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Institutional Quality and Electricity Supply Growth in a Developing Economy: The Case of Nigeria

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Abstract
Efficient and reliable power sector is a veritable channel for economic growth. Even with abundant electricity production sources, Nigeria's electricity production and distribution systems are technically weak. However, efforts such as the recent commercialization and privatization of the power sector have been made to solve these problems without significant success. Electricity supply processes may be affected by institutional quality. There are indications that institutional quality in Nigeria is weak and inefficient and this may affect supply of electricity in the country. Hence, this study examines the impact of institutional quality on electricity supply in Nigeria. Based on the Neoclassical Solow-Swan growth model, the study adopted the standard econometric error correction mechanism (ECM) and used time series data from 1981 to 2015. The ADF tests showed that all the variables were stationary and statistically significant and integrated of order one I(1). The Johansen cointegration results indicate existence of long run equilibrium relationships between the variables. ECM result was statistically significant with the correct sign. The speed of adjustment between the short run and long run behaviour of electricity supply variables was 59.73 percent. Institutional quality, with coefficient of -1.23 indicates that institutional quality in the country does not contribute positively to electricity supply growth. Following the above results, the study concludes that institutional quality impacts negatively on electricity supply and therefore inhibit electricity supply growth in Nigeria. The study recommends that to enhance institutional quality and therefore boost electricity supply in Nigeria, policies should be directed at enhancing institutional quality such as policies to encourage contract enforcements, enhance property rights, reduce corruption, enthrone good governance, and improve the legal and security systems.
Keywords: Institutional quality, electricity supply, energy, growth, power sector

1. Introduction

Sufficient electricity generation, transmission and distribution promote industrial operations and thus engender growth in all sectors of an economy (Ubi & Effiom, 2013; Ayodele, 2001). With adequate electricity supply, the people will be empowered to work at home and the micro, small and medium scale industries, and as well be engaged in large-scale industrial undertakings.

Electricity is generated from primary sources of energy such as solar, water, waves, wind, oil, gas, coal, tide, etc. Nigeria is well blessed with all these sources of energy. The country's annual average daily sunshine is 6.25 hours, solar radiation is averaged at about 5.25 kw/m^2/day and the country receives about $4.851x10^{12}$ kilowatts (kw) of energy every day from the sun (Solar Energy International, 2011; Odetunde, 2008). As at the year 2013, Nigeria had a proven crude petroleum oil reserve of about 37.2 billion barrels and proven natural gas reserve estimate of 182 trillion cubic feet. Its coal reserve is estimated at 2 billion metric tonnes (UEIA, 2013; Sambo, Garba, Zarma & Gaji, 2010). There is abundance of water, tidal waves and wind.

Despite the abundance of electricity production sources in the country, CIA (2014) report shows that Nigeria's net electricity generation per capita rates is one of the lowest from the global perspective. Her daily kilo watt per hour (kw/h) per capita of electricity generation for 2009 was 0.39 compared to Pakistan's 1.43 kw/h, Egypt's 4.29 kw/h, Brazil's 6.95 kw/h or China's 7.04 kw/h. Electricity distribution network and voltage profiles for the country are very poor resulting to more than 50 percent of the populace living without electricity supply (Osueke & Ezugwu, 2011). Electricity production and distribution systems are weak and susceptible to major setbacks.

The weak and inefficient system results from old and decaying infrastructure. Some of the electricity generation stations were built in the 1970s and are still being operated without major rehabilitation or upgrade. They are also poorly maintained. Also, until recently electricity generation, production and distribution has been inefficiently and poorly managed under the monopoly of a government agency, the National Electric Power Authority which later became known as Power Holding Company of Nigeria (Oyedepo, 2012).

Inadequate facilities and hence inefficiency in generating and supplying adequate electricity in the midst of increasing population, new technologies, vast geographical landscape and an increasing business environment, creates electricity supply problems. This supply inadequacy has damaging consequential effects on every sector of the Nigerian economy. This situation discourages enterprise; increases cost of business; leads to high prices; encourages unemployment and elevates poverty. This has caused Nigeria's businesses to lose huge financial resources that would have been used to promote industrial production.

As noted earlier, electricity production and distribution in Nigeria has been an exclusive preserve of a

government agency. Energy policy formulations and pattern/level of implementations are highly related to governance structure. In addition, electricity supply infrastructures and maintenance are affected by institutional quality in the country. These show that institutions may affect electricity supply.

