. The standard of living of a given country can be directly related to the *per capita* energy consumption. The recent world's energy crisis is due to two reasons: the rapid population growth and the increase in the living standard of whole societies. The *per capita* energy consumption is a measure of the *per capita* income as well as a measure of the prosperity of a nation Aliyu, , Ramli, & Saleh, 2013).

Energy supports the provision of basic needs such as cooked food, a comfortable living temperature, lighting, the use of appliances, piped water or sewerage, essential health care (refrigerated vaccines, emergency, and intensive care), educational aids, communication (radio, television, electronic mail, the World Wide Web), and transport(ECNUNDP,2015). Energy also fuels productive activities including agriculture, commerce, manufacturing, industry, and mining. Conversely, a lack of access to energy contributes to poverty and deprivation and can contribute to the economic decline. Energy and poverty reduction are not only closely connected with each other, but also with the socioeconomic development, which involves productivity, income growth, education, and health.

The Nigerian Power Sector

According to the World Bank, an estimated 41% of Nigerian businesses generate their own power supply to augment the national grid supply. At 126kWh per capita, Nigeria lags significantly behind other developing nations in terms of electricity consumption. Based on the country's current demographics and global trends, electricity consumption should be four to five times higher than it is today. This imply that Nigeria requires 180,000 MW for full power, which is a massive distance away from the new government's target of 10,000MW by 2020(Fagbenle, & Karayiannis, 1994)

Poor access to electricity in Nigeria has been a major impediment to Nigeria's economic growth. SMEs have been adjudged as the engine of economic growth but its performance is grossly dismal due to inadequate power supply. Researchers have identified the increase in energy use as a vital component of emerging economies; economic growth of the South Asia Association for Regional Cooperation (SAARC) countries. Over the past decades successive governments have endeavored to tackle Nigeria's energy deficit problem by maintaining a monopoly in power provision and pumping money into the poorly managed sector. Since the return to civilian rule in 1999, governments have spent on average about US$2bn annually on electricity provision, but with little service improvements to show for it. However, in August 2010 the then president, Goodluck Jonathan, launched the Power Sector Reform Roadmap, which was aimed at shifting the running of power utilities to the private sector. It included the privatization of the state-owned Power Holding Company of Nigeria (PHCN). And when in late 2013 almost all of the six power-generation plants and 11 distribution companies unbundled from PHCN were eventually sold, there was high public expectation that the new owners would bring a rapid end to frequent power outages in Africa's largest economy. There has been some improvement in recent months. Power generation reached a new peak of 5,075 mw on February 3rd. But current levels of supply and the overall production capacity of around 6,427 mw remain grossly inadequate (Gujba, Mulugetta, & Azapagic, 2011). For example, Nigeria has a lower electricity capacity than Slovakia, a country with about 3% of Nigeria's population.

The privatised electricity firms may have been freed of the state bureaucracy that previously hamstrung their operations, but these utilities still encounter a myriad of structural problems that continue to hamper growth in the power sector. These include shortage of gas supply for thermal plants, high levels of unpaid electricity bills and the country’s outdated and poorly maintained transmission network, which the government still owns but put under private management in 2012. Indeed, the transmission network cannot handle much more load than current peak electricity production. Unsurprisingly, many of the new power operators have struggled to make progress, especially as they have had to contend with ageing facilities requiring substantial amounts of investments to upgrade and expand (Adekoya, & Adewale, 1992).

To help the companies to get on their feet the Central Bank of Nigeria in early 2015 launched a N213bn (US$1.1bn) Nigeria Electricity Market Stabilization Facility to provide operators with soft loans. The government has also raised prices paid by electricity consumers under the Multi-Year Tariff Order (MYTO), introduced in June 2012 to gradually make tariffs more cost-reflective to encourage private investment. The latest adjustment in the current MYTO (2015-2024), which took effect on February 1st, raised prices by an average of 45%. In Lagos, Nigeria's commercial capital, small residential power users now pay N24 (US$0.12) per kwh, and heavy domestic users pay N29 per kwh.

Trade unions, anti-poverty groups and politicians have condemned the rises, saying that they are unjustified because there has been no significant improvement in services delivered by power companies and that the new charges are unaffordable to the majority of the population who exist on low incomes. The nation's two main central labour organisations, the Nigeria Labour Congress and the Trade Union Congress, have organised protests in major cities across the country to demand the reversal of the tariff increases. In mid-February the Senate, the upper chamber of the National Assembly, also passed a resolution calling for the revocation of the tariff rises. Senators contended that the tariff is retrogressive and amounts to extortion and exploitation of ordinary people.

The points made by the critics reflect the grievances of consumers, both households and businesses, who have suffered years of incessant power outages that have blighted lives and curtailed productive activities. However, the contention that electricity companies must first improve their services before raising prices may seem morally sound but is inconsistent with how a market economy works. Power providers need to invest substantially more money in equipment and employing skilled manpower to improve services—this process will take time and invariably raise production costs. To sustain the production of any good or service in the medium to long term requires the producer's revenue to at least cover their costs. In the case of electricity and other infrastructure services this cost is paid by either the end consumer or by government through subsidies or a combination of both.

