The Epileptic Nature of Electricity Supply and its Consequences on Industrial and Economic Performance in Nigeria

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Abstract

Nigeria industrial development over the years has been bedevilled by myriads of problems top among which is the erratic nature of electricity supply in the energy or power sector. Every successive government had promised to do something drastic to stabilize the sector in other to drive growth in the industrial sector. However, more than hundred years of amalgamation of northern and southern protectorate and 54 years after the attainment of independent in Nigeria, the Nation is plagued with chronic under development in every area of lives including poor, unreliable and epileptic electricity supply. This has no doubt affected the performance of industrial sector as an engine of growth in Nigeria and as such this paper was premised on testing empirically the impact of electricity supply on industrial and economic development in Nigeria from 1972 â??" 2010. To achieve this, the paper employed the Granger Causality test and the ARDL bounds test approach to cointegration proposed by Pesaran et al (2001). In order to determine the time series characteristics of variables used in the regression, the paper adopted the approach of NG and Perron (2001) modified unit root test. The Granger Causality results showed that there is a feedback causal relationship between GDP per capita and electricity supply. Unidirectional relationship is seen between capital employed and GDP per capita without a feedback effect, running from capital to GDP per capita.

Index terms— industrial performance, electricity supply, economic development, error correction.

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Ologundudu , Mojeed Muhammed Abstract-Nigeria industrial development over the years has been bedevilled by myriads of problems top among which is the erratic nature of electricity supply in the energy or power sector. Every successive government had promised to do something drastic to stabilize the sector in other to drive growth in the industrial sector. However, more than hundred years of amalgamation of northern and southern protectorate and 54 years after the attainment of independent in Nigeria, the Nation is plagued with chronic under development in every area of lives including poor, unreliable and epileptic electricity supply. This has no doubt affected the performance of industrial sector as an engine of growth in Nigeria and as such this paper was premised on testing empirically the impact of electricity supply on industrial and economic development in Nigeria from 1972 -2010. To achieve this, the paper employed the Granger Causality test and the ARDL bounds test approach to cointegration proposed by Pesaran et al (2001). In order to determine the time series characteristics of variables used in the regression, the paper adopted the approach of NG and Perron (2001) modified unit root test. The Granger Causality results showed that there is a feedback causal relationship between GDP per capita and electricity supply. Unidirectional relationship is seen between capital employed and GDP per capita without a feedback effect, running from capital to GDP per capita. The same unidirectional relationship is observed between electricity supply and capital; the causality runs from capital to electricity supply. The Granger causality test found no causal link in the case of industrial output and GDP per capita. The results of the long run and error correction model showed that industrial development, electricity supply, technology and capital employed are important determinants of economic development. Stability tests were also conducted using CUSUM and CUSUMQ and the Jarque-Bera normality test.

The results strongly suggest that the residuals are within the boundaries. This implies that the parameters of the model remained within its critical bounds of parameter stability throughout the period of study. The paper concludes that for Nigeria to drive economic development through industrialization, the country should fix the electricity supply problem.

other important resources, has attracted considerable interest in development economics in recent times. This is because of the critical role industrialization plays in economic development. Industrialization acts as a catalyst that accelerates the pace of structural transformation and diversification of economies; enables a country to fully utilize its or endowment and to depend less on foreign supply of finished goods or raw materials for its economic growth, development and sustenance.

In recognition of the importance of industrialization to economic growth and development, Nigeria since independence has adopted various policies, incentives and schemes to promote industrialization. Some of these policies include the import substitution, indigenisation policy (1972) structural adjustment programme (SAP) of the late 1980s. In 2000, Bank of industry, and small and medium equity investment schemes was established to reduce credit constraints faced by entrepreneurs. And recently in 2007, the Federal Government adopted the National Integrated Industrial Development (NIID) blueprint.

Despite these policies and incentives, available statistics indicate that the industrial sector seems to be experiencing sluggish growth. The survey by Manufacturing Association of Nigerian the first quarter of 2006 paint a gloomy picture of the Nigerian crisis industrial sector. For instance, the survey showed that only 10 per cent of manufacturing concerns in Nigeria operate at 48.8 per cent of installed capacity. The survey also notes that about 60 per cent of the companies operating were barely able to cover their average variable costs, while 30 per cent had completely closed down. According to that report, most of the industrial areas around the country suffered an average of 14.5 hours of power outage per day as against 9.5 hours of supply, and the cost generating power supply by firms for production constitute about 36 per cent of total cost of production (Okafor, 2008; Adegbamigbe, 2007 and Introduction ndustrialization, which is a deliberate and sustained application and combination of an appropriate technology, infrastructure, managerial expertise, and I Udaejah, 2006). Indeed, Nigeria's electricity sector is in crisis.

The supply of e1ecricity supply of in Nigeria is bedevilled with consistent crisis as exemplified by such indicators as electricity blackouts and persistent on self generating electricity. Indeed as noted by Ekpo (2009), Nigeria is running a generator economy with its adverse Global Journal of Researches in Engineering ( ) Volume XIV Issue IV Version I market is dominated on supply side by a state owned monopoly -Nigeria Electricity Distribution Company (NEDC) , the private and current owner of the former Power Holding Company of Nigeria (PHCN) and the National Electrical Power Authority (NEPA) -has been incapable of providing minimum acceptable international standards of electricity service that is reliable, accessible and available for the past decades.