North (1990) defines institutions as "the rules of the game in a society, or the humanly devised constraints that shape human exchange, whether political, social or economic". They also facilitate co-ordination and govern relationships between individuals and groups. Institutions play dominant roles in energy supply, while some institutions may encourage efficient energy supply, others may not (Kherallah & Kristen, 2001). According to Ojeaga, Odejimi, George and Azuh (2014), poor governance and weak institutions make policies, including energy policies, to be ineffective.

Institutional qualities include: governance, contract enforcement, corruption, property rights, legal and security system, etc. Institutional qualities in Nigeria are weak, for instance in West Africa, Nigeria is rated 13th out of 16 countries and in Africa she occupies 41st position out of 54 countries as regards good governance. Democratic processes have been interjected with autocratic military incursions during which most aspects of the constitution are changed or suppressed, and laws enacted overnight with retroactive effects. Corruption index is also very high. These create uncertainties which are inimical to investments and property rights (Oromareghake, 2013). On security, Boko Haram in the North East, cattle rustling in the North Central, Fulani herdsmen's wanton destruction of lives and properties in the Middle Belt and the East, oil pipe blow ups by militant groups in the South South, kidnapping and politically motivated killings in the West, electricity infrastructure vandalism, protests against oil price hikes, armed robberies and cultist activities in schools and streets and other vices are all security issues working against economic, social, financial and political progress of Nigeria. All these and many more may help to define energy supply status of the country.

This study is an imperative for studying and determining the relationship existing between institutional quality and electricity supply in Nigeria.

1.1 Institutional quality organs in Nigeria

i) Legal institutions: according to Soludo (2006), the supreme legal institution "is the constitution which is supplemented by the other enactments of the legislature and pronouncements of the courts. It spells out the economic relations embodied in property rights and rule of law". In Nigeria, cases abound where alternative legal institutional infrastructures weakens economic development efforts (Soludo, 2006). In periods of military rules, frequent changes or suppression of some sections of the constitution created room for uncertainties. Reforms and legal infrastructures put in place in Nigeria to strengthen the legal institutions according to Soludo (2006) include establishment of: "judiciary reforms and sacking of many corrupt judges; the Economic and Financial Crimes Commission (EFCC); Independent Corrupt Practices Commission (ICPC); the Energy Reform Bill; Anti-money laundering Act; Public Private Partnership in infrastructure provision; Pension Reform Act". Others are: "Privatization Act; Public Procurement Bill; CBN/BOFIA Acts; Mining Reform Bill; Fiscal Responsibility Bill"; and Petroleum Industry Bill. All these are geared towards strengthening the Nigerian nation and its economic base.

ii) Corruption: Akinpelu, Ogunseye, Bada and Agbeyangi (2013) laments that the highest index point Nigeria has attained in Corruption Perception Index (CPI) of Transparency International is 2.7 out of 10 points meaning that for the past 16 years, when the country has been appearing on the roll call, she has always been among the worst rated corrupt countries in the world. Ubi, Eko and Ndem, (2012) show that Nigeria recorded the highest corruption perception level in seven out of 8 corruption variables and has an index of 7.88, the highest among eight corrupt African nations. Transparency International Corruption Index of 2010 ranks Nigeria 134 out of 178 countries with 2.4 points, an increase from 130, 121, and 149 for 2009, 2008, and 2007 years' ranking respectively. The country is also ranked 22 ahead of other African countries (Transparency International, 2010). The more worrisome situation in Nigeria is expressed by Atelhe and Agada (2014), that corruption has developed a thick skin against all measures put in place to tackle it. For instance, those that are supposed to be at the forefront of the war against corruption are equally very corrupt. The battle against corruption has made Nigeria to evolve different programmes and policies, some for experimentation purposes. Such programmes and policies they assert include: "the Judicial Commissions of Inquiry; Code of Conduct Bureau; the Public Complaints Commission; Mass Mobilization for Social Justice and Economic Recovery (MAMSER)". Others are: "War Against Indiscipline and Corruption; the National Orientation Agency (NOA); Independent Corrupt Practices Commission (ICPC); the Economic and Financial Crime Commission (EFCC)"; etc. Despite all these, instead of corruption to abate, it blossoms.