Projected Population of Nigeria in 2050

Nigeria is projected to be the world’s third most populous country by the year 2050, according to a report released by the UN Department of Economic and Social Affairs. Statistics by experts show that by 2040, Nigeria’s population growth would have quadrupled without commensurate amenities and employment to sustain it. The report, titled ‘World Population Prospects: The 2017 Revision’, said with such development, Nigeria would overtake the United States in terms of population just as world population would reach 9.8 billion people. The report said “by

2050, the third most populous country will be Nigeria, which currently ranks seventh, and which is poised to replace the United States. "Among the 10 largest countries of the world, one is in Africa (Nigeria). "Amongst these, Nigeria's population, currently the seventh largest in the world, is growing the most rapidly. "Consequently, the population of Nigeria is projected to surpass that of the United States shortly before 2050, at which point it would become the third largest country in the world. "In 2050, the populations in six of the 10 largest countries are expected to exceed 300 million: China, India, Indonesia, Nigeria, Pakistan, and United States of America (in alphabetical order). "Africa, which has the youngest age distribution of any region, is projected to experience a rapid ageing of its population, the report noted. "Although the African population will remain relatively young for several more decades, the percentage of its population aged 60 or over is expected to rise from five per cent in 2017 to around nine per cent in 2050, and then to nearly 20 per cent by the end of the century." In addition, the birth rates in African countries are likely to "at least double" by 2050, according to the report.

Also, the report puts Nigeria's Births per 1, 000 population at 39; Deaths per 1, 000 population at 14; Net Migration Rate per 1, 000 population at -0; Infant Mortality Rate at 69; Total Fertility Rate at 5.5; Percent of Population who are less than age 15 as well as those that are age 65 and above at 43 and 3 respectively; GNI in Dollars as at 2014 at 5, 680; and the Percentage of population living in Urban areas at 50. It also puts Nigeria's Population per Square Kilometre of Arable land at 520 and Percent of Married Women between ages 15 and 49 using All Methods, as well as Modern Methods of Contraception during copulation with their spouses at 15 and 10 respectively. This rapid growth in the number of people over 65 will put a huge cost burden on the working young and the high fertility and population growth rates in the a developing nation in Nigeria. That will put even more economic, social and political pressure on the countries of the developed world.

Statement of the problem

Nigeria's electricity supply industry operates far below expectation with energy capacity at around 3,500MW to support a current population of over 180 million and projected population of 392 people in 2050. Even when Nigeria holds the unofficial title as Africa's pioneer in unbundling and privatizing its electricity sector? Baring in mind that the nature of this 'success' is multifaceted in so far as the process was successful but limited in commercial impact. Similarly, electricity generation capacity dropped to 2,329.9mw leading to losses of about #1.870bn in one day.

Take into consideration that privatised discos agreed to performance contracts under which they pledged to reduce the ATC&C losses of the disco over a five-year period. Failure to meet the performance agreements gives the Federal Government (FG) the right to repossess the asset for $1.However, due to inadequate or incorrectly calculated ATC&C losses (data that also supported the tariff structures) owners of the now privatized discos are sitting with an unacceptable high risk of not meeting the key performance indicator. How do you maintain trust in the sector under such a burden?Also, in spite of the presents administrations Power Sector Recovery Programme (PSRP) as a component of its Economic Recovery Growth Plan(ERGP) of 2015, metering and governance issues are still challenges mitigating against meaningful employment in Nigeria which has the capacity of escalating with population explosion in2050 if not checked. It's against this background that this research will address and make projections in the power and energy sector in relation to Nigeria population prosperity in 2050.

Brief Review of Literature

Economic debates surrounding the research can't explicitly link the relationship between energy consumption and economic growth to theories, though empirical evidences have stated results for about two decades. The seminal work of Kraft and Kraft (1978) presented the premier study on the causal relationship between economic growth and energy consumption; Also, research evidences have discovered a story correlation between electricity use and wealth creation (Hermann, 2001; Sorensen, 1983). Altinay and Karagol (2004) discovered a rising energy need for most developing countries; Turkey also facing an ever increasing electricity demand experienced 8.1% per annum in the average growth rates of total electricity consumption between 1980 and 2000; Nigeria also face similar trend experiencing about 23% increase in energy use between 2000 and 2008. Several studies have attempted the relationship and direction of causality between energy consumption and economic growth, Ahmed N, Hayat F.M, Hamed N and Inqman M (2012) investigated the relationship between energy consumption and economic growth in Pakistan for the period of 1973-2006 and found a positive relationship with a unidirectional causality from GDP to energy consumption. A similar study of Kouakou A. K (2010) in Cote d'Ivoire covering 1971-2008 found a bi-directional causality between per capita electricity consumption and per capita GDP. A study by Ouadraogo N.S (2012) for fifteen countries of ECOWAS from 1980-2008 using a panel cointegration technique found GDP and energy consumption as well as GDP and electricity to exhibit a long-run co-integrating relationship, likewise found a unidirectional causality running from GDP to energy consumption. Ciarreta A. and Zarraga A (2007) using a standard Granger causality test in a VAR found a unidirectional linear causality running from real GDP to electricity. Also, a premier work from by Morimoto R and Hope C found electricity supply to have a significant impact on variation in GDP in Sri Lanka; the result obtained is similar to Yang (2000). Several studies, most especially in developing economies have found electricity consumption to be a significant determinant of GDP growth

The Energy Future

The world will need much more energy to power homes and fuel transport for a growing population with rising living standards. But to counter climate change, energy must increasingly come from lower-carbon sources. Our know-how, technology and innovations are helping to deliver more, cleaner energy. Lives and livelihoods, economies and communities depend on convenient, reliable and affordable energy to prosper and grow. People today have never been more connected. More and more of us are enjoying better opportunities, better health and a higher standard of living.

