Analysis of Energy Crisis and How it Affects Production Sector and Economic Growth of Nigeria

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***Abstract*—The provision of energy is a stimulus to increased economy and social activities of any country. The Nigerian energy industry is probably one of the most inefficient in meeting the needs of its people. The gloomy energy service provision has adversely affected living standards of the population and made worse income and energy poverty in an economy where the majority of the people live on less than 200 naira a day. Whereas Nigeria is rich in energy resources and the sixth largest exporter of crude oil in the world, Nigeria's persistent energy crisis has weakened the industrialization process, and significantly undermined the effort to achieve and sustained economic growth, increased competitiveness of domestic industries, regional and global markets, and employment generation. This study will analyze Nigerian economy as one the developing countries due to rapid changes in the world economy. It also suggests that economic awareness and the interest rate must be combined with other vital factors to give the desired boost to industrial development, especially industrial sector. The evidence led to the suggestion that if Nigerian industrial sector is to benefit maximally, emphasis should first be placed on deregulation at the sub-sector level to form awe for effective and efficient linkage with the economic growth and development. In addition, an efficient transport infrastructure should be developed and local sourcing of raw materials actively encouraged. Thus, analyze the energy crisis and the way forward in Nigeria.**

***Index Terms*— economic growth, energy crisis, production sector**

I. INTRODUCTION

The economy, internationally, has been affected during the last few years by a succession of crises, Nigeria not been an exception. Economic growth act as a catalyst that accelerates the pace of structural transformation and diversification of the economy, enabling a country to fully utilize its natural resources and to depend less on foreign supply of finished goods or raw materials for its economic development. Economic growth being a deliberate and sustained application, a combination of an appropriate technology in managerial expertise and other resources has attracted considerable interest in economic development in recent times [1].

The Nigerian energy industry is probably one of the inefficient in meeting the need of its people. This is most evident in the persistent disequilibrium in the markets for electricity and petroleum products, especially kerosene and diesel. The energy service provision has adversely affected living standards of the population and exacerbated income and energy poverty in an economy where the majority of the people live on less than 200 naira a day. This energy crisis has weaken the Economic development process, and significantly undermined the effort to achieve sustainable economic growth, increased competitiveness of domestic industries, regional and global markets, and employment generation[2]. There is persistent inadequate quantity, poor quality, and low access to energy despite the enormous domestic endowments of renewable and non-renewable primary energy sources. For example, crude oil and natural gas reserves, estimated at 35 billion barrels and 185 trillion cubic feet, respectively. These fossil fuel reserves are more than enough to fuel most sub-Saharan Africa energy demand for several years [3]. Coal reserves are also substantial at 2.8 billion metric tons with a large amount of renewable energy resources including hydro electricity, solar, wind and biomass energy present [NSE 5]. Since the move to liberalized system, the economy witnessed series of changes that has substantially affected the trend and stability of the exchange rate, which had a radical change from the long operated fixed system from 1960s to the first half of the 1980s. This shifted dramatically from 1986 to when the structural adjustment programmed (SAP) began [NSE 4]. Despite being a world ranking exporter of liquefied natural gas (LNG), Nigeria's gas-dominated electric grid experiences frequent system collapse linked often to inadequate gas supply. The gas and oil pipe line vandalisation in the Niger Delta region has exacerbated the petroleum products and electricity supply problems. Largely, unrestrained gas, flare off has consistently put Nigeria among the world's largest source of carbon emission, a major factor in global warming [4]. The extensive substitution of poor public electricity supply with highly polluting self-generated power and the scarcity of kerosene combined have induced greater use of fuel wood for the low and middle income classes with adverse environmental consequences. Diesel shortages has crippled industrial production dependent on diesel-generated private electricity supply and also the protracted nature of the energy crises, the Nigeria's chronic energy infrastructural gaps which existed since the large scale inflow of oil income in the 1970's and worsened in recent times despite huge amounts of public expenditure in government dominated and controlled industry. The billion dollars of pubic investment into capacity expansion in the energy industry, contrast abruptly with the extremely poor supply outcomes measured by refinery output, rise in imported fuel and frequent power outages and voltage variation [5].