iii) Security: Security issue in Nigeria is of a major concern as threats of insecurity are almost becoming a way of life in the country. Insecurity and violence, reported Alubo (2011) in Ibrahim (2013), with accompanying negative consequences has engulf the whole country Nigeria like a thick black smoke choking life out of the people and their wealth and leaving behind as its trade mark agony, pains and misery. No section of the country is spared. Between 1999 and 2003, not less than 80 major violent eruptions were recorded. As at

2001, more than 6,000 people have been reportedly killed through violence. There are cases of armed robbery attacks on the Nigerian highways, financial institutions, business premises and private houses. Cases of insurgencies and militancy are recorded in the creeks of Niger Delta. Ethnic and religiously inclined crises and insurgencies are witnessed in the North Eastern states (Boko haram), Plateau, Oyo and other states of the country which has claimed lots of precious lives and billions of naira worth of wealth, houses and even communities. All these are indication of weak and incapable security system of our nation (Ibrahim, 2013). Different grades of electoral aggressiveness were reported during 2003, 2007, 2011 and 2015 elections and by-elections in some states of the country. Kidnapping has taken the centre stage in most parts of the country and people kidnapped are released after huge amounts has changed hands in form of ransom and those that could not withstand the harrowing experience or pay ransom get killed. There are cases of torture, brutality and extra judicial killings in disguise as investigation and accidental discharge by the police who are employed and paid to save lives and properties as reported by Human Rights Report 2010. These are also indicators of the sorry state of security situation in the country Nigeria.

iv) Governance and political institutions: before colonial administration of Nigeria, the country was made up of kingdoms, small nations and ethnic entities. Traditional governance institutions held sway in all these societies and these institutions were very similar in many respects (Roberts, 2004). These traditional governance institutions were the custodians of their citizen's norms, traditions, cultures and many other practices. Though their powers have been reduced now, they are still a force to reckon with, as they are still found in all the sections of the country till date. They symbolise indigenous people's traditions, customs, laws, rights, privileges, and laws which include Paramount Rulers and their Councils, Chiefs, Elders, and title holders. The appointments of these categories of leaders were based on their personalities, contributions and probably their economic powers. Considerations were also given to issues such as contributions to the security, growth and development of their communities. These traditional institutions possessed some executive, legislative as well as judicial powers. With the world wide spread of democracy, Nigeria adopted democratic form of governance through the instrumentality of both internal and external pressures exerted on the country with the hope that democratic governance will stimulate development (Omotola, 2007; Somolakae, 2007; Jamo, 2013). The last election Nigeria had within the control of their British colonial rulers took place in the last months of 1959, this election led the nation to independence in 1960. After then, the first post colonial elections held in the last months of the year 1964 ended in crisis. About November of 1965, elections conducted into Western state house of assembly landed the country into another stream of election related crisis. Due to continued crisis, the military on January 15, 1966 took over government plunging the country into more killings and wanton destruction of properties. Elections of 1979 was conducted with intentions to kick the military out of Nigeria's political scenery they unconstitutionally wandered into, however the outcome of that election did not go down well with some parties who challenged the election results in court. In 1983 general elections, the ruling party, NPN, was returned to power amidst complains of rigging. In December of 1983, the military junta once again ceased power. Another election on June 12, 1993 was dogged by controversy and the military continued in reign until 1999 when a general election was conducted. However the 1999 election was reportedly rigged like the previous elections in Nigeria. From 1999, democracy seems to have returned to stay in Nigeria, subsequent elections were held in 2003, 2007, 2011 (Oromareghake, 2013), and 2015. None of these elections can however be celebrated to be free, fair, participatory, competitive, legitimate, neutral, or impartial, as are required of good democratic elections.

2 Literature review

The electricity environment, as highlighted by Dramani and Tewari (2014) is influenced by such factors as historical, economic, political and physical conditions of the country while the institutional structure is determined by factors such as electricity related laws, policies and organisational elements. Electricity institutional structure is divided into electricity law, electricity policy, governance and management. These institutional parts are divided further to underscore a few of the very relevant institutional portions. Institutional structure is defined by political and economic qualities, they can influence effective functioning of the electricity sector since they are capable of promoting effective and efficient transformation of the sector. This indicates a kind of relationship between effective electricity sector and high quality institutions in a country. Empirical literatures from scholars are available that discusses such relationships in varied ways, these are considered in this section.

