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RESEARCH ARTICLE

ELECTRICITY INFRASTRUCTURE AS AN IMPEDIMENT TO DIGITAL ECONOMY AND ECONOMIC GROWTH IN NIGERIA: AN EMPIRICAL ANALYSIS

Obiamaka P. Egbo and Chinwe R. Okoyeuzu

Department of Banking and Finance, University of Nigeria - Enugu Campus, Enugu, Nigeria

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ABSTRACT

Infrastructure determines the flexibility of a system to meet future requirements for the purposes of being efficient and productive. Electricity Infrastructure is a great force that drives industrialization. Electric Power supply in Nigeria becomes very crucial to move the nation ahead. Unfortunately, one of the greatest infrastructural problem in the country is electricity crisis characterized by frequent power failures and load shedding. This Paper reveals the importance of Power Infrastructural development as a vital component toward achieving greater digital economy and economic growth in Nigeria. It shows the relationship between economic growth and power infrastructural development as one of the key factors to attain a cashless economy. This study used annual time series variables computed from natural logarithms of gross domestic product (GDP) at current price and electricity production from 1971 to 2008, that is a period of 38years. It was revealed that there exist a long-run relationship among the variable, GDP and ELECPRO. Also a short-run relationship but is unidirectional which flows from electricity production (ELECPRO) to economic growth (GDP). We therefore recommend that the government should to do all it takes in other to improve on the electricity infrastructure which will go a long way in improving the status of digital economy in Nigeria.

INTRODUCTION

One of the key developments which had immensely impacted on the economic growth pattern in the world in the new millennium has been the strides in the domain of Information Technology sector. Information Technology has drastically changed the business landscapes. The success of Nigeria as a nation depends on its ability to reach and exceed its economic and social potentials. Economies world over is in transition. The economy is increasingly becoming a digital economy. The Internet is the driving force for the growth of e-commerce. The world is moving rapidly towards a digital world where so much of what we do every day will be done over the Internet and through the digital economy. More and more essential services and businesses are finding their way onto the Internet. The fast-changing global digital economy presents enormous prospects for emerging economies. Although a number of e-commerce activities are emerging in Nigeria, many Nigerian societies predominantly use cash for transactions, its growth has been slow for a variety of reasons, including low levels of Internet penetration and limited communication infrastructure. Infrastructure determines the flexibility of a system to meet future requirements for the purposes of being efficient and productive. Very often it is the duty of the government to provide infrastructure due to its high cost and long gestation period.

***Corresponding author:** obiamaka.egbo@unn.edu.ng*

In Nigeria, poor electricity supply is perhaps the greatest infrastructure problem confronting the business sector. Adequate power supply is an unavoidable pre-requisite in a country's economic development. To provide adequate power is to ensure that Nigeria is among the digital economy. The digital economy and developments in ICT are inextricably linked . Theory of comparative advantage dictates that every economy cannot produce every goods or service economically at the same time, it becomes imperative for the countries to integrate themselves in the world economy. Technology transfer plays a vital role in the process of integration with the world economy. Besides financial and other tangible benefits, technology transfer helps win friends and cement political alliances, De (1999). In the emerging global economy, e-commerce and e-business have increasingly become a necessary component of business strategy and a strong catalyst for economic development. Electronic commerce (e-commerce) is the buying and selling of information, products and services via computer networks which make up the internet. It encompasses many diverse activities including electronic trading of goods and services, online delivery of digital content, electronic fund transfers, electronic share trading, electronic bills of lading, commercial auctions, online sourcing, public procurement, direct consumer marketing, and after-sales service. The need for Nigeria to become a digital economy is being threatened by the absence of requisite infrastructure for the efficient deployment and adoption of electronic payment and commerce. There is serious need for

necessary infrastructure for the promotion of economic growth and cashless trade transactions. This is because e-banking in advanced countries has reduced cost of production and transactional risks. In a bid to fast track the transition from a cash to cashless economy, the Central Bank of Nigeria (CBN) recently announced a new policy on cash withdrawal limits which may have a profound effect on banking operations, Ikechukwu Eze et.al. (2010). The increasing use of cash in transactions has dire consequences on the overall economy, particularly concerning cost of cash management to the banking, security, and money laundering. Due to the vast number of Nigerians outside the banking system, this situation may result in having billions of naira circulating through the informal sector, which has a negative impact on the country's economic growth and development. Such scenario is not healthy to the banking sector. The Central Bank of Nigeria (CBN) directed all commercial banks, savings and loans institutions, mortgage and microfinance banks in the country to ensure that, effective from June 1, 2012, daily cumulative free cash withdrawals and lodgements by individual and corporate customers do not exceed a maximum ceiling of N150, 000 and N1 million respectively.