Most of the energy we use today comes from oil and coal, and increasingly from natural gas. These hydrocarbons power, heat and cool homes and workplaces, and fuel transport systems that take us to work or school, or bring us to a holiday destination. They enable industries that sustain our lives, and provide the chemical ingredients to make most of the products we buy – like the device you are using to read this page. Global demand for energy is rising, driven by growing population with rising living standards.

By 2050 the number of people on the planet is forecast to grow to 9 billion - that's nearly 2 billion more of us than today. Many people in emerging economies will join the global middle class. They will buy refrigerators, computers and other appliances that consume energy. And many will buy cars, more than doubling the number on the road.

Energy and Sustainable Development in Nigeria

Sustainable energy involves the provision of energy services in a sustainable manner, which in turn necessitates that energy services be provided for all people in ways that, now and in the future, are sufficient to provide the basic necessities, affordable, not detrimental to the environment, and acceptable to communities and people. Linkages between sustainable energy and factors such as efficiency and economic growth have been investigated. The energy sector plays a pivotal role in attempts to achieve sustainable development, balancing economic and social developments with environmental protection (encapsulated in the 'strap line' for the 2002 Johannesburg World Summit on Sustainable Development of 'people, planet, and prosperity').

Energy services are essential ingredients of all three pillars of sustainable development - economic, social, and environmental. Economies that have replaced human and animal labor with more convenient and efficient sources of energy and technology are also the ones that have grown fastest. No country in modern times has succeeded in substantially reducing poverty without adequately increasing the provision and use of energy to make material progress. Indeed, by not ensuring a minimum access to energy services for a broad segment of the population, economic development of developing countries such as Nigeria beyond the level of subsistence has proven to be a real challenge.

At the national level, energy propels economic development by serving as the launch pad for industrial growth and, via transport and communications, providing access to international markets and trade. Reliable, efficient, and competitively priced energy supplies also attract foreign investment - a very important factor in boosting economic growth in recent times. At the local level, energy facilitates economic development by improving productivity and enabling local income generation through improved agricultural development (irrigation, crop processing, storage, and transport to market) and through non-farm employment, including micro-enterprise development. As an indicator of local recognition of the importance of energy for businesses, Nigerian manufacturers, who were asked to rank the constraints on their firms' activities, identified power breakdowns, and voltage fluctuations as their top two problems. Recent developments in Ghana's energy sector support this point (Ajayi, 2009).

The connection between energy, the environment, and sustainable development is worth highlighting. Energy supply and use are related to climate change as well as such environmental concerns as air pollution, ozone depletion, forest destruction, and emissions of radioactive substances. These issues must be addressed if society is to develop while maintaining a healthy and clean environment. Ideally, a society seeking sustainable development should use only energy resources which have no environmental impact. However, since all energy resources lead to some environmental impact, an improved efficiency and environmental stewardship can help overcome many of the concerns regarding the limitations imposed on sustainable development by environmental emissions and their negative impacts.

Energy is directly linked to the broader concept of sustainability and affects most of civilization. That is particularly evident since energy resources drive much if not most of the world's economic activity, in virtually all economic sectors. Also, energy resources, whether carbon-based or renewable, are obtained from the environment, and wastes from energy processes (production, transport, storage, utilization) are typically released to the environment. Given the intimate ties between energy and the key components of sustainable development, the attainment of energy sustainability is being increasingly recognized as a critical aspect of achieving sustainable development (Duru-Oguzie, 2015)

The reform of the energy sector is critical to sustainable development in Nigeria. This includes reviewing and reforming subsidies, establishing credible regulatory frameworks, developing policy environments through regulatory interventions, and creating market-based approaches such as emission trading. Globally, countries are developing strategies and policies to enable a sustainable development of their energy resources, thus contributing to fuel economic and social developments, while reducing air pollution and greenhouse gas emissions.

4.1 Data Presentation

Table 4.1.1

YEAR	UR	AE	EPTDL
1990	4.8	27.3	38.4164
1991	4.4	33.55838	37.58029
1992	3.4	34.61891	38.57355
1993	2.7	35.67639	27.85246
1994	2	36.72775	34.3249
1995	1.8	37.76992	37.71836
1996	3.4	38.79987	41.47017
1997	3.2	39.81451	42.27214
1998	3.2	40.81081	40.75177
1999	4.7	44.9	43.8374
2000	13.1	42.73761	38.14762
2001	13.6	43.67113	38.71427
2002	12.6	44.5923	37.53075
2003	14.8	52.2	33.39279
2004	13.4	46.42185	31.08136
2005	11.9	47.34236	23.70534
2006	12.3	48.27478	31.07313
2007	12.7	50.13092	11.53277
2008	14.9	50.3	9.422075
2009	19.7	51.19199	5.865399
2010	21.4	48	17.21603
2011	23.9	55.9	9.547237
2012	24.3	54.26991	8.656727
2013	28.5	55.6	15.11962
2014	30	56.37191	16.10727