Available statistics indicating the percentage utilization of the installed capacity of electricity and index of industrial production lends further credence to the nature of the electricity crisis. Example, in the decades of the 1970s, the installed capacity of electricity generation in megawatts is 1,097.79, while the average capacity utilization was 35.58 per cent. Installed capacity improved marginally to about 3,318.83 and only an average of 33.43 per cent was actually utilized in 1980s. The period from 1990 to 2003, saw average installed electricity generating capacity of about 6000MW, whereas the utilization rate was on the average below 40 per cent. In the 2007, installed electricity generation capacity was about 7,011MW, while actual utilization rate was 37.4 per cent **??**Okafor, 2008).

The low and unstable capacity utilization, evident in the average capacity utilization of less40 per cent in more than three decades, shows the large gap between installed and actual operational capacity. This large gap clearly indicates the level of technical inefficiency in the power system. Nigeria's persistent electricity crises have weakened the industrialization process, resulting to production stoppages and high operational cost, and significantly undermined the efforts of government of Nigeria to achieve sustained economic growth and development.

The objective of this paper therefore, is to investigate the joint interaction of industrialization, electricity supply, and economic development in Nigeria from 197 2 to 2010, within the framework of autoregressive distributed lag (ARDL) bounds testing approach to co-integration proposed by Pesaranet **??**2001). The significance of this study is to demonstrate empirically that however novel policies on incentives to drive the industrial sector are, if the electricity supply problem is not fixed, the policy objective, accelerating the growth of the industrial sector may not be realized.

Following the introduction, the rest of the paper is organized into six sections. Section two discussed the relevant literature and the theoretical underpinnings of the paper. In section three the paper attempts to examine the industrial development policies, incentives and institutions put place in Nigeria since independence to stimulate industrial development. The model and methodology of the study is presented in section four, and in section five empirical results are discussed while the paper concluding remarks was examined in section six.

1 II.

2 Literature Review and Theoretical Framework

They are plethora of literature on the interaction of electricity crisis, industrial growth and economic development. ??dell (1995) argued that for Columbia to industrialize, electricity supply and demand are important elements of the process. ??wayemi (1988) argued for the importance of energy Sector in the socioeconomic development of Nigeria. He submitted that strong demand and increased supply would stimulate increased income and higher living standards. Okafor (2008) used descriptive analysis to corroborate the views of these authors by arguing that poor and inefficient electricity supply has adverse implication for industrial development in Nigeria. Oke (2006) attributed the non-competitiveness of Nigeria's export goods to poor infrastructure especially electricity supply, which drives the running cost of firms. Archibong (1997) argued that the positive side of SAP could not be fully established due to administrative bottlenecks, rigidities and poor infrastructure, especially electricity supply. This undermined the effectiveness of fiscal and other incentives designed to stimulate the growth and diversification of the economy. Ndebbio (2006) argued that electricity supply drives industrialization process. He submitted that one important indicator whether a country is industrialized or not is the megawatt of electricity consumed. He further argued that a country's electricity consumption percapita in kilowatt hours (KWH) is proportional to the state of industrialization of that country. Ukpong (1976) established the existence of a positive relationship between electricity consumption and economic development. In addition, he submitted that the expansion of energy sector on the demand side is important factor in accelerating the growth of the industrial sector. Ekpo (2009) elaborated on the folly of running a generator economy and its adverse effects on investment. He strongly argued that for Nigeria to jump start and accelerate the pace of economic growth and development, the country should fix power supply problem. Aigbokan (1999) argued in his paper that fixing the energy sector is tantamount to shifting the production possibility curve of the country's economy. ??denikinju (2005) provided a strong argument to support the importance of energy supply. The poor knowledge, no study in Nigeria has attempted to test empirically the causal and long-run relationship between economic developments, industrialization and electricity supply using the ARDL bounds test approach to cointegration from the supply side. The gap this paper intends to fill.

There are a range of competing theories to the study of economic development. Each approach has its strength and weaknesses with different ideological, theoretical and empirical analysis. This study is anchored on the endogenous growth model. The motivation for the endogenous growth model stems from the failure of the neoclassical theories to explain the sources of long-run economic growth. The neoclassical theory does not explain the intrinsic characteristic of economies that causes them to grow over extended period of time. The neoclassical theory focuses on the dynamic process through which capital-labour ratios approach long-run equilibrium. In the absence of external technological change, which is not clearly explained in the neoclassical model, all economies will converge to zero growth.

The neoclassical theory see rising GDP as a temporary phenomenon resulting from technological change or a short-term equilibrating process in which an economy approaches its long-run equilibrium. The neoclassical theory credits the bulk of economic growth to a completely independent process of technological progress.

According to neoclassical theory, the low capital-labour ratios of developing countries promise exceptionally high rates of return on investment. Based on this premise, it was expected that the free-market development of the concept of endogenous growth or, more simply, the new growth theory. The new growth theory represents a key component of the emerging development theory.

The new growth theory provides a theoretical framework for analyzing endogenous growth, persistent GNP growth that is determined by the system governing the production process rather than by forces outside that system. In contrast to traditional neoclassical theory, these models hold GNP growth to be a natural consequence of long-run equilibrium. The principal motivations of the new growth theory are to explain both growth rate differentials across countries and a greater proportion of the growth observed. In particular, endogenous growth theorists seek to explain the factors that determine the rate of growth of GDP that is left unexplained and exogenously determined in the Solow neoclassical growth equation (that is, the Solow residual).