In a study for Ghana, Dramani and Tewari (2014) examined institutions and electricity sector's performance from 1990 to 2010 using descriptive statistics, ordinary least square (OLS) and error component model (EC). The study utilized three procedures of: institutional effects on the performance indicators of the electricity sector; the role of regulatory institutions on the rate of return applying yardstick competition; and measuring the efficiency levels of the distribution segment using Data Envelopment Analysis (DEA). They

revealed that institutions influence the reserve margin, installed capacity, and peak demand positively and possess the potential of reversing the negative trends of global reliability indices such as system average interruption duration index (SAIDI), etc. Thus, institutions should be considered an important tool in addressing Ghana's electricity problems, as in any other economy.

Yu (2010) concentrated on legislative processes and institutions as key ingredients of China's energy advancement. The study shows that to grasp the import and make progress towards better China's energy situations, as in any other country, a thorough evaluation of energy laws/legislation as well as its institutions is very necessary. They concluded, among others, that inability to have a single energy administrative system for the country and lack of an effective energy institution for the country can pose significant institutional setbacks to energy sector advancements. They then recommended, among others, the enhancement of institutional development.

Golden and Min (2012) examined political institution's effects on electricity supply. Power Corporation of Uttar Pradesh in India was used as source of data for the study. Their objective was to: study the politics of electricity theft between 2000 and 2009; and determine if elections, political parties, and criminal status of state legislatures affect power theft. The study adopted descriptive analysis and ordinary least square (OLS) and showed that electricity theft changes with the electoral cycle. Years legislative elections are held will record significantly high electricity theft than years of no election. This indicates that political institutions can be used to encourage or discourage power theft in a society and hence promote electricity supply to citizens. Though the study failed to show whether electric power theft can be linked to political criminality or weak institutions, it has nonetheless established a link between electricity supply problem (power theft) and political institutions available in a particular state.

On policies and institution building, García (2010) carried out a study on best policies and institutions for renewable electricity supply using China as a case, where policies and institutions were partially and imperfectly related to best practices. The study showed that "best practice" is a function of policies that can facilitate private investment through perfection of market mechanism; as well as the establishment of liberal-market institutions (good governance, corporate competition, and enhanced information), which would also facilitate investment. Also, that there is need for institutions to display governance, i.e. legal security, capable bureaucracy and predictability of regulations and openness to competition and foreign participation. Policies here is defined as "those rules set by public authorities as the preferred course of action toward a desired outcome, and institutions as the structure of economic actors (governmental and corporate) and the mechanism that influences these actors and relations between them".

Olarinde and Omojolaibi (2014), based on endogenous growth model studied the long run and short run relationship between institutional quality, electricity consumption and the rate of growth of Nigeria's economy between 1980 and 2011. The study applied the ARDL test and VECM based test technique to show whether there is a short run and long run relationship between the model's variables. Findings showed that there exist a short run as well as long run relationship between economic growth, energy consumption and institution in the country. The long run estimated elasticity coefficient of electricity consumption was positively significant and less than unity, and as well significantly impacts institutions. These imply that electricity consumption and institutions are essential for Nigeria's growth process. The application of the ECM-based Granger causality test was found to be consistent with the ARDL test, the result indicated that institutions, electricity consumption, labour force, oil prices and gross capital formation did Granger caused growth. This means that there exists a bi-directional Granger causal relationship between institutional quality and electricity consumption in both the long and short-run periods. From this study we can see that Nigeria needs uninterrupted power supply to help close the wide gap between electricity demand and supply. It should be noted that if this gap is closed, energy demand will be high because consistent supply will trigger economic activities, encourage entrepreneurship, propel industry and enhance economic growth in Nigeria.

A similar study by Bouoiyour, Selmi and Shahbaz (2014) was undertaken for Algeria as a rentier state between 1971 and 2012. The study adopted ARDL bound test. They also employed the innovative accounting approach. They assessed the "relationship between electricity consumption and institutions in a rentier state by integrating variables such as: economic growth, urbanisation, trade openness and foreign direct investment". The study found that "institutions play an important role in explaining the co-integration among the variables in the long run". This indicates that weak governance structure may affect electricity consumption directly or indirectly through urbanisation and foreign direct investment. With considerable amount of income, government will be enabled to cut down some tax burdens and domestic spending, all leading to weakened institutions (Aslaksen, 2011).