Trend analysis for variables

Fig 1

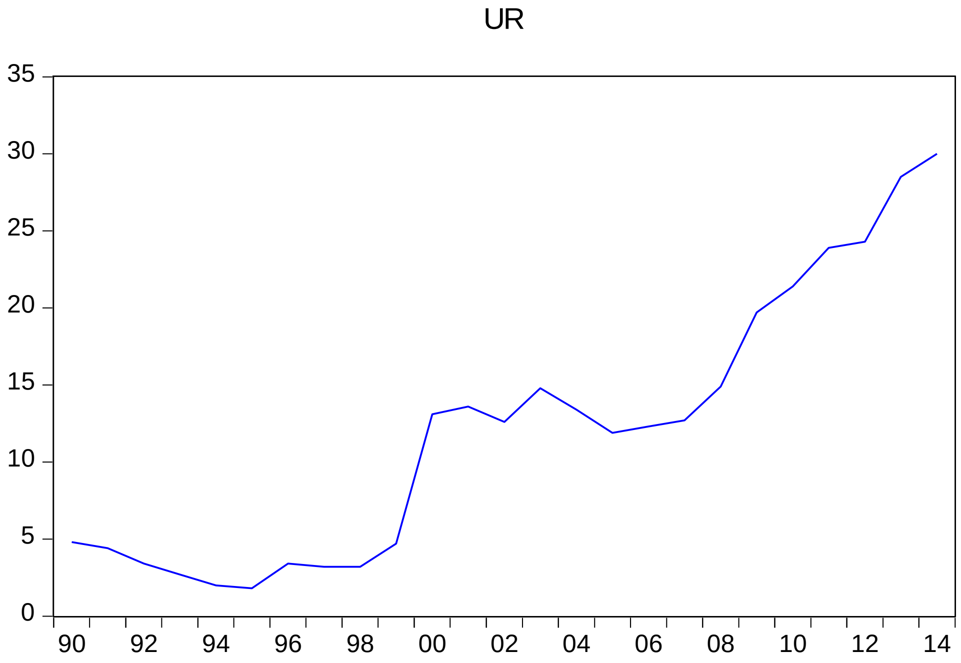

Fig 1 shows the trend analysis of unemployment rate from 1990 to 2014 in Nigeria with the y axis representing the trend value in percentage and the x axis representing the trend in years. It could be observed that the variable have witness decrease in trend value from 1990 to 1995. In 1996 to 2005, the economy witness fluctuations ranging from increases and decreases in unemployment rate. However, from 2006 to 2014, unemployment rate is seen to be on the increase with fluctuations in the rate of change.

Fig 2

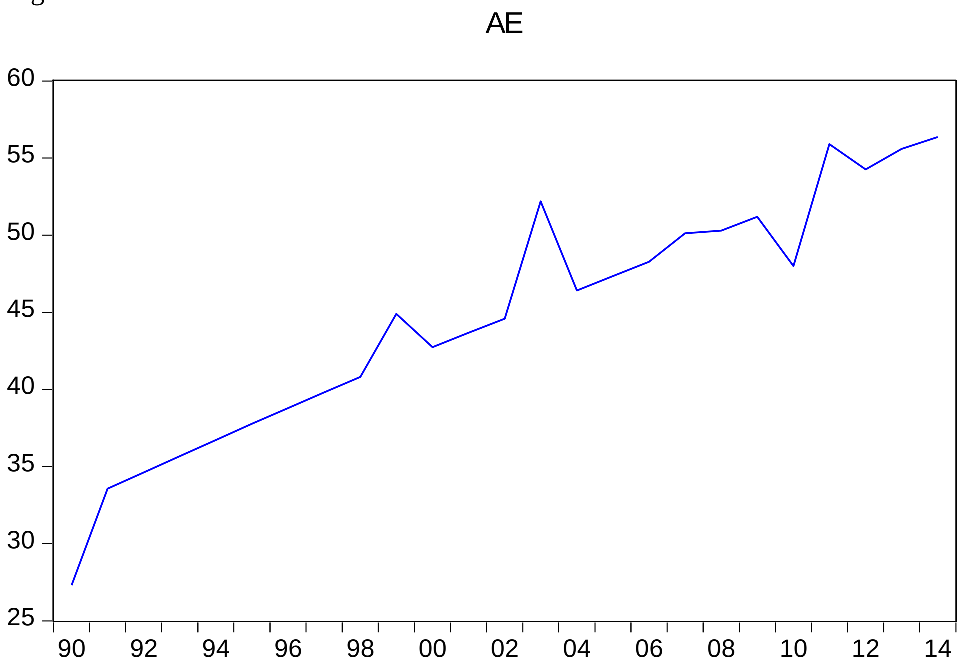

Fig 2 shows the trend analysis Access to Electricity (% of Population) (AE) from 1990 to 2014 with the y axis representing the trend value in percentage of Population that have access to electricity and the x axis representing the trend in years. It could be observed that the percentage of Population that have access to electricity in the economy have witness a steady increase in a fluctuating manner and also in a zigzag form from 1999 to 2014.