Models of endogenous growth bear some structural resemblance to their neoclassical counterparts, but they differ considerably in their underlying assumptions and the conclusions drawn. The most significant theoretical differences stem from discarding the neoclassical assumption of diminishing marginal returns to capital investments, permitting increasing returns to scale in aggregate production, and frequently focusing on the role of externalities in determining the rate of return on capital investments. By assuming that public and private investments in human capital generate external economies and productivity improvements that offset the natural tendency for diminishing returns, endogenous growth theory seeks to explain the existence of increasing returns to scale and the divergent long-term growth patterns among countries. And whereas technology still plays an important role in these models, it is no longer necessary to explain long-term growth.

A useful way to contrast the new (endogenous) growth with traditional neoclassical theory is to recognize that many endogenous growth theories can be expressed by the simple equation Y=AK, as in the Harrod-Domar model. In this formulation, A is intended to represent any factor that affects technology, and K again includes both physical and human capital. And there are no diminishing returns to capital in this formula, so the possibility exists that investments in reforms imposed on highly indebted countries by the World Bank and the International

Monetary Fund should have prompted higher investment, rising productivity, and improved standards of living. Yet even after the prescribed liberalization of trade and domestic markets, many LDCs experienced little or no growth and failed to attract new foreign investment or to halt the flight of domestic capital. The anomalous behavior of developing-world capital flows (from poor to rich nations) helped provide the impetus for the physical and human capital can generate external economies and productivity improvements that exceed private gains by an amount sufficient to offset diminishing returns. The net result is sustained long-term growth -an outcome prohibited by traditional neoclassical growth theory.

Thus even though the new growth theory reemphasizes the importance of savings and human capital' investments for .achieving rapid growth, it also leads to several implications for growth that are in direct Global Journal of Researches in Engineering ( ) Volume XIV Issue IV Version I leading to the equilibration of growth rates across closed economies; national growth rates remain constant and differ across countries depending on national savings rates and technology levels. Furthermore, there is no tendency for per capita income levels in capital-poor countries to catch up with those in rich countries with similar savings and population growth rates. A serious consequence of these facts is that a temporary or prolonged recession in one country can lead to a permanent increase in the income gap between itself and wealthier countries.

Perhaps the most interesting aspect of endogenous growth models is that they help explain anomalous international flows of capital that exacerbate wealth disparities between developed and developing countries. The potentially high rates of return on investment offered by developing economies with low capital-labour ratios are greatly eroded by lower levels of complementary investments in human capital (education), infrastructure, research and development (R&D). In turn, poor countries benefit less from the broader social gains associated with each of these alternative forms of capital expenditure. Because individuals receive no personal gain from the positive externalities created by their own investments, the free market leads to the accumulation of less than the optimal level of complementary capital.

Where complementary investments produce social as well as private benefits, governments may improve the efficiency of resource allocation. They can do this by providing public goods (infrastructure) or encouraging private investment in knowledge-intensive industries where human capital can be accumulated and subsequent increasing returns to scale generated. Unlike the Solow model, new growth theory models explain technological change as an endogenous outcome of public and private investments in human capital and knowledge-intensive industries. Thus in contrast to the neoclassical counterrevolution theories, models of endogenous growth suggest an active role for public policy in promoting economic development through direct and indirect investments in human capital formation and the encouragement of foreign private investment in knowledge-intensive industries such as computer software and telecommunications (Stern, 1991; Sala-i-Martin, 1990; Romer, 1986; Helpman, 1986; Lucas, 1988; Barro, 1990;Todaro and Smith, 2003).

3 III.

4 Overview of Industrial Policies Incentives and Institutional Support

Given the importance and relevance of industrialization (industrial sector) to economic growth and development, Nigeria since independence has put in place various policies, incentives and institutions to strategies embarked upon in Nigeria since independence are summarized and presented in this section.

Import Substitution Industrialization policy was the first industrial strategy embarked upon by the Nigeria government immediately after attaining independence. It objectives of this policy among others include to lessen overdependence on foreign trade and to save foreign exchange by producing those items that were formerly imported. For example detergents, food, textiles, household appliances etc.

In 1972, the Nigerian Indigenization policy was adopted following the obvious failure of the import substitution strategy. The major objective of this policy was to strengthen Nigeria economy. others include the transfer of ownership and control to Nigerians in respect of those enterprises formally wholly or mainly owned and controlled by foreigners, fostering widespread ownership of enterprises among Nigerian citizens, the creation of opportunities for Nigeria indigenous businessmen, the encouragement of foreign businessmen and investors to move from the unsophisticated area of economy to the area where large investments are more needed.

The Structural Adjustment Programme (SAP) was adopted in June, 1986 and it received the blessings of Breton Wood institutions. SAP was regarded as the universal recipe that would bring the desired transformation of the economy from agrarian to industrial. In particular, this policy came up to improved the weaknesses, and ineffectiveness of earlier policies. Its aims and objectives include promoting investment, stimulating non-oil exports and providing a base for private sector led development, promote efficiency of firms and between the domestic imports competing firms and foreign firms in order to promote efficiency, reduction of levels of both tariff and non tariff barriers, the commodity marketing boards and market determination of exchange rate as well as deregulation of interest rates. The National Economic Reconstruction Fund (NERFUND) was established in the same year as complementary institution to the industrial policy. NERFUND seeks to address the medium and long-term financial constraints experienced by small and medium scale entrepreneurs, provide the required financial resources to participating merchant and commercial banks to lend to small and medium scale firms and provide or foreign denominated loans to participating firms for a period of five to ten years with a grace of one to three years. As a complement to the Bank of Industry, Small and Medium Industries Equity Investment Scheme (SMIEIS) was also set up in 2000. The objective was to assist in the coordination of the scheme with a guideline that 60 percent of the SMIEIS fund should go to core real sector. 30 percent to services, and 10 percent to micro enterprises through NGOs. The other objectives of SMIEIS include increased per capita income/output and initiating changes in the structure of business the society through growth, increased output and employment opportunities, enhanced regional economic balance through industrial dispersal, moderate rural/urban migration, easy adaptation to local technology and promote efficient resource utilization. As part of the efforts towards the implementation of Nigeria's Industrial Policy, which fuelled the competitiveness of the industrial sector, finance, technological advancement, incentives to industries, research and development, among others, the National Integrated Industrial Development (NIID) blueprint was adopted by the Federal Government in 2007. The NIID is a country service framework developed by the United Nations Industrial Development Organization (UNIDO) in collaboration with Federal Ministry of Industry and other stakeholders. The framework comprised four integrated programmes;©