The studies reviewed above indicate that there exist some relationships between electricity supply and institutional factors. These relationships are such that where there are weak and inefficient institutional qualities, electricity supply will be affected negatively and otherwise where there are strong and efficient institutional quality. As adduced by North (1990), institutions matter.

3 Theoretical framework

The Solow-Swan model is anchored on the neoclassical aggregate production function which expresses the relationship of aggregate output of a particular economy with total: available labour in the same economy; human capital in the economy as well as physical capital in the economy, in addition to some measures of intensity of technology available in such an economy. Solow-Swan model profess that the only way long-run growth can be maintained is through increase in total factor productivity (TFP). TFP is assumed to be exogenous with the ability to keep increasing indefinitely. But increase in TFP mainly result from technological improvements which includes anything that the conventional factors of production exclude and comes from a number of sources, including electricity supply (energy) and institutional quality (Vlahinić-Dizdarević & Žiković, 2010).

Institutional quality affects energy supply and demand either positively or negatively. Weak institutional quality, negative norms, behaviours and cultures, poor infrastructural facilities, governance and policies, as well as poor communication, information and energy services, non conducive economic and financial institutions all negatively affect energy. Where these institutional qualities are in the opposite realms and states, energy supply will be encouraged (Ojeaga, Odejimi, Goerge & Azuh, 2014; Nytorv, 2013; Shove, 2003).

Thus, based on the Solow-Swan neo classical growth framework which forms the theoretical background for this research, the model specified for this work shall be in the form developed by Arrow (1962) and simplified in a Cobb-Douglas production function format as:

$$Q_t = AK_t^{\alpha},L_t^{1-\alpha} \quad - \quad - \quad (1)$$

Where: Q_t = Outputs at time t; L_t = Labour Stock at time t; K_t = Capital at time t; A and K = Total Factor Productivity; A = Efficiency Parameter; α and α-1 = coefficient parameters.

Technology is the efficiency parameter and thus the factor which can be logically connected to energy. It is energy that powers any kind of technology. However, energy production process requires huge amounts of capital investments. These investments are associated and influenced by the quality of institutions available in a particular economic environment. Thus following Stern and Cutler (2004), Dramani and Tewari (2014), Olarinde and Omojolaibi (2014), and others, it can thus be assumed that the efficiency parameter (A) is a function of electricity supply, institutional quality, and other exogenous factors (C), i.e.

$$A = f(ELS, INSTQ, C) \quad - \quad - \quad (2)$$

Where: ELS = Electricity Supply growth ; INSTQ = Institutional Quality; and C = Exogenous factors

4 Model specification

This study covers the period from 1981 to 2015. Econometric approach for the study relies on time series data regression. The data for the study were sourced from Central Bank of Nigeria statistical bulletins and annual reports, Ministry of Power, National Electricity Regulation Commission, and World Bank.

Given the production function: $Q_t = AK_t^{\alpha},L_t^{1-\alpha}$ and that A = f(ELS, INSTQ, C). By endogenising electricity supply (ELS) and institutional quality (INSTQ), we can form our explicit estimation functions for electricity supply growth. From studies by Bouoiyour, Selmi and Shahbaz (2014), Dramani and Tewari (2014), Ubi, Effiom, Okon and Oduneka (2012), etc. the various factors of electricity supply and demand can be categorized as: annual rainfall, per capita GDP, electricity prices, government investment (funding) in power sector, state of technology, etc.

Therefore making electric supply growth our dependent variable we have:

$$ELS = f(PCGDP, ELP, TECH, INSTQ, ELCON, RAIN, GOVINV, DUM) \quad - \quad - \quad (3)$$

Where: ELS = Electricity Supply in mega watt

PCGDP = Per capita gross domestic product measured in millions of Naira
ELP = Electricity prices in Naira of mega watt of electricity per hour (₦/mw/hr)
TECH = Technology (time variance, one year is taken as one data point)
INSTQ = Institutional quality measured in contract intensive money (CIM)
ELCON = Industrial electricity consumption in megawatt of electricity per hour
RAIN = Rainfall measured in millimetres (mm) of rainfall per year
GOVINV = Government investment (expenditure) in the power sector in millions of Naira
DUM = Electricity market structure reforms ((zero and one for periods before (1980 to 2004) and after (2005 to 2015)) reformation in the power sector respectively.