Fig 3

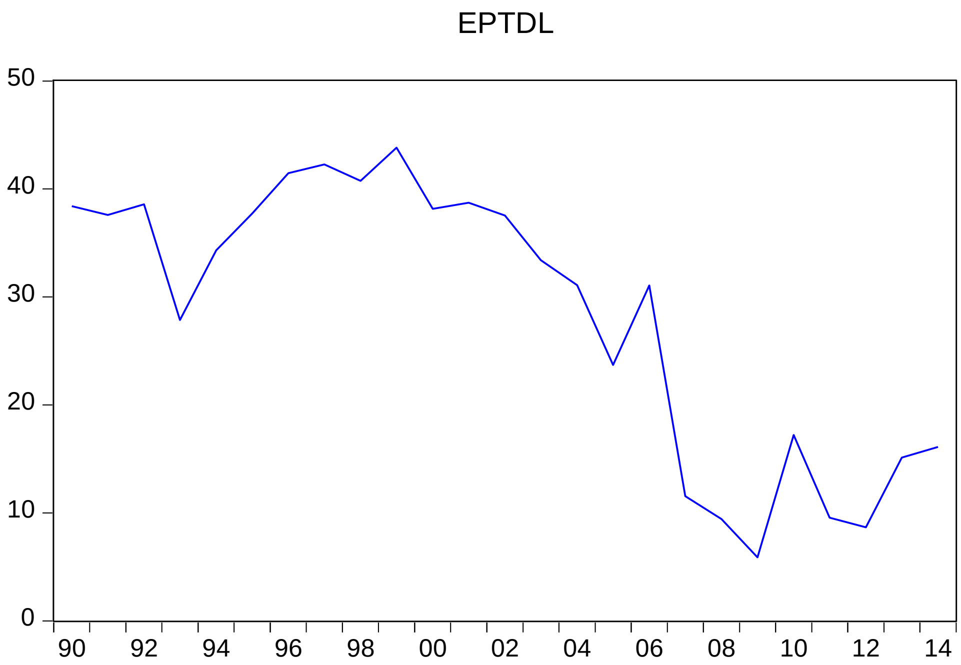

Fig 3 shows the trend analysis of Electric power transmission and distribution losses (% of output) in Nigeria from 1990 to 2014 with the y axis representing the trend value of Electric power transmission and distribution losses (% of output) and the x axis representing the trend in years. It could be observed Electric power transmission and distribution losses (% of output) witness a fluctuation in trend value from 1990 to 2014. However, in general, there have been decreases in Electric power transmission and distribution losses (% of output).

4.2 Data Analysis

The descriptive analysis of the macro-economic variables used in this study is presented in table 1 below.

Table 4.2 : Descriptive Statistics Analysis of Variables

	UR	AE	EPTDL
Mean	12.02800	44.67925	28.39639
Median	12.60000	44.90000	33.39279
Maximum	30.00000	56.37191	43.83740
Minimum	1.800000	27.30000	5.865399
Std. Dev.	8.698492	7.813507	12.68335
Skewness	0.540035	-0.289304	-0.539248
Kurtosis	2.218756	2.283111	1.723229
Jarque-Bera	1.850930	0.884081	2.909684
Probability	0.396347	0.642724	0.233437
Sum	300.7000	1116.981	709.9098
Sum Sq. Dev.	1815.930	1465.221	3860.819
Observations	25	25	25

Table 4.2 section provides some preliminary analyses involving the description of relevant statistical properties of the variables under consideration. These analyses are carried in regards to the statistical distributions of the variables. From Table 4.2, it is shown only unemployment rate (UR) is positively skewed implying that the right tail is particularly extreme as the mean of the variable is greater than its median. Also, considering the Kurtosis, from table 4.2 above none exceeds three therefore they are not peaked or leptokurtic but flat or platykurtic.

4.2.1 Unit Root Test Results

This study commenced it empirical analysis by testing the properties of the time series, used for analysis. The stationarity test on the variables was carried out using both the Augmented Dickey-Fuller (ADF) and the Philip-Perron tests and the results are presented in table 1. It was observed from the ADF test estimate on the left hand of table 1 that all the variables were integrated of order one. The results of the ADF estimate was confirmed by the Philip-Perron test result, on the other column (right hand) of table 4.2.1.

Table 4.2.1: Unit Root Test Result

Variables	Augmented Dickey-Fuller (ADF) Test Level	1st Diff	Status	Phillip-Perron (PP) Test Level	1st Diff	Status
UR	0.930711	-3.891440***	I(1)	0.830081	-3.860278***	I(1)
AE	-0.912861	-5.595417***	I(1)	-2.010433	-16.80050***	I(1)
EPTDL	-1.170604	-6.525611***	I(1)	-0.997028	-6.525611***	I(1)

NOTE: The asterisks ***, ** and * indicates significant levels at 1%, 5% and 10% respectively where the variables became stationary. The optimal lag length selected using the Schwarz Information Criterion within a maximum of 5 lags is 0. Variables are as defined in chapter 3.

A. Johansen Co-integration test

The co-integration test is used to check for long run relationship between the dependent and independent variables (Ogundipe and Amaghionyeodiwe, 2013). The co-integration test was carried out using the Johansen technique also using Eviews software package and it produced the following results:

Table 4.3.5 Test for Johansen Co-integration Using Trace Statistic

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.663360	39.55185	29.79707	0.0028
At most 1 *	0.547214	16.68826	15.49471	0.0329
At most 2	0.002341	0.049229	3.841466	0.8244

Source: Author's Compilation from E-views 9.5

From the above table the trace indicates two co-integrating equation at 5 percent level.

Table 4.3.5.1 Test for Johansen Co-integration Using Max-Eigen Value

Hypothesized No. of CE(s)	Eigen Value	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.663360	22.86359	21.13162	0.0282
At most 1 *	0.547214	16.63903	14.26460	0.0207
At most 2	0.002341	0.049229	3.841466	0.8244

Source: Author's Compilation from E-views 9.5

From the above table the Max-Eigen value indicates two co-integrating equation at 5 percent level. Based on the above tables we reject the null hypothesis of no co-integrating equations.