. Nigeria has five domestic refineries owned by the government with capacity to process about 450,000 barrels

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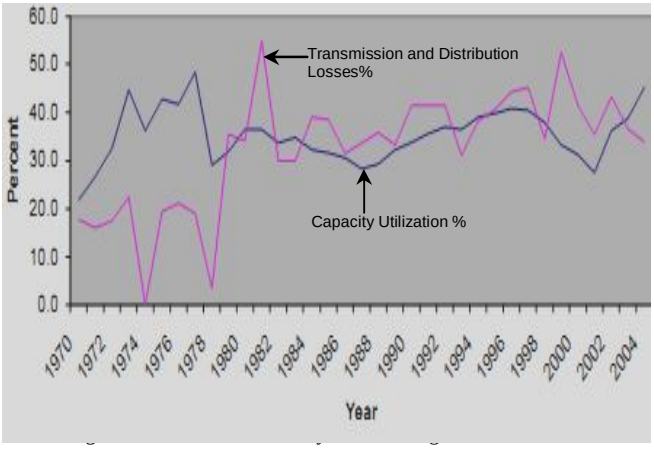
of oil per day, yet its imports, constitute more than 75% of petroleum products requirements. Nigeria owned refineries have hardly operated about 40% capacity utilization rate for any extended period of time in the past two decades [5]. The gasoline market is much better supplied than kerosene and diesel due to its high political profile, which explains why the government has embarked on large import volumes to remedy domestic shortages of the product, with subsidy support in the range of 700 to 800 billion naira in 2008, according to the Minister for Energy. The weaker political pressures exerted by consumers of kerosene and diesel on the government and the constraints on public financing of large scale import of these products, largely explains their more severe and persistent market shortages. Nigeria's electricity market, which has been dominated on the supply side by Power Holding Company of Nigeria (PHCN) formerly called the National Electric Power Authority (NEPA), has been incapable of providing minimum acceptable international standards of electricity service reliability, accessibility and availability for the past few decades. The nature of the poor record in electricity supply is apparent in the trend in transmission and distribution losses shown in Figure 1[6]:



Source: [6] Data from PHCN and NEPA

The double digit transmission and distribution losses are extremely large by international standards. The system losses are five to six times to what obtain in well-run power systems. The high level of power losses and the significant illegal access to public power supply are indicative of the crisis in the industrial sector.

The trend in capacity utilization provides another perspective on the electricity crisis (Figure 1). The low and unstable capacity utilization, evident in an average capacity utilization of less that 40% for most of the period, shows the large gap between installed and actual operational capacity. It is a reflection of the gross technical inefficiency in the power system. The role of insufficient operational capacity due to ageing facilities that are poorly maintained on poor service provision is indisputable. Despite the size of inoperable capacity, no new plant has been added to the grid since 1990. The installed power generating capacity is about 6,000 MW. The operable capacity is less than 3,000 MW. This is made up of hydroelectric and gas-fired power generating plants. The plant mix is dominated by gas-fired plants. The infrastructure facilities are not only old, they are also habitually affected by water flow and gas supply problems. The water flow problems which have seriously undermined the performance of the three hydro stations (Kainji, Jebba and Shiroro) in recent years are linked to reduced water volumes in the River Niger and its tributaries due to climate change. Increased frequency of gas supply disruptions to gas-fuelled generating plants have also reduced electricity generation. Gas pipeline attacks have made worse the power supply problem through disruption in gas supplies to the power stations.

Although peak electricity demand has been less than half of installed capacity in the past decade, load shedding occurs regularly. Power outages in the manufacturing sector provide another dimension of the crisis. In 2004, major manufacturing firms experienced 316 outages. This increased by 26% in 2005 followed by an explosive 43% increase between 2006 and 2007. Though no published data exist, near collapse of the generating system to far below 2000 MW for prolonged periods of time suggest that the number of outages in 2008 will also be very high. This poor service delivery has rendered public supply a standby source as many consumers who cannot afford irregular and poor quality service substitute more expensive captive supply alternatives to minimize the negative consequences of power supply interruptions on their production activities and profitability. An estimated 20 percent of the investment in industrial projects is allocated to alternative source of electricity supply. In summary, the causal factors in Nigeria's energy crisis include:

- Prevalence of a regime of price control;
- Weak concern for cost recovery and lack of adequate economic incentives to induce the state-owned companies (NNPC and PHCN) to engage in efficient production and investment behaviour which seems apparently in the existence of large input and output subsidies;
- Multiplicity of economic and non-economic objectives without proper identification of the trade-offs among these different objectives which can be deduced implicit in its pricing policies in both electricity and petroleum products markets.
- Institutional and governance failures which induced gross distortions and inefficiency in production, investment choices and high costs of operation, low return on investment and expensive delays and cost overruns in the state energy enterprises.