For the regression function to be in an estimation form, equation (3) is reformulated to include the stochastic error term:

$$ELS = b_0 + b_1PGDP + b_2ELP + b_3TECH + b_4INSTQ + b_5ELCON + b_6RAIN + b_7GOVINV + b_8DUM + v \quad - \quad - \quad 4)$$

Where: v = Stochastic Error Term. Other variables are as earlier defined; b_1 to b_7 are the parameter estimates measuring the impact of the explanatory variables. Aprior expected parameter values are: $0 < b_1$ to b_8

5 Empirical results

Table 1. Correlation matrix

	ELS	PGDP	GOVINV	ELP	ELCON	INSTQ	RAIN	TECH	DUM
ELS	1.0000	0.9587	0.6457	0.9296	0.9253	0.7328	0.5362	0.8672	0.8330
PGDP	0.9587	1.0000	0.9183	0.8907	0.8498	0.7615	0.4160	0.7830	0.8338
GOVINV	0.6457	0.9183	1.0000	0.7872	0.7302	0.6338	0.2958	0.6220	0.6655
ELP	0.9296	0.8907	0.7872	1.0000	0.6533	0.5689	0.7681	0.9357	0.7529
ELCON	0.9253	0.8498	0.7302	0.6533	1.0000	0.7309	0.5203	0.8385	0.8092
INSTQ	0.7328	0.7615	0.6338	0.5689	0.7309	1.0000	0.0693	0.5669	0.8357
RAIN	0.5362	0.4160	0.2958	0.7681	0.5203	0.0693	1.0000	0.7992	0.3995
TECH	0.8672	0.7830	0.6220	0.9357	0.8385	0.5669	0.7992	1.0000	0.9573
DUM	0.8330	0.8338	0.6655	0.7529	0.8092	0.8357	0.39957	0.9573	1.0000

Source: Computed by the Author (2016)

As shown in Table 1, correlation analysis undertaken indicates that all the regressors in the electricity supply equation were found to possess positive relationships with electricity supply. These imply that changes in each of these variables positively impact on the other variables in the model. This also guided us in dropping some variables in the model that were strongly correlated in order to avoid multicolinearity.

Table 2. Results of the augmented Dickey-Fuller (ADF) unit root tests

Variables	Level	1st Difference	Remarks
GOVINV	0.493694	-4.603638***	I(1)
ELCON	-0.962527	-8.148139***	I(1)
ELP	1.181042	-5.412346***	I(1)
INSTQ	-0.679324	-6.391510***	I(1)
PCGDP	2.692490	-7.514412***	I(1)
RAIN	-1.551040	-5.836048***	I(1)
ELS	0.720391	-7.857469***	I(1)

Source: Computed by the Author (2016)

Note: Test critical values (Constant): 10% = -2.6148; 5% level = -2.9527; 1% level = -3.6422

*** signify significance at one percent

Table 3. Pairwise Granger causality tests results

Null Hypothesis:	Obs	F-Statistic	Prob.
ELCON does not Granger cause ELS	33	6.30246	0.0055
ELS does not Granger cause ELCON		2.78896	0.0786
GOVINV does not Granger cause ELS	33	7.99279	0.0018
ELS does not Granger cause GOVINV		3.50132	0.0439
RAIN does not Granger cause ELS	33	6.66132	0.0004
ELS does not Granger cause RAIN		0.12474	0.8832
ELP does not Granger Cause ELS	33	0.96615	0.3929
ELS does not Granger Cause ELP		3.20564	0.0526
INSTQ does not Granger Cause ELS	33	0.46977	0.6300
ELS does not Granger Cause INSTQ		0.89424	0.4203

0.05q90

Source: Computed by the Author (2016)

Results of the unit root tests using the augmented Dickey-Fuller technique indicate that all the variables in the equation were stationary at first difference and are therefore integrated of order one I(1). Test for Granger causality results shown in table 3 indicate that there is uni-directional Granger causal relationship between electricity consumption and electricity supply; that there exists bi-directional causal relationship between government investments in the power sector and electricity supply in Nigeria; and rainfall have a unidirectional causal relationship with electricity supply, the direction of causality running from rainfall to electricity supply. However, institutional quality and electricity supply are independent of each of other. So also is electricity prices and electricity supply.