B. Error Correction Estimates Using Vector Error Correction Model (VECM)

Table 4.3.6. Lag Length Selection

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-57.87629	NA	14.85061	5.534209	5.682987	5.569256
1	-46.51397	18.59289*	5.803090	4.592179	4.790550*	4.638909
2	-45.10658	2.175062	5.614454*	4.555143*	4.803108	4.613556*
3	-45.07980	0.038945	6.171258	4.643618	4.941175	4.713714

In an attempt to carry out the vector autoregression estimation, the choice of lag length is paramount. We therefore utilized various lag length selection criteria: Sequential modified LR test statistic with each test at 5%, the Final prediction error (FPE), Akaike information criterion (AIC), Schwarz information criterion (SC) and the Hannan-Quinn information criterion (HQ). However each of these has different penalty factors. Some studies have chosen each of these criteria on different occasions. For instance, some have used the LR and FPE criteria. The AIC is known for long lag length while the SC for short. We adopted the HQ criterion on the ground that its optimal lag length is in- between the AIC and SC based on frequent practical experience. Therefore the optimal lag length for HQ = 2 which also equal that of all criterion. It should be noted that a higher lag length results in a loss of observation in the series.

Table 4.3.6.1. Var Residual Serial Correlation LM Test

Lags	LM-Stat	Prob
1	1.076883	0.2994
2	1.326406	0.2494
3	3.55E-05	0.9952

The LM test of residual serial correlation shows no autocorrelation among the successive residuals at any of the selected lags as shown by all probability values being greater than 5% level.

Vector Error Correction Estimates

$$\Delta UR=\beta_0+\sum_{i=1}^{n}\left(\beta_1\Delta UR_{t-i}\right)+\sum_{i=1}^{n}\left(\beta_2\Delta AE_{t-i}\right)+\sum_{i=1}^{n}\left(\beta_3\Delta INTR_{t-i}\right)+\sum_{i=1}^{n}\left(\beta_4\Delta EPTDL_{t-i}\right)+\ \varphi Z_{t-i}+\mu_t$$

Where

t-i = lag values of variables

φ = coefficient of the error correction term

Z = error correction term and is the OLS residual from the following long run cointegrating regression:

$UR=\beta_0+\beta_1 AE+\beta_2 EPTDL+\mu_i$

Note: the term, error-correction, relates to the fact that last period deviation from long-run equilibrium (the error) influences the short run dynamics of the depedent variable, thus, the coefficient of the error term (φ) is the speed of adjustment because it measures the speed at which UR returns to equilibrium after a change in the explanatory variables.

Table 4.3.6.2 Table Showing Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 05/11/18 Time: 16:16
Sample (adjusted): 1994 2014
Included observations: 21 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1	CointEq2
UR(-1)	1.000000	0.000000

AE(-1)	0.000000	1.000000	
EPTDL(-1)	0.501410	0.359854	
	(0.08417)	(0.07813)	
	[5.95678]	[4.60600]	
C	-26.12063	-55.88435	

Error Correction:	D(UR)	D(AE)	D(EPTDL)
CointEq1	-0.986003	0.050737	-0.690871
	(0.33793)	(0.24126)	(0.89638)
	[-2.91777]	[0.21030]	[-0.77073]
CointEq2	0.890895	-0.232742	-0.212983
	(0.34304)	(0.24491)	(0.90994)
	[2.59705]	[-0.95032]	[-0.23406]
D(UR(-1))	0.543086	-0.109089	0.645475
	(0.27748)	(0.19810)	(0.73603)
	[1.95721]	[-0.55067]	[0.87696]
D(UR(-2))	0.315996	-0.176590	0.418710
	(0.29196)	(0.20844)	(0.77444)
	[1.08233]	[-0.84720]	[0.54066]
D(UR(-3))	0.770432	0.666021	1.232998
	(0.32413)	(0.23141)	(0.85979)
	[2.37690]	[2.87810]	[1.43407]
D(AE(-1))	-0.255132	-0.840634	0.600183
	(0.30571)	(0.21826)	(0.81092)
	[-0.83456]	[-3.85159]	[0.74013]
D(AE(-2))	0.284709	-0.478285	1.186828
	(0.30854)	(0.22028)	(0.81843)
	[0.92276]	[-2.17128]	[1.45013]
D(AE(-3))	0.218664	-0.359283	1.495658
	(0.24289)	(0.17341)	(0.64428)
	[0.90026]	[-2.07189]	[2.32143]
D(EPTDL(-1))	0.223036	0.064929	0.071967
	(0.11256)	(0.08036)	(0.29857)
	[1.98150]	[0.80798]	[0.24104]
D(EPTDL(-2))	0.034496	0.099577	0.065130
	(0.10203)	(0.07284)	(0.27064)
	[0.33810]	[1.36701]	[0.24065]
D(EPTDL(-3))	0.029658	0.115133	-0.059997
	(0.09491)	(0.06776)	(0.25177)
	[0.31248]	[1.69907]	[-0.23831]
C	-0.335600	2.846308	-6.568521
	(1.10460)	(0.78861)	(2.93004)
	[-0.30382]	[3.60925]	[-2.24178]