The recent reversal of the privatization process evident in government plans to strengthen the two public companies in the energy industry raises some concerns about government intentions in the two industries. The government is planning to strengthen PHCH and empower it to build more power plants and NNPC to build more refineries notwithstanding the history of poor investment and production out-comes from public energy enterprises.

II. LITERATURE REVIEW

The Energy sector was the focus of intense development interest during the 1990s as plans for the energy industry contribution to economic growth in creation of jobs and value by extracting, transforming and distributing energy goods and services throughout the economy [2]. It is widely recognized that substantial expansion in quantity, quality and access to energy infrastructure services, are essential to rapid and sustained economic growth, employment generation,

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poverty reduction and overall well-being of the population in a country where most of the 140 million people are poor. Thus, the persistent suboptimal levels of energy infrastructure capacity and service provision from both growth and welfare maximization perspectives raises the fundamental question: What ought to be done to establish and sustain a robust energy industry characterized by acceptable international Standards of service reliability, accessibility and availability and that will support sustainable human development in Nigeria and the West African region [5]. Overcoming the energy crises and ensuring international standards in quantity, access, quality and reliability of energy services in Nigeria is a prerequisite for achieving the desire of the government that Nigeria be one of the top 15 economies in the world by 2020. This defines the scale of policy challenges for energy economic growth investment and operations. Also, additional factors include three important initial conditions associated with electricity and petroleum products crises. These are the current low level of electricity and energy consumption per capita by global development standards; the depressing state of socio-economic conditions in an economy just recovering from almost two decades of poor performance and deepening poverty. The wide energy gap and poverty in comparative regional terms is apparent in per capita electricity consumption in Nigeria being 140 Kwh in 2004 compared to 1337 Kwh in Egypt and 4560 Kwh in South Africa [6]. The government projects that generating capacity should increase to eliminate current electricity poverty and raise electricity per capita to 1,110kwh in 2015 and 5,000Kwh in 2030. Even then, Nigeria's per capita consumption in 2030 will be about 20% above the level that obtained in South Africa in 2003 [5]. In some countries that are heavily dependent on energy exports the share is even higher: 30% in Nigeria, 35% in Venezuela and 57% in Kuwait [7]. Meeting the challenges of providing adequate, reliable and widely accessible electricity service involves more than summing up numbers and getting other technical things right from the domestic perspective. The domestic solutions to investment, production and delivery problems should be a factor in the West African region given the two ECOWAS energy initiatives, the West African Power Pool (WAPP) and West African Gas Pipeline (WAGP). Domestic energy supply expansion must be examined in the context and integrated into ECOWAS energy given the current regional WAGP and WAPP as forerunners of the proposed integrated West African energy market. The peculiar nature and initial conditions in the industry may suggest some roles for the government in the production and delivery of electricity. This is particularly so if only one of the 23 Independent Power Producers (IPP) given licenses by NERC to add 8237 MW to existing capacity has done anything tangible. Part of the problem is the attempt by IPP to lock in high tariff into their power purchase agreement (PPA) and its take-or-pay clause for unnecessarily long periods though production could come from more efficient plants in the future. It was partly to prevent the foreign private IPP's from holding the country to ransom because of the power crisis that the Obasanjo Administration as an interim measure close to the end of its tenure, decided to embark on a rapid expansion of generating plant capacity with assistance from the Chinese. In all, seven power stations were planned to be constructed in the Niger Delta region to utilize flared gas under the suspended but controversial National Integrated Power Project (NIPP). In addition, a new large 2,600MW hydro project costing US$3.46 billion with assistance from the Chinese government is also underway. Though the NIPP has been suspended, the decision should be revisited given the reluctance of the private sector to set up power plants. After construction, these plants should be privatized or concessional to guarantee efficient service delivery. Government intervention through NIPP will moderate the scaling up in the tariff that the sector requires to provide affordable and adequate electricity. The new multi-year tariff scheme which is yet to be fully operational is an important step in bringing new capital to the electricity industry. Effective implementation of the core reforms in the Electricity Power Sector Reform Act would ensure industry operation based on global best practices. The plan of the government to phase out the subsidy for gasoline and truly free the products market in 2009 following recent shortages in kerosene and diesel is highly desirable. While both renewable and non-renewable energy resources will be utilized in meeting future energy demand, the continued dominance of fossil fuels supplemented by hydroelectricity is envisaged in the medium term. Coal, hydro, solar, biomass, wind and nuclear energy technologies are alternative electricity generation options under consideration. Developing and deploying clean energy should be part of the investment strategy with the focus however on progressively adopting cleaner fossil fuels based on renewable energy sources to meet rural electricity demand. Notably, the government plans to achieve 20% of electricity supply to be derived from renewable resources by 2025 [5, 8]. Coal and nuclear energy also feature on the investment option list. Nuclear generating capacity of 5000 MWe is expected by 2026. The projected amount of investment to meet domestic power system expansion in 2030 is estimated at about $262 billion. This amount is enormous given the antecedent of the industry. Though the financial requirement is daunting, it is achievable. The successful privatization of the telecommunication industry which brought in more than $12 billion of new investment in the last four years provides support for this position. The mobilization of the financial resources to support a dramatic scaling up of energy infrastructure capacity must factor in the risks associated with investment to strengthen the refining, pipeline, distribution network and power supply system. These risks are in four dimensions: economic, socio-political, technological and environmental (methane leaks, climate change compatibility, nuclear accidents spills). Optimal sharing of these risks among the three principal market actors namely: consumers, investor/producers and the government is essential to efficient resource allocation in the industry for a sustainable energy future in Nigeria and the West African sub-region. Having the appropriate incentive structure anchored on industry restructuring, privatization and sound regulatory framework, and financial support for renewable energy will improve the likelihood of success in achieving a vibrant Nigerian energy industry as the hub of West African energy. Finally, there is the issue of security of supply of oil and gas pipelines associated with resource control agitation in the Niger Delta. Developing, procuring and applying best practices in the industry will impact the volume and quality of investment.