Electricity infrastructure plays a very important role in the socio-economic and technological development of such a cashless economy. The electricity demand in Nigeria is more than the supply .As if it is not bad enough, the supply is even epileptic in nature. The country is faced with acute electricity problems, which is hindering its development and poses serious challenge to policy makers both in the private and public sectors. The main focus of this paper is to analyze the degree of impact electricity infrastructure have on digital economy and the economic growth of Nigeria. This paper is divided into five sections. Apart from section one, which treated the introduction, objectives of the research; section two discusses the conceptual framework and other issues. Section three appraises the challenges facing digital economy in Nigeria. Section four presents the methodology used and data analysis while five contains the conclusion and recommendations.

CONCEPTUAL FRAME WORK AND OTHER ISSUES

Information Technology (IT) has been defined variously. Shelly et. al(2005) explains IT to include hardware, software, databases, networks, and other related components which are used to build information systems. William et.al.(2005) define Information Technology as "a general term that describes any technology that help to produce, manipulate, process, store, communicate, and/or disseminate information". Digital Economy is the use of information and communication technology to help transform the lives of individuals, society or business. Electronic commerce or e-commerce refers to a wide range of online business activities for products and services. It also pertains to "any form of business transaction in which the parties interact electronically rather than by physical exchanges or direct physical contact, Anita Rosen, (2000). It is the use of electronic communications and digital information processing technology in business transactions to create, transform, and redefine relationships for value creation between or among organizations, and between organizations and individuals. E-commerce plays a major role in the economy by enabling sellers and buyers to create economic value through exchange of information, goods/services and payments, Thornton and White (2001). King and Teo (1996) noted that firms that made innovative use of IT gained a favourable image and hence increased their value in the industry more than those firms that did not do so. A digital economy would create knowledge and have an informed society, this would improve the country's competitive advantage. The challenge to expand and maintain banking market share has influenced many banks to invest more in making better use of the Internet. This suggests that a bank has a chance to improve its image in this way. Financial sector appears to be a clear leader in the growth of IT. It was among the first to incorporate electronic data processing in its operations, through check handling, book-keeping, credit analysis and ATMs. Mayer(1987) while narrating the history of computer usage in banking demonstrates that the use of computers in banking first began in the early 1950s, when the first large commercial computer was built for Bank of America.

Infrastructure contributes to economic development by increasing productivity and providing amenities which enhance the quality of life. The services generated as a result of an adequate infrastructure base will translate to an increase in aggregate output which has positive impact on economic growth. Although early studies on the effect of infrastructure on macroeconomic productivity may date back to Ratner(1983), Aschauer(1989) and, more recently, Mitsui and Inoue (1995) as well as chapter 2 of Yoshino and Nakajima (ed.) (1999). All these studies found infrastructure as an effective factor of production. And there are many empirical studies using economic growth theory, for example, Easterly and Rebelo (1993), Devarajan, Swaroop and Zou (1996), Barro (1997), and Nakazato (1999).

The success use of e-commerce depends on an effective electronic payment system**.** An electronic payment system (EPS) is a system of financial exchange between buyers and sellers in the online environment that is facilitated by a digital financial instrument (such as encrypted credit card numbers, electronic checks, or digital cash) backed by a bank, an intermediary, or by legal tender.EPS plays an important role in e-commerce because it closes the e-commerce loop. The immense benefits associated with the use of electronic payments both to the individuals and the country are so much. In the developed economy , the story is different from what is obtainable in Nigeria. In Nigeria, majority of transaction are done with cash whereas in the western world almost 97% of transactions are done without physical cash being exchanged and this has greatly reduced cost, corruption and money laundering. We are of the view that digital economy will ease security challenges because when robbers know that people do not carry cash around they would not take the risk of coming after them . It will also increase the speed of transactions as you can transfer money right from your desk in your office into somebody's account anywhere in Nigeria and indeed the world at large. Nigerian banks have rapidly introduced innovative banking technologies and e-banking services in recent years. Almost all banks have invested in expanding and improving the IT systems and a number of new e-banking services have been developed. The effect of this has been to make life easier for people .This means that they enjoy better personal security, as their chances of being robbed

decreases appreciably. There is also the convenience of going to draw cash from ATM close to your home or office and at any time of the day or week, instead of taking the (probably) long journey to your bank and then wasting valuable man hours on the queue in the banking hall.

ELECTRICITY

One of the key engine that drives industrialization is Electric power supply. Substantial expansion in quantity, quality and access to infrastructure services, especially electricity, is fundamental to rapid and sustained economic growth, and poverty reduction Adenikinju (2005). Constant power supply is the hallmark of a developed economy. Any nation whose energy need is epileptic in supply prolongs her development and risks losing potential investors Electricity production in Nigeria over the last 40 years has varied from gas-fired, oil fired, hydroelectric power stations to coal-fired stations with hydroelectric power systems and gas fired systems taking precedence. This is predicated by the fact that the primary fuel sources (Coal, Oil, water, Gas) for these power stations are readily available. In spite of the vastness of these resources in Nigeria, only four sources (coal, crude oil, natural gas and hydro) are currently being utilised in processed forms while two others (woodfuel and solar) are used in their crude forms for heating, cooking and lighting The most frustrating and disturbing economic development issues in the Nigerian economy and society, particularly since the 1990s, is that of the inadequacy of electricity supply and distribution. This is because electricity supply programme keep on expanding in the country without necessarily allowing the transmission grids to keep pace with the programme requirements.