5 Bank of

? Industrial governance and public/private sector partnership. ? Strengthening industry's institutional support base: a cluster development initiative to grow the Small and Medium Enterprises (SMEs) using common facilities.

? Environment and Energy: The challenge of low power generation and utilization to be addressed through rural renewable energy. ? Rural private sector agro-industrial development.

In addition, the Federal Government adopted the recommendation of the Presidential Committee on restructuring the moribund textile Industry in Nigeria with the approval of a N5Obillion loan to the subsector. Efforts to boost the development of SMEs through the construction of one industrial in each of the six geopolitical zones of the country by the Small and Medium Enterprises Development Agency of Nigeria (SMEDAN) continued. The parks would provide industrial plots with regular power supply, potable water, and sewage system.

To support this initiative of the Federal Government of Nigeria, the Nigerian Electricity Regulatory Commission (NERC) issued 14 new licenses in 2007 to private operators for the establishment of independent power plants with varied capacities and expected total output of 6,010MW. All the licensed power generating plants were gas-based. This brought the total number of licenses issued by the commission to 23, with expected total output of 9,152.0MW. Two new distribution agencies were also granted licenses to commence operation. **??**Ndebbio and Ekpo. 1991, CBN Annual Report and Statement of **??**ccount, 2007) In pursuance of these objectives, the government has experimented with a number of incentivesat positively influencing the performance and productivity of the industrial sector. Some of these incentives include tax holidays, tariff protection, outright ban on certain commodities to encourage domestic production, building of industrial estates (export processing zones) and Industrial Raw Material Research and Development Council (IRMRDC) etc.© 2014 Global Journals Inc. (US)

IV.

6 The Model

The model adopted for this study is based on the endogenous growth theory used elsewhere by Stern (1991); Romer **??**1986, **??**990); Sala-i-martin (1990); Ndiyo (2003); Help man (1992) and Barro (1990).(1986) departs from Solow by assuming that the economy-wide capital stock, positively affects at the industry level, so that there may be increasing returns to scale at the economy-wide level. Romer's model endogenizes the reason why growth might depend on the rate of investment (as in the Harrod-Domar mode1)simplified version presented in this study, we abstract from the Global Journal of Researches in Engineering ( ) Volume XIV Issue IV Version I endogenous growth model, in order to concentrate on issues concerning industrialization.

7 The general endogenuous production function

Gdppc= AK i a L i 1 -a K B**(1)**

We assume symmetry across industries for simplicity, so that each industry will use the same capital and labour. Then, we have the aggregate production function asGdppc=AK a L B**(2)**

Where Gdppc = real GDP per capita at time t A = total factor productivity (3) K = Capital stock L = Labour We assume that the impact of electricity supply and industrial output on economic performance possibly operates through total factor productivity (TFP). Moreover, any gains from increased electricity on TFP would depend on the rate of capacity utilization in industries. Since the paper intends to investigate the impact of electricity supply and industrialization on economic performance, we assume therefore, that TFP is a function of electricity supply (elects) and industrialization (proxy as index of industrial production) and technology (tech). Thus A = f (elects, Indpr, tech) (

Combining equations 2 and 3, we get Gdppc = CtKt ? L ? elects ø , indpr d , $Tech^{a}$

Where ?., i, ?, ø,d, and are elasticity coefficients. From equation 4 an explicit estimation function is specified, after taking the natural logs of both sides as follows L0gGDPPC = a 0 + aLogkt + ?LogLt + ø Logelects +

dLogindpr + ãLogtech + Et (6) Where Et is the white noise error term. The sign of all the elasticity coefficients are expected to positive.

To investigate the determinants of industrial development the paper specilles equation 6 as follows:Logindpr = b 0 + aLogkt + LogLt + ?Logelects + ªLogtech + Et (7)

The sign of the respective coefficients are expected to be positive.

V.

8 Methodology

This paper investigates the relationship between economic development, industrialization and electricity supply. Technology, capital and labour employed in the course of economic development included to investigate their relative impact on Nigeria's economic performance, using annual time data from 1972-2010. The data are all sourced from Central Bank of Nigeria statistical bulletin2007, 2008 and 2009. . In order to investigate the relationship that exists between the dependent variable, this paper adopts the following procedures.

First, the time series characteristics of the variable are investigated. The purpose is to determine order of integration. The paper conduct unit root test on the variables included in the regression by employing the Ng and Perron (2001) modified Unit Root tests. The objective here is to determine the underlying properties of the process that generate the present result and discussion of the analysis while conclusion is presented in the study time series variables employed. The choice of the Ng and Perron (2001) modified unit root test is based on the fact that the tests are more suitable for small samples than the traditional tests. In addition, as observed by Sinha (2007) the null hypothesis of a unitis not over-rejected when Ng and Perron (2001), modified unit root tests are employed.