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III. METHODOLOGY

Undoubtedly, there are extensive research works on the role of industrialization in the actualization of economic growth and development. However, there seems to be no consensus in these studies on the empirical form of the specification of a model qualifying the impact of manufacturing sector that can take or follow. Conventionally, empirical specification of growth (proxy with development) oriented model often follow the Solow growth model, although subsequently modified by Mankiw et al (1992) (which is termed "Augmented Solow growth model").

Solow (1956) postulated that economic growth is as a result of the accumulation of physical capital and an expansion of the labour force in conjunction with an "exogenous" factor, technological progress that makes physical capital and labour more productive [1]. In the simplified version presented in this study, we extract from the household sector, an important feature of the original endogenous growth model, in order to concentrate on issues concerning industrialization.

The general endogenous production function:

$$Gdppc = Aki^{\alpha}Li^{1-\alpha}K^{\beta} \quad (1)$$

We assume symmetry across industries for simplicity, so that each industry will use the same level of capital and labour. Then, we have the aggregate production function as:

$$Gdppc = Aki^{\alpha}K^{\beta} \quad (2)$$

Where:
Gdppc = real GDP per capita at time t,
A = total factor productivity,
K = Capital stock,
L = Labour.

Following Beck, Levine and Loayza (2000), we include initial income to control convergence effects and secondary school enrolment to capture human capital accumulation. Further, we include several policy variables, such as government expenditures as a share of GDP, the share of exports and imports in GDP, the inflation rate, the black market premium and the share of credit to the private sector by financial institutions in GDP.

For the purpose of this study, the above model specification will be adopted and build upon, proxy economic development with Gross Domestic Product (GDP); industrialization (proxy by manufacturing output); Exchange rate to examine the healthy competitiveness, inflation rate and interest rate to examine the effect of institutional framework and government expenditure to check government commitment on the provision of infrastructure facilities that will attract investors. With these adjustment incorporated into the model, it can therefore be specified in the form expressed below:

$$\log GDP = a_0 + a_1 \log M + a_2 EXR + a_3 INFR + a_4 IR + a_5 GEXP + U_t \quad (3)$$

Where:
GDP = Real Gross Domestic Product;
M = manufacturing sector output;
EXR = Exchange rate;
INFR = Inflation rate;
IR = Interest rate;
GEXP = Government expenditure;
Parameters = $a_0, a_1, a_2, a_3, a_4, a_5$;
U_t = Error term.