Besides, many of the associated equipment, machines and other facilities for generation, transmission and distribution had operated for several years beyond their normal life-span without adequate and regular maintenance, servicing and rehabilitation. The call for power sector reform in Nigeria is primarily as a result of inadequate electricity supply, incessant power outages, low generating plant availability and high technical and non-technical losses that characterized the Nigerian electricity industry. Power sector reforms in a developing economy such as Nigeria poses great challenges not only to the government that initiated the programme but also to the populace who are the consumer of energy and to the new born PHCN that have replaced NEPA. These challenges includes, Economic and social, Technical, Political and Environmental. However, for the programme to bring positive changes, members of the Nigerian Electricity Regulatory Commission should be effective, efficient, un-biased in its role and corruption-free while the body itself should be truly independent

THE CHALLENGES FACING DIGITAL ECONOMY IN NIGERIA

Nigeria is a developing country daunted with several challenges, ranging from economic, political, social and infrastructure. As the country lacks a good technological infrastructure, there are major impediments to technology transfer. While tremendous progress is being made on card system in developed countries, the African continent appears to have been left significantly behind. The inclination in developed countries is to move more towards electronic payment than any other form of payment for convenient, fast and easy business transactions. In developing countries, the underdeveloped electronic payments system is a serious impediment to the growth of e-commerce. Some of the challenges are poor electricity infrastructure high level of illiteracy in the country, other obstacles include lack of suitable legal framework and security instruments, inadequate banking systems, poorly developed telecommunications infrastructure, especially beyond urban areas. Kehinde Akintola, (2008) noted that 74 percent of Nigerian adults had no bank accounts as at 2008. When cash is not in the banking system the implication is that banks cannot lend that cash, that simply means that the cash is not working for the economy. Another big challenge is on changing people's mindset to embrace card transactions. People are used to cash.

One major impediment in Nigeria is infrastructure. Some of the problems facing electricity generation in this country include poor maintenance planning, poor funding of the sector, vandalisation of sensitive facilities and many more. The country lacks the infrastructure which can readily support e-payment; so, investors have to pay so much .The implication of this is that e-payment will be targeted at the elite class only, while the masses will be left out. Again is that the private sector in Nigeria, consists mostly of small and medium enterprises. Ideally, these businesses should be the potential engine of growth in the information economy. However, most of these businesses do not have a presence on the internet. This is a barrier for e-commerce and e-business development. For the digital economy to reach its potential and move the country forward, the end user needs to understand how it works and how to use it. Much still needs to be done to encourage e-commerce in Nigeria. Due to security issues and confidence on clients, Nigerian entrepreneurs find it difficult to accept credit cards as a means of payment. There is a low level of confidence in the use of an electronic payment system (EPS) and it has a lot to do with security with lack of a legal framework for adjudicating fraud in the system. Cash is the preferred mode of payment not only on account of security but also because of anonymity, which is useful for tax evasion purposes or keeping secret what one's money is being spent on.

Achieving a digital economy in Nigeria therefore will require serious dedication and commitment on the part of the government and private sector to realize such a huge dream. The goal of every information system based in any organization is to improve performance on the job and this performance efficiency is only achieved when proper IT systems are used by the organizations (Khan, 2003). Nigeria's low point of sale terminal (PoS) density and poor last mile connectivity constitute significant drawbacks to the success of digital economy. The Automated Teller Machine(ATM) is a lot easier to withdraw money or to check account balance. However, most Nigerians use it only for withdrawal despite its popularity. The Automated Teller machine (ATM) can perform other functions, like cash transfer, mobile phone, credit recharge and bill payment but it is mostly used for cash withdrawal. This has ended up not reducing cash in the economy but has increased it. Many Nigerians complain of experiences where they attempt to withdraw cash on another bank's ATM and their accounts were debited without

payments and when the victims reported the matter with their banks, they found that they had to wait for between two and six weeks to get refunds. Bank officials explained that the long delays were because of cross-bank transaction protocols. These are not encouraging. In summary, among the relevant issues that need to be resolved with respect to EPS are: consumer protection from fraud through efficiency in record-keeping, transaction privacy and safety, competitive payment services to ensure equal access to all consumers and the right to choice of institutions and payment methods. Legal frameworks in developing countries should also begin to recognize electronic transactions and payment schemes.