Secondly, the paper examines the causal relationship between the dependent and explanatory variables by employing the Granger causality tests for co-integrating systems. Such an exercise will provide an understanding of the interactions among the variables in the system and will shed light on directions of the causality. Thirdly, the paper proceeds further to test the long-run (cointegration) relationship between the variables used in the model by employing the (ARLD) bounds testing approach to cointegration proposed by Pesaran et al (2001).

In this paper, the Autoregressive Distributed Lag (ARDL) bound test used extensively bysaran and Shin (1996); Pesaran and Pesaran (1997); **??**esaran and Smith (1997) and Pesaranet al (2001) are employed. This technique has a number of advantages over Johansen cointegration techniques. Whereas the Johansen techniques require large data sample, a luxury that most developing economies do not have, the ARDL model is the most useful method of determining the existence of

The Epileptic Nature of Electricity Supply and its Consequences on Industrial and Economic Performance in Nigeria household sector, an important feature of the original cointegration in small samples (Ghatak and Siddiki 2001). A second advantage of ARDL approach iswhile other cointegration techniques require all of the variables to b,e of the same order, the ARDL approach can be applied whether the variables in the regression are purely of 1(1) and/or purely 1(0) or a mixture of both. This implies that the ARDL approach avoids the pre testing problem associated with standard cointegration, which requires that the variables be already be classified into 1(1) (Pesaraiiet al2001).

A third advantage of the ARDL method is that if a researcher is not sure of the unit root properties of the **??**001), the first step in any cointegration technique is to determine the order of integration of each variable in the model. This however, would depend on which root one uses, and different unit root test could lead to contradictory results. For example, applying the conventional unit root test such as Augmented Dickey Fuller and Phillip Perron tests, one may incorrectly conclude that a unit root is present in a series that is actually stationary around a one-time structural break. This problem of testing for unit root is avoided with ARDL approach.

The ARDL approach requires two steps. In the first step, the existence of any long run relationship among the variables of interest is determined by using the F-test. The second stage requires the estimation of the long run relationship and to determine their values, thereafter the short run elasticity of the variables with the error correction representation of the ARDL model. The purpose of applying the ECM version of the ARDL is to determine the speed of adjustment to equilibrium. As argued by Pesaran and Pesaran (1997), the ARDL model is presented by equation **??**The F-test is used to test the existence of long run relationship. When long run relationship exists, Ftest indicates which variable should be normalized. The null hypothesis for no cointegration among variables in equation (**??**) is H0: 1 = 2 = 3 = 4 = 5 = 6 =0 against Against alternative H1: 1 # 2 # 3# 4 # 0 5 # 6

The F-test has a non-standard distribution which depends on whether variables included in the model are 1(0) or 1(1); the number of variables and whether the model contains an intercept/or a trend. Given a relative small sample size in this study of 38 observations, the critical values are as reported by Pesaran et al (2001) which is based on small sample size.

If the F-test statistics exceeds their respective upper critical values, we can conclude that there is evidence of a long run relationship between the variables regardless of the order of integration of the variables. If the F-test statistics is below the upper critical value, we cannot reject the null hypothesis of no cointegration and if it lies between the bounds, a conclusive influence cannot be made without knowing the order of integration of the underlying variables.

If there is evidence of long run relationship (cointegration) of the variables, the following long run model is estimated. the period 1972-2010. The calculated F-statistics for the long run model and short run error correction model is presented in table55The critical values are reported in the same table and are based on critical values as reported in Pesaran et al (2001). The calculated Fstatistics for the long run model is 12.21 and that of the short run model is 5.3. These values are higher than the upper and lower bound critical values at 5 per cent levels of significance. This implies that the null hypothesis of no cointegration cannot be accepted at 5 per cent and 10 per cent levels of significance and therefore, there is a long run relationship among the variables under scrutiny.

9 VI. Empirical Result and Discussion

The results of the Ng and Perron (2001) modified unit root test is presented in table 5.0. Three of the variables under scrutiny namely GDP per capita, electricity supply (elects) and index of industrialoutput (indpr) are 1(1) process, which means that they are stationary at first difference. Capital (Kap) and Labour force (lab) are 1(0) process, implying that they are stationary at levels.

The purpose of testing for the stationarity properties of the variables in bounds approach to cointegration is because the (ARDL) bounds testing approach is applicable only in the presence of 1(1 and 1(0) variables or a mixture of both. This means that the assumption of bounds testing will collapse in the presence of 1(2) variable. The Ng and Perron (2001) modified unit root results presented in table 5.0, implies that the bounds testing approach is applicable in this study, as all the variables are a mixture of 1(1) or 1(0).

To investigate the causal relationship in the case of GDP growth rate, industrial output electricity supply, capital, labour, and technology variables, this paper adopts the Granger Causality test. As presented in table5.l, the results show that there is a feedback causal relationship between GDPPC and electricity supply. Unidirectional relationship is seen between Kap and GDP per capita without a feedback effect, running from Kap to GDP per capita. The same unidirectional relationship is observed between elects and Kap, the causality runs from Kap to elects. The causality result also revealed a unidirectional relationship without feedback effect between Lab and elects. The study found no causal link between indpr and GDP per capita.