From the specified model equation above, endogenous variable is GDP while the exogenous variables are manufacturing sector output, exchange rate, inflation rate and interest rate.

A. *Empirical Analysis*

The investigation of the relation between economic growth and manufacturing sector output and other relevant indices in Nigeria is analyzed based on the specified model in section three. In capturing the precise link, economic growth is regressed on manufacturing sector output and other macroeconomic variables like inflation rate, government expenditure, exchange rate and inflation rate which are considered as an important factor that could affect the economy at large. The OLS is employed in estimating the model and the Augmented Dickey-fuller (ADF) unit root test is used to examine the properties of the time series variables incorporated in this study.

IV. MODEL ESTIMATION AND ANALYSIS

The result of the estimated model examined is presented in Table 1.

TABLE 1
SHOWING RESULTS

Symbol	Quantity	Std. Error	t-stat	Prob
C	122258.3	25454.27	4.803058	0.0001
LOGM	0.977854	0.156982	6.229101	0.0000
EXR	-37.78304	351.8946	-0.107370	0.9154
IR	3564.477	1329.865	2.680330	0.0134
INFR	105.5852	417.9887	0.252603	0.8028
LOGGEXP	-0.011485	0.018029	-0.637017	0.5304

Dependent variable: LOGGDP
Method: Least square
Sample: 1980-2007
R-Square = 0.957000 **Adjusted R-Square** = 0.947652
F-Statistic = 102.3764 **Durbin-Watson stat** = 0.395378
Prob (F-Stat) = 0.0000

A. *Interpretation of the Estimation Results*

The multiple linear regression analysis was equally employed to capture the effect of some important macro economic variables and manufacturing sector output have been assumed to either directly or indirectly influence the economic growth and development in Nigeria for the period 1980-2009.

The regression equation results shows that there is positive relationship between endogenous variable and exogenous variables except for exchange rate and government expenditure. The probability shows that infrastructural facilities provision through government expenditure was not adequate, inflation rate, exchange rate has not been favorable, a unit increase in commercial banks loans as Central Bank of Nigeria perform his supervisory role using interest rate as one of the tools bring about a percent increase in manufacturing sector output. The adjusted co-

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efficient of determination (R^2) shows that the equation has a good fit with 0.947 percent of the analysis. The study also indicates that in countries where industrialization are given a primary place, act as a catalyst to economic development process. Experience from various countries, attest to the relevance of manufacturing sector as a catalyst to economic growth and development.

The study recognized the various governmental policies that have been implemented by the government to promote the development of SMEs, varying from monetary to fiscal policies before, during and after Structural Adjustment Programmed (SAP), then recent National Economic Empowerment and Development Strategy (NEEDS). The study recognizes finance using interest rate, inflation rate as well as major influence in development (GDP) explained by the variables in the equation. For second order test, F-statistic is perfect and the Durbin Watson (D.W) statistics of 0.39 as it is significantly below the bench mark of 2.00, we can conclude that there is no auto correlation or serial correlation in the model specification; hence, the linear assumption is not violated. The f-statistics test is statistically, thus, shows the manufacturing sector output is statistically significant. The second order test confirms the significance of the research hypothesis.

The unit root test result reveals that all the time series variables are non-stationary at level and first difference for both intercept and deterministic trend. But, all the series are found to reject the null hypothesis of no-stationary at second difference. Therefore, all the series are taken to be stationary at second difference for unit root models with intercept and trend.

V. CONCLUSION

This paper eliminates the electricity curse and emergence of the required strong economic growth response contingent on:

- Radical reform in the production sector embodying changes to improve and strengthen the industry governance structure to enhance accountability and minimize corruption;
- Strengthening current reform anchored on restructuring of both the petroleum and power industries for competition and creating jobs.
- Eliminating security of supply of gas associated with resource control agitation in the Niger Delta region.

However, the current government attempt to slow down and reverse the reform plans embodied in the Electricity Power Sector Reform Act will impede the faster actualization of equilibrium in the energy markets. The scale of disequilibrium in the energy markets and poor quality of supply coupled with the social, economic and environmental costs of large scale substitution of inefficient fuel alternatives, strongly suggest the immense need of new investment and more efficient operation of its energy infrastructure. Ultimately what is important to the consumers and producers in Nigeria is elimination of the disequilibria in the energy markets and more importantly, giving them wide accessibility to affordable and environmentally friendly energy economic growth supply for the development in the production sector.

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