METHODOLOGY AND DATA ANALYSIS

The paper by Engle and Granger (1987) has led them to receive the Nobel prize in 2003. Engle and Granger (1987) provided a totally new method for analyzing time series. It is well known that a time-series model can only be built once the included series in the model are stationary. This is, however, not the case for most series of practical interest. Moreover, working with transformed series makes it difficult to interpret the results or impossible to use the model for forecasting. To overcome this dilemma, Engle and Granger (1987) show that if independent series are integrated of the same order *d*, denoted by I(*d*), and if the residuals of the linear regression among these series are integrated of the order *d.b*, I(*d.b*), then the series are said to be co-integrated of the order *d*, *b*, denoted as CI(*d*,*b*). There is a great advantage in finding (long-term) co-integration relationships, as the series need no longer be transformed and, hence, the forecasting power increases substantially. Several steps can be distinguished in undertaking a co-integration analysis on time series (e.g. Hondroyiannis *et al*, 2002, Beki *et al*, 1999). For ease of exposition, but without loss of generality, we consider two time series only, namely *xt* and *yt*. First, the order of integration of *xt* and *yt* has to be established. Non-stationary series are particularly problematic when they have a unit root, which is equal to being integrated of the order one, I(1). This series is a random walk (possibly with drift), where the future value is equal to the past value (possibly with drift) with an error. The difficulty in using a random walk series is that it is typically heteroscedastic and cannot be used for forecasts. It is possible to test for a unit root using the Augmented Dickey-Fuller (ADF) test (Said and Dickey 1984) or the Phillips-Perron (PP) test (Phillips and Perron 1988). For instance, the ADF produces a statistic, which needs to cross a critical value above which the series can be confirmed to be stationary. This test needs to be run for different orders of integration, with trend and/or intercept and a number of lags. In this manner the order of integration can be determined. Second, let us assume that *xt* and *yt* are integrated of the order one: I(1). By running a simple OLS, it can be verified whether these series are co-integrated.

This is the case once the residuals are stationary. This can be verified by undertaking either the Johansen maximum likelihood cointegration test or by determining the order of integration of the residuals by using the same ADF as before again.

$$y_{t=}\emptyset + x_t \quad (1)$$

Once the residuals εt of Equation (1) are white noise, then there is one co-integrating factor (as established by the OLS), which is a good predictor of the long-term relationship among the variables (Harvey 1990). In general, when more variables are considered, it is possible to find multiple co-integrating vectors. Third, a so-called vector error-correction modelling approach is needed to test for the exogenity of the variables. The short-term variation can be predicted by using an error correction mode (ECM). For instance, by using the following model:

$$\Delta y_t = \alpha + \sum_{i=1}^{k} \beta_i \Delta y_{t-1} + \sum_{j=1}^{m} \gamma_j \Delta \chi_{t-j+1} + \delta ECT_{t-1} + \varepsilon_t \quad (2)$$

Where the α, β, γ, δ.s are coefficients which need to be derived through a VAR regression, Δ is the difference, and φ is the co-integrating factor, which can be derived through OLS in a first stage. ECT stands for error correction term, which can be established by Equation (1).

Fourth, the causality between variables can be established. It is then possible to verify whether, say, power *Granger*-causes economic growth, the other way around, or both. Moreover, once a co-integration relation is established between *xt* and *yt* then either *xt* has to (Granger) cause *yt*, the other way around, or both. Masih and Masih (1997), for instance, propose the ECM in equation (3):

$$\Delta y_t = \alpha_1 + \sum_{i=1}^{m} \beta_{1i} \Delta \chi_{t-i+1} + \sum_{i=1}^{m} \gamma_{1i} \Delta y_{t-i} + \delta ECT_{t-1} + \varepsilon_{1t}$$

$$\Delta y_t = \alpha_2 + \sum_{i=1}^{m} \beta_{2i} \Delta \chi_{t-i} + \sum_{i=1}^{m} \gamma_{2i} \Delta y_{t-i} + \delta ECT_{t-1} + \varepsilon_{2t}$$

$$ECT_{t=}y_t + \emptyset x_t \quad (3)$$

Where, as before, the α, β, γ, δ.s are coefficients which need to be derived through a VAR regression, Δ is the difference, and φ is the co-integrating factor, which can be derived through OLS in a first stage. ECT stands for error correction term.

PRESENTATION OF ANALYSIS

The main focus of this paper is to analyze the degree of impact electric infrastructure has on digital economy and in turn impact on the country's economic growth as proxied by the GDP. In other to ascertain the relationship between electric power infrastructure (as proxied by electricity production/kWh) and economic growth (as proxied by GDP), the researchers used a linear regression approach in determining their influence and relationship on the growth of the Nigerian economy. The statistical methods used include the Ordinary Least Squares Method (OLS), Unit root test and Cointegration Test.

The linear regression model is as follows:

$$logGDP_t = \alpha_1 + \beta_1 \sum_{i=1}^{k+d} \alpha_{1i} logELECPRO_{t-i} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

To calculate for a causal relationship, the following model is adopted

$$logGDP_t = \gamma_0 + \sum_{i=1}^{k+d} \alpha_{1i} logGDP_{t-i} + \sum_{i=1}^{k+d} \beta_{1i} logELECPRO_{t-i} + \varepsilon_{1t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots 5a$$

$$logELECPRO_t = \gamma_0 + \sum_{i=1}^{k+d} \alpha_{2i} logELECPRO_{t-i} + \sum_{i=1}^{K+D} \beta_{2i} logGDP_{t-i} + \varepsilon_{2i} \ldots\ldots\ldots\ldots\ldots\ldots 5b$$

The equations 5a and 5b shows the expected causal relationship between economic growth (GDP) and electric production (ELECPRO) respectively. It is assumed that the error term are uncorrelated and that GDP and ELECPRO are stationary.