R-squared	0.564924	0.868861	0.618944
Adj. R-squared	0.033163	0.708580	0.153209
Sum sq. resids	47.04917	23.98111	331.0450
S.E. equation	2.286413	1.632351	6.064881
F-statistic	1.062365	5.420852	1.328962
Log likelihood	-38.26775	-31.19152	-58.75390
Akaike AIC	4.787405	4.113478	6.738466
Schwarz SC	5.384275	4.710348	7.335336
Mean dependent	1.300000	0.985501	-0.559295
S.D. dependent	2.325296	3.023803	6.590740
Determinant resid covariance (dof adj.)		300.9603	
Determinant resid covariance		23.69075	
Log likelihood		-122.6265	
Akaike information criterion		15.67872	
Schwarz criterion		17.76776	

Source: Author's Compilation from Eviews 9.5

Estimated VECM with uras the target Variable

$$\Delta UR = -0.335600 + 0.543086\Delta UR_{t-1} + 0.315996\Delta UR_{t-2} + 0.770432\Delta UR_{t-3} - 0.255132\Delta AE_{t-1} + 0.284709\Delta AE_{t-2} + 0.218664\Delta AE_{t-3} + 0.223036\Delta EPTDL_{t-1} + 0.034496\Delta EPTDL_{t-2} + 0.029658\Delta EPTDL_{t-3} - 0.986003Z_{t-1} + \mu_t$$

The above table contains the vector error coefficient estimates. The a priori for the vector error correction coefficient (alpha) is that it must be negative. The alpha meets this expectation and this implies that 98.6 per cent of the errors are corrected in the long run. By being negative, it tells us that if there is to be a departure in one direction, the correction will have to be pulled back to the other direction so as to ensure the equilibrium is to be returned. Thus to interpret this is that above 98.6% of departures in long-run equilibrium is corrected each period.

C. Causality Test:

Here, we specify the error correction model estimates as follows in the system equation to find the p-values to determine the long-run causality as well as the short-run causality.

D(UR) = C(1)* [UR_{t-1} + 0.501410436985*$EPTDL_{t-1}$ - 26.120625164] + C(2)*[AE_{t-1} + 0.359854273149*$EPTDL_{t-1}$ - 55.8843487784]+ C(3)*D(UR(-1)) + C(4)*D(UR(-2)) + C(5)*D(UR(-3)) + C(6)*D(AE(-1)) + C(7)*D(AE(-2)) + C(8)*D(AE(-3)) + C(9)*D(EPTDL(-1)) + C(10)*D(EPTDL(-2)) + C(11)*D(EPTDL(-3)) + C(12)

NOTE: cointegreting equation is given in [ ], c(1) and c(2) are the long-term coefficient while c(3),…, c(11) are they short term coefficient.

Table 6.3.6.3. Vector Autorgression Estimates (VAR), lag length = 2

Dependent Variable: D(UR)
Method: Least Squares
Sample (adjusted): 1994 2014
Included observations: 21 after adjustments

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	-0.986003	0.337930	-2.917773	0.0171
C(2)	0.890895	0.343041	2.597050	0.0289
C(3)	0.543086	0.277479	1.957211	0.0820
C(4)	0.315996	0.291959	1.082329	0.3073
C(5)	0.770432	0.324133	2.376899	0.0414
C(6)	-0.255132	0.305709	-0.834558	0.4256
C(7)	0.284709	0.308541	0.922760	0.3802

C(8)	0.218664	0.242890	0.900261	0.3914
C(9)	0.223036	0.112559	1.981502	0.0789
C(10)	0.034496	0.102030	0.338096	0.7430
C(11)	0.029658	0.094914	0.312476	0.7618
C(12)	-0.335600	1.104603	-0.303820	0.7682

R-squared	0.564924	Mean dependent var	1.300000
Adjusted R-squared	0.033163	S.D. dependent var	2.325296
S.E. of regression	2.286413	Akaike info criterion	4.787405
Sum squared resid	47.04917	Schwarz criterion	5.384275
Log likelihood	-38.26775	Hannan-Quinn criter.	4.916941
F-statistic	1.062365	Durbin-Watson stat	1.934030
Prob(F-statistic)	0.471597		

Short-run Dynamics

The short run coefficient which are c(3), c(4), c(5) are the short run coefficient associated with the Deeping lag values in the target variable. But we are particularly interested in c(6), c(7), c(7), c(8), c(9), c(10) and c(11) because these are the short run coefficient that will tell us whether in the short-run or granger causes unemployment rate.

Hypothesis

H_0: c(6)=c(7)=c(8)= c(9)=c(10)=c(11)=0 (Access to Electricity and Electric Power Transmission and Distribution Losses does not Granger Cause Unemployment rate).

H_1: c(6)=c(7)=c(8)= c(9)=c(10)=c(11)≠0 (Access to Electricity and Electric Power Transmission and Distribution Losses Granger Cause Unemployment rate).

The Granger Causality test follows chi-square distribution with two degree of freedom (df) at 5% level of significance.

Decision rule:

Reject H_0, if $X^2_{cal} > X^2_{tab}$ (0.05) and accept, if otherwise.

$X^2_{cal} = 7.046469$

$X^2_{tab} = 12.59$

Therefore we accept H_0 and conclude that Access to Electricity and Electric Power Transmission and Distribution Losses does not Granger Cause Unemployment rate in the short-run since $X^2_{cal} < X^2_{tab}$.