Table 4. Cointegration resutls

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	statistic	Critical value	Prob.**
None *	0.993593	555.9773	219.4016	0.0000
At most 1 *	0.962501	389.3158	179.5098	0.0000
At most 2 *	0.950886	280.9624	143.6691	0.0000
At most 3 *	0.896882	181.5131	111.7805	0.0000
At most 4 *	0.766678	106.5410	83.93712	0.0005
At most 5	0.463444	58.51488	60.06141	0.0671
At most 6	0.407584	37.96962	40.17493	0.0819

Source: Computed by the Author (2016)

Note: * denotes rejection of the hypothesis at 0.05 level; Trace test indicates five cointegrating equations at 0.05 level; **MacKinnon-Haug-Michelis (1999) p-values

Table 5. Lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-1197.727	NA	3.05e+26	75.17046	75.39948	75.24637
1	-1073.391	202.0466*	6.27e+23*	68.96193*	70.33606*	69.41742*
2	-1053.591	25.98750	9.82e+23	69.28693	71.80616	70.12199
3	-1024.473	29.11831	1.07e+24	69.02954	72.69388	70.24416

Source: Computed by the Author (2016)

Notes: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic (each test at 5% level); AIC: Akaike information criterion; FPE: Final prediction error; HQ: Hannan-Quinn information criterion; SC: Schwarz information criterion

The Johansen cointegration results as shown in table 4 indicate at most five cointegrating equations at five percent level of significance. This shows that there exist unique long run equilibrium relationships between the variables in the equation. To determine the lag structure, the lag length selection for the error correction model (ECM) was determined using: Final Prediction Error (FPE); Akaike Information Criterion (AIC); Schwarze Information Criterion (SC); and Hannan-Quinn Information Criterion (HQ), table 5 shows that the optimal lag length for the model is one (1).

Table 6. Parsimonious ECM results

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(ELS(-1))	0.821361	0.186352	4.407569	0.0002
D(ELP(-1))	2.145576	0.538785	3.982242	0.0005
D(ELCON)	7.372453	1.642663	4.488112	0.0001
D(ELCON(-1))	-8.707843	2.641711	-3.296289	0.0029
D(INSTQ)	-1.230940	5.711944	-2.155028	0.0410
D(GOVEXP)	4.993240	2.433210	2.052120	0.0501
D(RAIN(-1))	33.68354	7.806026	4.315068	0.0002
DUM(-1)	1.559726	1.025153	1.521458	0.1407
ECM(-1)	-0.597316	0.143989	-4.148335	0.0004
C	39010.95	9016.105	4.326807	0.0002
R-squared	0.791060	Mean dependent var		1446.419
Adjusted R-squared	0.768199	S.D. dependent var		887.6396
S.E. of regression	96.42587	Akaike info criterion		12.19735
Sum squared resid	232448.7	Schwarz criterion		12.60139
Log likelihood	-198.3550	F-statistic		346.4257
Durbin-Watson stat	1.922756	Prob(F-statistic)		0.000000

Source: Computed by the Author (2016)

ECM in this study follows the general-to-specific method where the overparametized ECM are estimated at first and then followed by the parsimonious ECM derived from the former. From the pair-wise correlational statistics shown in table 1, the ELS equation variables: PCGDP and GOVINV; TECH and ELP; ELS and ELCON were highly correlated among themselves at over 90 percent levels. To avoid the problem of multicollinearity, decrease the numbers of explanatory variables and therefore increase the degrees of freedom in the regression analysis, PCGDP and TECH were eliminated from the model.

In order to examine the impact of institutional quality on electricity supply in Nigeria, institutional quality (INSTQ) was regressed on aggregate electricity supply. Electricity price (ELP), electricity consumption

(ELCON) government investment in the power sector (GOVINV), aggregate volume of rainfall (RAIN), and structural changes in the power sector (DUM) were also added as major determinants of electricity supply. The parsimonious ECM result shown in table 6 reveals that the error correction coefficient, which indicates the speed with which the dynamic model restores back to equilibrium when it deviates and the speed with which variables would return to equilibrium was (-0.5973) negative and significant with t-statistics of -4.148. This suggests that a long term equilibrium relationships exist between electricity supply and all the variables that influenced its short-run equilibrium which are captured in the equation. As revealed, the speed of adjustment of 59.73 percent between the short-term and the long-term behaviours of electricity supply with its independent variables was relatively high. This implies that adjustment is covered up within one year. The significance of the coefficient of ECM flows along with the submission made before that these variables are actually cointegrated.