The next task of the paper having established the order of integration and the causal link between the variables included in the model is to estimate equation 5. The purpose is to establish the long run relationship among the variables. Following Pesaran et al (2001), since the time series are annul, the paper adopt 2 as the maximum order of the lags in the ARDL and estimated equation 5 and if cointegration exists among the variables we proceed to estimate equation 6 and 8, for technology, industrial output and electricity supply, are significant factors influencing GDP per capita. This is because the four variables do not only con form to a priori economic expectations; they are statistically significant at 5 and 10 per cent levels of significance. Their statistical significance strongly suggests that a 1 per cent increase in industrial output, capital, technology and electricity supply leads to about 3.8, 1.1, 4.1 and 4.5 per cent increase in real output respectively.

Following the estimation of the long run coefficients, the paper proceeds to estimate the error correction model. The paper adopts the general to specific approach to arrive at the parsimonious estimate by eliminating jointly insignificant variables. The error correction term shows the speed of adjustment to restore equilibrium in the dynamic model. In particular, the ECM coefficients show how quickly variables converge to equilibrium and the ECM coefficient is expected to have a negative sign. As observed by Banerjere et al (1998), a highly significant error correction term is a strong confirmation of the existence of a stable long run relationship.

The result of the bound testing cointegration shows that all the variables have the a priori sign and are statistically significant. This confirms the long run result that electricity supply, technology, industrial output and capital employed jointly determined economic development in Nigeria.

As previously discoursed, the error correction term indicates the speed of adjustment to restore equilibrium. The ECM variable has the correct a priori sign and is highly statistically significant. The speed of adjustment of 0.64 shows a high level of convergence.

In particular, about 63 per cent of disequilibrium or deviation from long run growth rate of GDP in the previous period is corrected in the current year.

The diagnostic statistics are quite good. There is no evidence of serial autocorrelation as indicated by the value of the DW of 2.16. The normality test proved that the error term is normally distributed, as indicated in table 5:4. The paper conducted stability test of the long run and short run coefficients using the cumulative sum (CUSUM) and the cumulative sum of squares (CUSUMQ) and Jarque-I3era normality tests.

As observed by Bahmani-Okooee and Wing NG (2001), the stability of the regression coefficients is evaluated by stability tests and stability tests can show whether or not the regression equation is stable over time. This stability test is appropriate in time series data, especially when one is uncertain when change might have taken place. The null hypothesis is that the coefficient vector is the same in every period. statistics remains within the critical bound of 5 per cent significance level, the null hypothesis, which states that all coefficients in the error correction model are stable, cannot be rejected.

The plot of the Jarque-Bera and recursive residual is presented in figures 5.1 to 5.3 in the appendix. As shown in the graphs, the plot of CUSUM and CUSUMQ residuals are within the boundaries. This implies that the stability of the parameters of the model has remained within its critical bounds of parameter stability throughout the period of study. The result of the Jarque-Bera test lends credence to the stability of the parameters in the

GDP per capita model. The results of these tests strongly suggest that the model is fairly well specified and robust for policy analysis.

VII.

10 Conclusion

This study attempted to investigate the impact of industrial development and electricity supply on economic development in Nigeria from l972 to 20l0. The study adopted the endogenous growth model because it approximates developing countries economic conditions better than other growth theories. In particular, this study investigated the impact of industrial output (indpr), capital (kap), labour force (lab), electricity supply in Mega Watt (elects) and technology (tech) on Nigeria's economic performance using the recently developed (ARDL) bounds testing approach to cointegration proposed by Pesaran et al (2001).

In order to determine the time series characteristics of variables used in the regression, the paper adopted the approach of NG and Perron (2001) modified unit root test. This approach was adopted because it is suitable for small samples than the traditional test such Dickey-Fuller and Phillip Perron tests. The result of the unit root test showed that the variables are either stationary at levels or at first difference, which clearly means that the bounds testing approach to cointegration can be adopted in this paper.

The paper adopted the Granger causality test to establish the causal link in the case of GDP per capita, electricity supply, industrial output, capital, labour force and technology. The results show that there is a feedback causal relationship between GDPPC and electricity supply. Unidirectional relationship is seen between Kap and GDP per capita without a feedback effect, running from Kap to GDP per capita. The same unidirectional relationship is observed between elects and Kap, the causality runs from Kap to elects. The causality result also revealed a unidirectional relationship without feedback effect between Lab and elects. The Granger causality test found no causal link in the case of industrial output and GDP per capita.

The result of the causality tests provides useful insight to policy formulation and implementation. It indicates that the contribution of the industrial sector to economic development was below the expected threshold given the gamut of industrial policies put in place since independence. This poor causality could be attributed to poor infrastructure especially electricity supply. This assertion agrees with submission of Ajanaku (2007), who argued that poor electricity supply and other factors have contributed to the dismal performance of the nation's industrial sector. For instance, the sector's contribution to GDP has continued to drop since 1990, from 4.7 per cent in 2003; 4.06 per cent in 2004 and 4.2 per cent in 2005. These figures represent the lowest contribution of the industrial sector to economic growth since independence in 1960. And according to Manufacturing Associationof Nigeria survey of small and medium term enterprises in 2007, small and medium term industries who are the drivers of the economy that should be growing is experiencing stunted growth. 1'he multinationals are not fairing any better. The major reason for their declining growth is poor infrastructure especially electricity supply. The causality result showed very strongly that electricity supply is crucial in stimulating economic growth and development rate.