Long-run Dynamics

Considering the error correction model (ECM), c(1) which represents the speed of adjustment towards long-run equilibrium. This value has to be negative and statistically significant for it to fulfil its economic interpretation. As can be seen above, it satisfied both conditions. It is negative -0.986003) and statistically significant (0.0171< 0.05). By being negative, it tells us that if there is to be a departure in one direction, the correction will have to be pulled back to the other direction so as to ensure the equilibrium is to be returned. Thus to interpret this is that above 98.6% of departures in long-run equilibrium is corrected each period.

Also since c(1) is statically significant, it implies that, our focus is on the causal relationship between Access to Electricity and Electric Power Transmission and Distribution Losses on Unemployment rate we can reject the null hypothesis states that Access to Electricity and Electric Power Transmission and Distribution Losses does not Granger Cause Unemployment rate by the rule of thumb which states that the probability of long-run term adjustment must be less than 0.5 to show causal relationship. Therefore we reject the null hypothesis and conclude that a bi-directional causal relationship exists between Access to Electricity and Electric Power Transmission and Distribution Losses on Unemployment rate in Nigeria.

D. Heteroscedasticity test

The test asymptotically follows a chi-square distribution with degree of freedom equal to the number of regressors {excluding the constant term}. The auxiliary model can be stated thus:

$$Ut = \beta_0 + \beta_1 UR + \beta_2 AE + \beta_3 EPTDL + \beta_4 UR^2 + \beta_5 AE^2 + \beta_6 EPTDL^2 + Vi.$$

Where Vi = pure noise error.
This model is run and an auxiliary R^2 from it is obtained.
The hypothesis to the test is stated thus;
H_0: {Homoscedasticity}
H_1: {Heteroscedasticity}.

Note: the sample size {n} multiplies by the R^2 obtained from the auxiliary regression asymptotically follows the chi-square distribution with degree of freedom equal to the number of regressors {excluding constant term} in the auxiliary regression. Using E-view package saves us the above rigour by calculating the chi-square value.

Decision Rule:
Reject the null hypothesis if $X^2_{cal} > X^2_{tab}$ at 5% level of significance. If otherwise, accept the null hypothesis. From the obtained results, X^2_{cal} 0.3921{12} = 12.68782 < X^2_{tab} 0.05 {12} = 21.03, we therefore accept the null hypothesis of homoscedasticity showing that the error terms do have constant variance.

E. Auto correlation test
The model is checked for autocorrelation using the Breusch-Godfrey
Serial Correlation LM Test which is shown in table below.

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.333900	Prob. F(2,7)	0.7269
Obs*R-squared	1.828921	Prob. Chi-Square(2)	0.4007

Author's Computation (2018)

There is no evidence of serial correlation as the p-value (0.4007) is greater than 0.05 level of significance.

F. Normality test
The normality test adopted is the Jargue – Bera (JB) test of normality. The JB test of normality is an asymptotic or large sample, and if is based on the OLS residuals. This test computes the skewness and kurtosis measures of the OLS residuals and it follows the chi square distribution (Gujarati, 2004).
Hypothesis
H_0: $\mu_1 = 0$ (The error term does not follows a normal distribution).
H_1: $\mu_1 \neq 0$ (The error term follow a normal distribution).
The normality test follows chi-square distribution with two degree of freedom (df) at 5% level of significance.

Decision rule:
Reject H_0, if p- value of JB > 0.05 and accept, if otherwise.
From the result obtained from Jargue – Bera (JB) test of normality, JB = 2.539913 and p-value = 0.280844, Therefore we accept H_0 and conclude that the error term follow a normal.

Conclusion
Nigeria is endowed with an average intensity of 5.25kWh/m^2 per day of solar energy over an average period of 6 hours daily. The government of Nigeria has a policy of diversifying the energy supply mix of the country to include solar energy, and in particular, electricity from solar PV.With less than 4,000MW dispatched on average over the last two years due to constraints in gas supply, electricity transmission and distribution, the energy value chain in Nigeria requires a multitude of challenges relating to infrastructure, liquidity and governance to be addressed.The lack of constant electricity supply has left consumers destitute, seeking alternative solutions – most often in the form of diesel gensets – and has garnered an unwillingness to pay for electricity consumed.The positive news is that the Federal Government recently launched the Nigerian Power Sector Recovery Programme: 2017 – 2021, which lays out plans to improve the financial capacity of Nigerian Bulk Electricity Trading's (NBET) and improve the viability of the distribution companies in the country.It is ultimately the end consumer that requires the electricity and who supports the value chain; therefore, distribution companies must be aided through policy to implement distribution infrastructure networks, metering projects and billing solutions. Clear-cut and efficient policy reforms should also be introduced by the present Federal Government in order to essentially address some of the traditional problematic issues of the electric power sector such as dilapidated infrastructure, technological deficiency, insufficient investment, poor maintenance, inefficient pricing system and corruption. This remedial proposals would definitely ensure reliable, adequate power supply and long-term energy and economic sustainability with increased standard of living and reduced cost of living for Nigerian citizens. This country needs to do all it can to really be the giant of Africa

Recommendations
1. Wind and Nuclear energy is a clean energy source with potential for consistent energy supply.
2. Nigeria also has enough uranium which is needed to fuel the nuclear plants and so, increased amount of electricity would be produced,
3. There is also a high level of solar radiation in Nigeria but it too has its own economic

limitations and a low capacity factor in addition to the high cost of Photovoltaic (PV) cells.

4. A combination of different forms of energy sources should be utilized with a clear cut focus on developing credible policy reforms aimed at attracting investments in renewable energy sources such as biofuels, wind and solar energy which Nigeria has in abundance.

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