RESULTS OF ANALYSIS

Table 1: OLS Result

Dependent Variable: LOG(GDP)
Method: Least Squares
Date: 10/30/11 Time: 15:48
Sample: 1971 2008
Included observations: 38

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-54.65178	7.749638	-7.052172	0.0000
LOG(ELECPRO)	2.919506	0.336280	8.681778	0.0000

R-squared	0.676763	Mean dependent var	12.59669
Adjusted R-squared	0.667784	S.D. dependent var	2.562655
S.E. of regression	1.477068	Akaike info criterion	3.669191
Sum squared resid	78.54229	Schwarz criterion	3.755380
Log likelihood	-67.71463	F-statistic	75.37327
Durbin-Watson stat	1.180695	Prob(F-statistic)	0.000000

Estimation Command:
==========
LS LOG(GDP) C LOG(ELECPRO)
Estimation Equation:
==========
LOG(GDP) = C(1) + C(2)*LOG(ELECPRO)
Substituted Coefficients:
==========
LOG(GDP) = -54.65178296 + 2.919506426*LOG(ELECPRO)

Wald Test:
Equation: OLS

Null Hypothesis:	C(2)		
F-statistic	75.37327	Probability	0.000000
Chi-square	75.37327	Probability	0.000000

From the OLS test above, we can see that the probability value 0.00000 is lower than 0.5 which suggests the rejection of the null hypothesis for the two tailed test at 5% level of significance. This shows that there is a relationship between GDP and ELECPRO in Nigeria for the period under review. We will ascertain the particular kind of relationship by testing for cointegration (to find out a long-run relationship) and granger causality test (to find a short-run relationship). To make sure that the presence of serial correlation is not in the residuals of the estimated equation, we need to perform a more general Breusch-Godfrey test for serial correlation in the residuals. This is basically because, if the estimates are uncorrected, serial correlation in the residuals will lead to incorrect estimates of the standard errors, and invalid statistical inference for the coefficients of the equation. The result is shown in table 2 below.

Table 2: Breusch-Godfrey Serial Correlation LM Test

F-statistic	3.320072	Probability	0.048184
Obs*R-squared	6.208774	Probability	0.044852

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 10/30/11 Time: 16:45
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.524434	7.327070	-0.208055	0.8364
LOG(ELECPRO)	0.067761	0.318021	0.213070	0.8325
RESID(-1)	0.349159	0.173035	2.017848	0.0516
RESID(-2)	0.145576	0.177990	0.817885	0.4191

R-squared	0.163389	Mean dependent var	-2.94E-14
Adjusted R-squared	0.089570	S.D. dependent var	1.456971
S.E. of regression	1.390190	Akaike info criterion	3.596059
Sum squared resid	65.70936	Schwarz criterion	3.768436
Log likelihood	-64.32511	F-statistic	2.213381
Durbin-Watson stat	1.975831	Prob(F-statistic)	0.104433

From the probability figure above, test indicates an absence of serial correlation. In other to find out if the order of integration of the variables, we did a unit root stationarity test by employing the Augmented Dickey Fuller test. The ADF tests allow you to specify how lagged difference terms are to be included in the ADF test equation. In this case, we have chosen to estimate an ADF test that includes a constant in the test regression and employs automatic lag length selection using a Schwarz Information Criterion (SIC) and a maximum lag length of 1 and 2 years for the variables ELECPRO and GDP.

Table 3: Unit root at level GDP including intercept at 1 lag

ADF Test Statistic	-1.060961	1% Critical Value*	-3.6228
		5% Critical Value	-2.9446
		10% Critical Value	-2.6105

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGGDP)
Method: Least Squares
Date: 11/01/11 Time: 20:54
Sample(adjusted): 1973 2008
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGGDP(-1)	-0.115395	0.108765	-1.060961	0.2964
D(LOGGDP(-1))	-0.439844	0.158928	-2.767568	0.0092
C	1.775584	1.377610	1.288887	0.2064

R-squared	0.275659	Mean dependent var	0.225715
Adjusted R-squared	0.231760	S.D. dependent var	1.672754
S.E. of regression	1.466157	Akaike info criterion	3.682822
Sum squared resid	70.93738	Schwarz criterion	3.814782
Log likelihood	-63.29080	F-statistic	6.279335
Durbin-Watson stat	2.238775	Prob(F-statistic)	0.004887

ADF Test Statistic	-0.689513	1% Critical Value*	-3.6289
		5% Critical Value	-2.9472
		10% Critical Value	-2.6118

*MacKinnon critical values for rejection of hypothesis of a unit root.