The value of adjusted R^2 which is 0.76.82 means that about 77 percent of total changes in electricity supply are determined through variations in the independent variables. This shows a good fit for the equation. The Durbin-Watson statistics of 1.92 (approximately 2.0) indicate the absence of serial correlation in the equation, as such, the equation is good for policy analysis.

The result of the analysis shows that institutional quality (INSTQ) coefficient has negative sign (-1.23) This shows that institutional quality impacts negatively on electricity supply in Nigeria and affirm that institutional quality in the country is weak and inefficient. This result indicates that a one percent increase in institutional quality leads to a 1.23 percent decrease in megawatts of electricity supply in the country.

Electricity price (ELP), electricity consumption (ELCON), government investment in the power sector (GOVINV), and annual rainfall (RAIN) all have positive coefficients and are statistically significant. These are in line with the apriori expectations of this study and economic prescriptions. This goes in tandem with Ubi, Effiom, Okon and Oduneka (2012) that these variables are among the major factors that determine the megawatts of electricity supplied in Nigeria, although their study showed that "electricity price does not have reliable influence on electricity supply in Nigeria". The result here implies that increases in these variables will translate to increased electricity supply.

6. Discussion of results

The results showed that institutional quality impacts positively on electricity supply in Nigeria. This result is in consonance with those of Dramani and Tewari (2014) and Golden and Min (2012) who differently established some links between institutional quality and electricity supply in Ghana and India respectively. Though these studies show some positive relationship between institutional quality and electricity supply in those countries, the case is different for Nigeria. This result confirms that institutional quality in Nigeria is weak and inefficient and that institutional quality impact negatively and inhibit progress of electricity supply in the country. As indicated by Yu (2010) "to better understand and improve energy development, a comprehensive examination and improvement of a country's institutional quality is essential". This is because where institutional quality is ineffective and inefficient, it will reflect in inefficient and ineffective power supply and ultimately on the economy as a whole. Emovon, Kareem and Adeyeri (2010) argue that a steady and reliable electric power supply is a major factor of economic growth and development. They reveal that with total grid capacity of about 8,876 megawatts for Nigeria only about 3,653 megawatts were available for supplies by December of year 2009. An indication that actual electricity power supplied is less than 41 percent of total installed power capacity in Nigeria. This lacuna they reasoned was caused mostly by institutional factors, such as: corruption; poor maintenance management (governance), inadequate funding, among others. Though the needed power generation resources are in abundance in the country, and that Nigeria is supplying uninterrupted electricity to countries such as Togo, Benin Republic and Niger Republic, those institutional factors play down on power generation and hence distancing the gap between domestic electricity supply and demand in the country. From this study's findings, it is indicative that to improve electricity supply in Nigeria, institutional qualities should be made to be effective and efficient.

7. Conclusion

The findings of this research study show that institutional quality in Nigeria impact negatively on electricity supply growth. On the basis of this finding, it is concluded that if institutional quality is improved and made to be effective, electricity supply will be enhanced, this will in turn promote growth in the country. Improved institutional quality is therefore a factor for achieving electricity supply growth in Nigeria. Also, electricity generation, transmission and distribution should be effectively and efficiently provided to further improve the country's institutional quality.

8. Recommendations

To enhance institutional quality and therefore boost electricity supply growth, the nation's laws and contract enforcement mechanisms should be overhauled and strengthened. Thus, there is need to build up policies that

will enhance institutional quality such as development of policies that will encourage contract enforcements, enhance property rights, fight corruption genuinely, enthrone good and effective governance and political institutions, restructure and genuinely improve the legal and security systems and refurbish the educational system among others.

Considering the fact that electricity, if adequately supplied can drive the wheels of industrialization, and its interaction with institutional quality can boost economic growth, policies should be directed to more power generation, transmission and distribution in the country.

The results indicate that proper funding of the power sector will enhance electricity production positively. Policy should be directed at providing funds at a cheaper cost to investors in the power sector. These funds will enhance the purchase and replacement of old and worn out transformers and other equipments that will boost electricity supply in the country.

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