The results of the long run and error correction model showed that the index of industrial development, electricity supply, technology and capital employed are important determinants of economic development. The paper tested for cointegration using the F-statistics as proposed by Pesaran et al (2001). The calculated Fstatistics in the long run and short run models were well above the upper and lower bound critical values as provided for in Peseran et al ??2001). The ECM variable was highly significant with the correct a priori sign, which showed the existence of long run relationship among the variables under consideration.

To test the importance of electricity supply and industrial development in economic development, the long run and short run equations were estimated first without the inclusion of electricity supply and industrial output, it was discovered that with the inclusion of electricity supply and industrial output, the overall results improved significantly. The diagnostic tests, the statistical significance and the a priori signs of the coefficients improved as well.

The important conclusion provided by findings of this study is that however novel an industrial policy may be, without fixing the electricity supply problem in Nigeria, the country may not be able to drive economic development to the desired threshold.

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The Epileptic Nature of Electricity Supply and its Consequences on Industrial and Economic Performance in Nigeria Appendices The critical values are taken from Pesaran et al (2001), unrestricted intercept and no trend with seven variables at 1 percent is 3.027 to 4.296; at 10 percent are 2.035 to 3.153. [1] [2] [3]

[3]The Epileptic Nature of Electricity Supply and its Consequences on Industrial and Economic Performance in Nigeria

Figure 1:

$$\Delta LGdppc_t = a_0 + \sum [illegible] + U_t \quad (7)$$

Where

a_i, i=1,2,3,4,5,6 are the long run multipliers

α, θ, λ, β, d, δ = are the short run dynamic coefficients of the ARDL model

Δ = is the first-difference operator

P = optimal lag length

The F-test is used to test the existence of long run relationship. When long run relationship exists, F- test indicates which variable should be normalized. The null hypothesis for no cointegration among variables in equation (7) is

$H_0: \lambda_1 = \lambda_2 = \lambda_3 = \lambda_4 = \lambda_5 = \lambda_6 = 0$ against

Against alternative

$H_1: \lambda_1 \neq \lambda_2 \neq \lambda_3 \neq \lambda_4 \neq 0 \; \lambda_5 \neq \lambda_6 \neq$

Figure 2:

$$LGDP_t = \alpha_1 + \sum [illegible] \quad (8)$$

The orders of the lags in the ARDL model are selected by either the Akaike Information Criteria (AIC) or the Scharz Bayesian Criteria (SBC), before the selected model is estimated by ordinary least squares. For annual data, Pesaran et al (2001) recommended choosing a maximum of 2 lags. The paper adopted a lag length of 2 because it minimizes SBC criteria.

The ARDL specification of the short run dynamics can be derived by constructing an error correction model (ECM) of the following form

$$\Delta LGDPR_t = \alpha_2 + \sum [illegible] \quad (9)$$

Where d in ECM_{t-1} is the speed of adjustment and the error term, defined as:

$$ECM_t = LGDP_t - \alpha_2 - \sum [illegible] \quad (10)$$

Figure 3:

Stability Tests

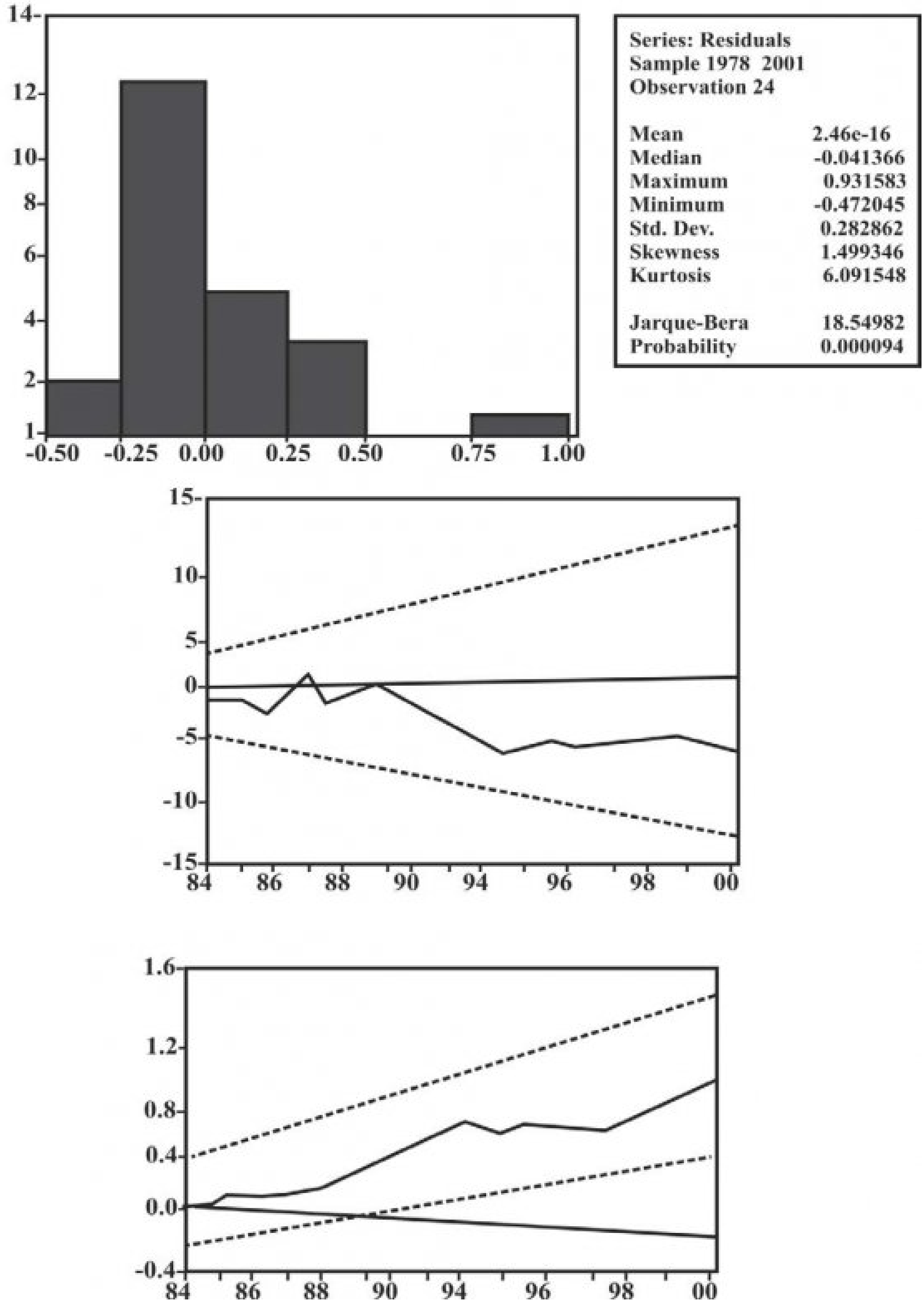

Figure 4:

Figure 5:

5

Variables	MZa	MZt	MSB	MPT
log(gdppc)	-18.6301	-3.02188	0.16220	1.42329
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-18.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500
log(elects)	-19.0489	-3.08021	0.16170	1.30753
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-8.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500
dLog(gdplab)	15.8456	2.81454	0.17762	1.54694
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-8.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500
log(indpr)	-15.0013	-2.73862	0.18256	1.63362
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-8.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500
log(kap)	-16.1012	-283271	0.17593	1.53888
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-8.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500
log(lab)	-7.49221	-1.86393	0.24878	3.52739
1%	-13.8000	-2.5800	0.17400	1.7800
5%	-8.1000	-1.9800	0.23300	3.1700
10%	-5.7000	-1.6200	0.27500	4.4500

Figure 6: Table 5 :

1

Null Hypothesis	F-statistics	Probability	Decision	Causality
Indr door nor Granger cause gdppc	1.38502	0.2664	Accept	Independent
Gppc does not Granger cause indpr	0.66415	0.5224	Accept	
Elects does not Granger cause gdppc	6.22773	0.0055	Reject	Feedback
Gdppc does not Granger cause elects	3.00532	0.0646	Reject	
Kap does not Granger cause gdppc	600.530	7.E-22	Reject	Unidirectional
Gdppc does not Granger cause kap	0.09707	09078	Accept	
Lab does not Granger cause elects	3.53391	0.0419	Reject	Unidirectional
Elects does not Granger cause lab	0.32381	0.7259	Accept	
Elects does not Granger cause indpr	0.77603	0.4702	Accept	Reject
Indpr does not Granger cause elects	4.05848	0.0288	Reject	
Kap does not Granger cause elects	0.77603	0.4702.	Accept	Reject
Elects does not Granger cause kap	4.05848	0.0288	Reject	

Figure 7: Table 1 :

2

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Variable C Log(kap) Log(lab) Log(elects) Log(tech)	Coefficient	T-statistics	Probability
	5.757297	5.700311	0.0000
	0.111232	4.247550	0.0003
	0.224283	0.845585	0.4058
	0.452754	3.543821	0.0034
	0.405781	3.070092	0.0051
Gdplab	0.005991	2.555885	0.0171
Log(indpr)	0.378619	1.922852	0.0660
R2 =0.65; F-statistics =12.21;D.W=1.6			

Figure 8: Table 2 :

5

	3 : Overparametized Result		
Variable	Coefficient	T-statistics	Probability
Dlog(gdppc(-1)	2.115872	0.411363	0.6881
Dlog(indpr(-1))	-0.517975	-0.459591	0.6540
Dlog(indpr(-2))	2.310543	2.263321	0.0430
Dlog(elects(-1))	0.562072	0.921168	0.3751
Dlog(elects(-2))	-0.686395	-1.221845	0.2452
Dlog(elects(-3))	0.456381	2.126534	0.0234
Log(kap(-1))	0.167257	0.341928	0.7383
Log(kap(-2))	0.009117	3.219889	0.0032
Log(lab(-1))	4.403576	1.466558	0.1682
Log(lab(-2))	-3.899951	-1.189778	0.2571
Dlog(gdplab(-1))	0.742241	0.561524	0.5848
Dlog(gdplab(-2))	-0.902594	-0.743773	0.4713
Log(tech(-1))	0.463572	3.247692	0.0035
Ecm1(-1)	-0.562391	-3.342341	0.0025
R2=0.47; F-statistics =6.73; D.W=2.5			
	Table 5.4 : Parsimonious Result		
Variable	Coefficient	T-statistics	Probability
C	0.209360	1.935513	0.0254
Dlog(indpr(-2)	2.369628	3.258182	0.0044
Dlog(elects(-2))	0.622652	2.673291	0.0265
Log(kap(-2))	0.205177	1.859725	0.0354
Log(tech(-1))	0.750557	2.053808	0.0548
Ecm1(-1)	-0.637709	-2.107843	0.0493
R2=0.44; F-Statistics =5.2; D.W=2.16			

Figure 9: Table 5 .

5

Computed F-statistics (long run mode)	12.21
Computed F-statistics error correction model	5.3
Bound Testing Critical value	5% lower (2.365); upper (3.553)

Figure 10: Table 5 .

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