Table 4: Unit root at level GDP including intercept at 2 lag

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGGDP)
Method: Least Squares
Date: 11/01/11 Time: 21:03
Sample(adjusted): 1974 2008
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGGDP(-1)	-0.080040	0.116081	-0.689513	0.4956
D(LOGGDP(-1))	-0.596476	0.189257	-3.151676	0.0036
D(LOGGDP(-2))	-0.274005	0.175792	-1.558686	0.1292
C	1.440093	1.465366	0.982753	0.3333
R-squared	0.331287	Mean dependent var		0.226937
Adjusted R-squared	0.266572	S.D. dependent var		1.697159
S.E. of regression	1.453454	Akaike info criterion		3.692973
Sum squared resid	65.48834	Schwarz criterion		3.870727
Log likelihood	-60.62702	F-statistic		5.119224
Durbin-Watson stat	2.119357	Prob(F-statistic)		0.005417

Table 5: Unit root at level ELECPRO including intercept at 1 lag

ADF Test Statistic	-3.497393	1% Critical Value*	-3.6228
		5% Critical Value	-2.9446
		10% Critical Value	-2.6105

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGELECPRO)
Method: Least Squares
Date: 11/01/11 Time: 20:54
Sample(adjusted): 1973 2008
Included observations: 36 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGELECPRO(-1)	-0.093404	0.026707	-3.497393	0.0014
D(LOGELECPRO(-1))	-0.317965	0.155769	-2.041262	0.0493
C	2.238338	0.619389	3.613782	0.0010
R-squared	0.287810	Mean dependent var		0.062350
Adjusted R-squared	0.244647	S.D. dependent var		0.117063
S.E. of regression	0.101741	Akaike info criterion		-1.653121
Sum squared resid	0.341589	Schwarz criterion		-1.521161
Log likelihood	32.75618	F-statistic		6.667985
Durbin-Watson stat	2.043182	Prob(F-statistic)		0.003697
ADF Test Statistic	-3.497393	1% Critical Value*		-3.6228
		5% Critical Value		-2.9446
		10% Critical Value		-2.6105

*MacKinnon critical values for rejection of hypothesis of a unit root.

Table 6: Unit root at level ELECPRO including intercept at 2 lag

ADF Test Statistic	-3.187430	1% Critical Value*	-3.6289
		5% Critical Value	-2.9472
		10% Critical Value	-2.6118

*MacKinnon critical values for rejection of hypothesis of a unit root.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LOGELECPRO)
Method: Least Squares
Date: 11/01/11 Time: 21:05
Sample(adjusted): 1974 2008
Included observations: 35 after adjusting endpoints

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LOGELECPRO(-1)	-0.102464	0.032146	-3.187430	0.0033
D(LOGELECPRO(-1))	-0.346177	0.167519	-2.066492	0.0472
D(LOGELECPRO(-2))	-0.099409	0.170616	-0.582648	0.5643
C	2.457052	0.751901	3.267788	0.0027
R-squared	0.281298	Mean dependent var		0.059562
Adjusted R-squared	0.211747	S.D. dependent var		0.117553
S.E. of regression	0.104368	Akaike info criterion		-1.574581
Sum squared resid	0.337672	Schwarz criterion		-1.396827
Log likelihood	31.55517	F-statistic		4.044448
Durbin-Watson stat	1.744729	Prob(F-statistic)		0.015469

From the unit root test in tables 3 to 6 above ADF Unit root test above, not all the computed test statistics are greater than their critical values at 1%, 5% and 10% significant level respectively, this means that we can reject Ho. This shows that log of GDP series have a unit root problem and are non-stationary both in their level with 1 and 2 lag respectively. While that of ELECPRO do not have unit root and are therefore stationary their level with both 1 and 2 lag. Since some of these series are non-stationary and others are not , we will therefore determine if there is a co-integrating relationship between them. This is important, since if they are co-integrated, a long-run relationship between the variables would exist even if they are individually non-stationary and we could then estimate an error-correction model (Engle and Granger, 1987). The cointegration result are as follows using the procedure explained above.

Table 7: Cointegration Test

Date: 11/01/11 Time: 21:28
Sample: 1971 2008
Included observations: 36
Test assumption:
Linear deterministic trend in the data
Series: LOGELECPRO LOGGDP
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.286560	19.70353	15.41	20.04	None *
0.189143	7.547872	3.76	6.65	At most 1 **

*(**) denotes rejection of the hypothesis at 5%(1%) significance level
L.R. test indicates 2 co-integrating equation(s) at 5% significance level

Unnormalized Co-integrating Coefficients:

LOGELECPRO	LOGGDP
0.028284	0.072184
-0.482706	0.126137

Normalized Co-integrating Coefficients: 1 Co-integrating Equation(s)

LOGELECPRO	LOGGDP	C
1.000000	2.552156	-55.16534
	(12.6273)	
Log likelihood	-27.74251	

Another test we conducted is to check whether the two variables are co-integrated. This is vital, since if they are co-integrated, a long-run relationship between the variables would exist even if they are individually non-stationary. From the result, we can see that the Likelihood ratio is greater than the critical value, which shows that there is a cointegration. The null hypothesis $r = 0$ and $r \leq 1$ can clearly be rejected. The calculated test value of 19.70353 and 7.547872 are greater than their 5% critical values of 15.41 and 3.76 respectively. This suggests that there exist two co-integrated relationships, and therefore there exist a long-run relationship among the variable, GDP and ELECPRO. The existence of at least one co-integrating vector among the variables implies that an ECT can be estimated. Now, we would check if the error correction term ECT_t in the following equation is stationary or not. The result is shown below with the estimates of the coefficients.

$$logELECPRO_t = \alpha + \sum_{i=1}^{k} \beta_i logELECPRO_{t-i} + \sum_{j=1}^{m} \gamma_j logGDP_{t-j+i} + \delta ECT_{t-1} + \varepsilon_t \dots\dots 6$$

Table 8: Vector error correction estimates

Date: 11/01/11 Time: 21:50
Sample(adjusted): 1974 2008
Included observations: 35 after adjusting Endpoints
Standard errors & t-statistics in parentheses

Cointegrating Eq:	CointEq1	
LOGELECPRO(-1)	1.000000	
LOGGDP(-1)	0.253559	
	(0.46209)	
	(0.54872)	
C	-26.32046	
Error Correction:	D(LOGELECPRO)	D(LOGGDP)
CointEq1	-0.059537	-0.232605
	(0.01881)	(0.24385)
	(-3.16489)	(-0.95387)
D(LOGELECPRO(-1))	-0.353687	-5.596110
	(0.17548)	(2.27468)
	(-2.01557)	(-2.46018)
D(LOGELECPRO(-2))	-0.209983	-0.017748
	(0.19147)	(2.48205)
	(-1.09666)	(-0.00715)
D(LOGGDP(-1))	-0.007069	-0.539677
	(0.01338)	(0.17342)
	(-0.52843)	(-3.11196)
D(LOGGDP(-2))	-0.002597	-0.328716
	(0.01254)	(0.16255)
	(-0.20707)	(-2.02225)
C	0.100329	0.797962
	(0.02733)	(0.35428)
	(3.67094)	(2.25234)
R-squared	0.312673	0.445905
Adj. R-squared	0.194168	0.350371
Sum sq. resids	0.322931	54.26359
S.E. equation	0.105525	1.367903
F-statistic	2.638486	4.667510
Log likelihood	32.33630	-57.33669
Akaike AIC	-1.504931	3.619239
Schwarz SC	-1.238300	3.885871
Mean dependent	0.059562	0.226937
S.D. dependent	0.117553	1.697159
Determinant Residual Covariance		0.014305
Log Likelihood		-25.00039
Akaike Information Criteria		2.228594
Schwarz Criteria		2.850733

Using the estimation of the error correction model, we arrived at the following result for the long-run relationship.

D(LOGELECPRO)= -0.0595372284*(LOGELECPRO(-1) + 0.2535587388*LOGGDP(-1)-26.32045979)-0.3536871283*D(LOGELECPRO(-1))-0.2099827126*D(LOGELECPRO(-2))-0.007069434589*D(LOGGDP(-1))-0.002596613871*D(LOGGDP(-2)) + 0.1003288493

D(LOGGDP) = - 0.2326053747*(LOGELECPRO(-1) + 0.2535587388*LOGGDP(-1) - 26.32045979)-5.596109814*D(LOGELECPRO(-1))-0.01774839479*D(LOGELECPRO(-2))-0.5396767354*D(LOGGDP(-1))-0.3287160849*D(LOGGDP(-2)) + 0.7979615438

From the estimation we have above, it can be ascertained that electricity consumption in a specific year strongly influences economic growth in that year (which is denoted by a positive sign) and the also the electricity consumption and economic growth of the previous year respectively (positive and negative sign). The influence of the lag of 2 is not statistically significant and is thus negligible.

Table 9: Pairwise Granger Causality Tests
Date: 11/09/11 Time: 07:25
Sample: 1971 2008
Lags: 2

Null Hypothesis	Obs	F-Statistic	Probability	Causality
LOGGDP does not Granger Cause LOGELECPRO	36	0.35897	0.70126	No
LOGELECPRO does not Granger Cause LOGGDP		6.20788	0.00540	Yes

In the table above, the F-statistic and the probability values indicate if the null hypothesis should be accepted or rejected. In the first row where we have the null hypothesis LOGGDP does not Granger cause LOGELECPRO, we have the F-statistic as 0.35897 with a probability value of 0.70126 which indicates no causality. On the other hand, the null hypothesis that LOGELECPRO does not Granger cause LOGGDP has 6.20788 as the F-statistic with a probability value of 0.00540 indicating that there is a causality. From what we observed, the null hypothesis that GDP does not Granger cause ELECPRO is accepted, showing no causality relationship from GDP to ELECPRO. Moreover, there is a unidirectional relationship form ELECPRO to GDP indicating a causality. It can therefore be said that in during the period under review, there exist a short-run relationship between the two variables which shows that electricity production in the short-run affect the economic growth of Nigeria.

CONCLUSION AND RECOMMENDATIONS

Information Technology is one of the most exciting areas of research that has had an intense focus throughout the globe over the decade. It is a key to competitiveness and economic growth. Due to emerging global economy, e-commerce and e-business have increasingly become a necessary component of business strategy and a strong catalyst for economic development. A strong banking industry is important in every country and can have a significant effect in supporting economic growth through efficient financial services. But this can only be achieved if there is a strong infrastructure base in the economy that would sustain it in a digital economy. To achieve success, Nigeria must have world class ICT infrastructure, especially in electricity production and generation. Lack of electricity infrastructural development will bring about a great recession in the technology development and the unattractive investment climate in Nigeria and in effect, engendering economic growth. Development of the Power infrastructure will increase access to quality power/electricity; it will enhance the development of rural areas and increase technology development in Nigeria. From our analysis, we found that there is both long-run and short-run relationship between electricity infrastructure and economic growth in Nigeria, which in turn affects our quest for a digital economy.

Therefore it becomes imperative for the government and all stakeholders to do all it takes in other to improve our electricity infrastructure with a good maintenance culture to create an enabling environment for a digital economy. There is also a need for digital confidence which we believe will be crucial to the success of the digital economy. A combination of the right rules, education, online risk mitigation tools and law enforcement will improve trust and confidence amongst end users. For Nigeria to join the developed economies, e-payment must form the bedrock of all financial transactions. For this country be moved forward, we need to consider reducing the usage of cash. Such will help in reducing transfer/processing fees, increases processing/transaction time, offers multiple payment option and gives immediate notification of all transaction on customer's account. There are no doubts many challenges and we cannot run away from the fact that we want to look beyond these challenges. We

need to see how despite these challenges we can use electronic payment more.

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APPENDIX

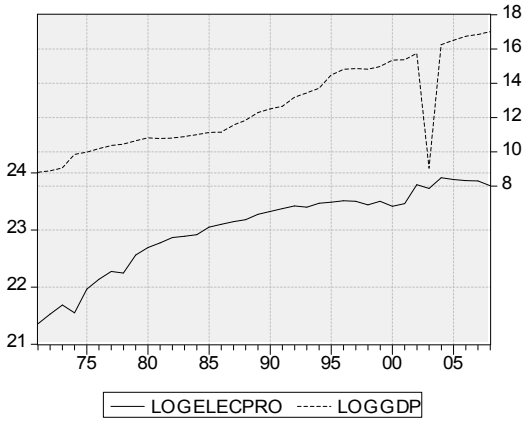
Log of the variables Electricity Production and Gross Domestic product (GDP)

Year	LOGELECPRO	LOGGDP
1971	21.3582541	8.802507463
1972	21.52840152	8.880098685
1973	21.68834673	9.06305772
1974	21.55050675	9.842840118
1975	21.96568983	9.97465406
1976	22.13571516	10.19076204
1977	22.27359048	10.35838706
1978	22.24474647	10.44987625
1979	22.5603173	10.64482233
1980	22.69303201	10.81239711
1981	22.7743079	10.77100182
1982	22.86708964	10.80098886
1983	22.888082	10.88007156
1984	22.91871105	10.9957883
1985	23.04771026	11.12591796

1986	23.09965886	11.14398995
1987	23.14496641	11.56383624
1988	23.17891531	11.84284054
1989	23.27372612	12.2863038
1990	23.32321102	12.49706174
1991	23.37418115	12.65120644
1992	23.42018768	13.18555186
1993	23.39775925	13.43552195
1994	23.46610386	13.70999803
1995	23.48687688	14.47469322
1996	23.51092788	14.8097689
1997	23.50314045	14.84583423
1998	23.43862261	14.81188002
1999	23.50140165	14.97678949
2000	23.41294838	15.33767392
2001	23.46171591	15.36839632
2002	23.79336319	15.74882475
2003	23.7281065	9.046294513
2004	23.91271285	16.25009422
2005	23.88192446	16.50826024
2006	23.86353126	16.73676681
2007	23.85780307	16.84358018
2008	23.7730127	17.00583584

Source: Data used was obtained from CBN Statistical bulletin and World Databank.

Graphical Representation of the variables



Descriptive Statistics

Mean	23.03419	12.59669
Median	23.29847	12.06457
Maximum	23.91271	17.00584
Minimum	21.35825	8.802507
Std. Dev.	0.722103	2.562655
Skewness	-0.902845	0.259941
Kurtosis	2.774972	1.746288
Jarque-Bera	5.242660	2.916613
Probability	0.072706	0.232630
Observations	38	38

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