POWER SECTOR REFORM, INDUSTRIAL TRANSFORMATION AND VISION 20:2020 IN NIGERIA: AN ECONOMETRIC INVESTIGATION

Akaonye Ben Uzoh
Department of Social Science, Federal Polytechnic Nekede, Owerri
and
Erasmus E. Duru
Department of Economics, Paul University, Awka
E-mail: uzohben@yahoo.com +2348036775442

Abstract
The relevance of the power sector in the realization of Nigeria's Vision 20:2020 cannot be overemphasized, for it is through the power sector that real industrial transformation can take place and help to reduce poverty to the barest minimum. The paper makes use of secondary data sourced from Central Bank of Nigeria Statistical Bulletin and World Bank data. The variables of analysis include industrial output, electricity generation and consumption, interest rate, and gross domestic product among others. A simultaneous equation model was applied, making use of Two Stage Least Squares(TSLS). Results show that electricity generation had no significant impact on the industrial output. It was therefore recommended that a real power sector reform be pursued which will have a direct or an indirect effect on the output of industrial production, increase in small and medium scale production, reduction in unemployment and general poverty level.

Keywords: Power sector, reform, industrial transformation, Vision 20:2020

Introduction

Vision 20:20:20 is the mantra for Nigeria's vision to be one of the twenty industrialized countries in the world by the year two thousand and twenty. Industrialization on the other hand has been seen all over the world as the cornerstone for the growth and prosperity of any economy. However, availability and access to electricity will help to boost the Nigerian economy and foster the achievement of the vision 20:2020. Myrdal (1986) holds that manufacturing industry represents virtually the only hope for greatly increasing labour productivity and raising levels of living. Nehru (1965) insisted that real progress must ultimately depend on industrialization while according to Nwosu (2000), it is incontestable that there is a strong and positive correlation between the wealth and standard of living of a country and the extent and kind of industrialization. This correlation cannot exist without enough power to engineer these plants and machines to work to near or full capacity utilization. This is where the problem of the Nigeria industrial sector lies. Erratic and epileptic power supply has had detrimental consequences for the sector over the years. Diji (2005) opines that the broad objective behind all energy sector planning is the need to ensure the best use of scare resources, in order to further socio-economic development efforts and improvement on the quality of life of the citizen.

Overview of the power sector in Nigeria

The Nigeria electric power industry started operation in 1896 with the construction of a 30 Kilowatts generating plant at Ijora by Public Works Department (PWD). In 1925, a privately owned company called National Electricity Supply Company (NESCO) started the generation of electricity using 2 megawatts hydro-electric station at Kurra fall near Jos. The aim of establishing the electricity firm was to supply electricity to Tin mines at Jos and its environs.

In 1950, the Federal Government established Electricity Corporation of Nigeria (ECN) to oversee the development of the electricity sector. In 1951, with the growth and demand of electricity, the ECN commenced the exploitation of the water resources of power in Nigeria and by 1962 the Niger Dam Authority (NDA) was established to build and operate dams. The first phase of 760 MW at Kainji Hydro-electric station began and was completed in 1968 (Diji,

2000) and other phases were completed and commissioned between 1968 and 1970.

However, in 1989, 578 MW Jebba hydro electric station was commissioned while 600 MW capacity Shiroro Dam was commissioned in 1990. In 1972, ECN and NDA were merged and called National Electric Power Authority (NEPA) by Decree No 24 of 27th June 1972. This body is in- charge of generation, transmission distribution and sale of electricity in Nigeria. NEPA maintained 8 (eight) power stations of the primary energy and the renewable energy, hydro generated capacity of 6136MW. According to Diji (2005), the power stations are variously located in close proximity to the energy sources. For instance, the three hydro stations at Kainji, Jebba and Shiroro take advantages of the geo-topography of the river catchment basins in the North. The thermal station at Sapele, Afam and Ughelli, harnessed the rich oil and gas deposits of the Niger Delta in the South. The only exception to these rules are the load centre derived thermal stations at Ijora and Egbin which were built to serve Nigeria industrial and commercial centre, Lagos. The only coal fixed power station was situated in Oji in Enugu State and was commissioned in 1956. There are also stations at Calabar, Kaduna, Makurdi, Mubi, Maiduguri, Minna and Suleja and diesel units which operate off-line to serve specified cities.

In line with the global practice of consulting Independent Power Producers (IPP), NEPA generation section has made a number of Power Purchases Agreement (PPA). The first of such is the 270 MW PPA with ENRON/AES Corporation of the United State of America (U.S.A) at Egbin in Lagos State. ENRON Barge Nigerian Ltd installed a 9 X 30 MW Barge, mounted frame 6 gas turbine on September 2001. Another agreement was made with Geometric power Inc. and Aggreko International project Ltd for 15MW electricity each from a set of diesel engine generator. Despite these efforts, power outage continues to go on unabated.

Mordi (2010) et al outline some of the problems facing the power sector as:
-Lack of preventive and routine maintenance of facilities; lack of maintenance culture.
-Frequent breakdown arising from obsolet and heavily over-load equipment
-Lack of co-ordination between town planning authorities and power sector workers resulting in over- and additional loading or illegal connections by the consumers
-poor funding of the organization
-inadequate budgetary provision and undue delay in the release of the fund
-inefficient billing and corrupt collection system that leads to huge recoverable indebtedness
-vandalization and pilfering power sector equipment by staff and the general public.
This made the Federal government to privatize NEPA and rename it Power Holding Company of Nigeria PLC (PHCN), broken into 18 independent units which include the transmission company of Nigeria, six generation companies and eleven distributing companies.

However, with the government's plan of privatizing NEPA, the president commissioned the NNPC/AGIP Power Station at Okpai in Delta State in April 2005. The unbundling process of NEPA that commenced in January 2004 with the creation of eleven distribution companies reached its peak in October 2012, with the sale of the ten distribution companies, from which the Federal Government made ₦19.25b.

Theoretical framework

There are many theories on the study of industrialization towards economic growth. Each approach has its dimension, line of reasoning, argument and conclusion. Obasan and Adediran (2010) based their study on the endogenous growth model, a kind of growth that is determined by the system governing the production process rather than by forces outside that system. The endogenous growth model believes that Gross National Product (GNP) growth is a result of natural consequence of long-run equilibrium. The endogenous growth theorists seek to explain the factors that determine the rate of growth of GNP that is left unexplained and exogenously determined in the Solow neoclassical growth equation (that is Solow residual).

Empirical studies

Several empirical studies on impact of power supply have been undertaken by different writers.

Ishola (2005) reports that electricity reform may be likened to fire which, if unregulated, produces havoc while regulated gives light and warmth. Diji (2005) reveals that despite heavy investment in hydro-power it has not improved the economy. Afolabi and Adebayo (2012) using Vector Auto Regression (VAR) find out that there are negative significant economic consequences of power at large on the commercial services, household and industrial sector of Nigeria.

Vivien et al (2008) opined that African manufacturing enterprise reports power outages on the average of 56 days a year, costing firm 5.6 percents of their revenue.

Escaribano, Gausch and Pena (2008) study reveals that power infrastructure dampens economic growth and weakens competitiveness and reduces productivity which in turn reduces the growth potential of any economy.

Abugu (2007) observed that power outage in Nigeria has relationship with generator merchandise who wants to sell their products and as such conspire with the leaders.

Methodology

The research is based on econometric analysis while the date for the study is time series data. The data are real gross domestic product, output of the manufacturing sector as proxy for industrialization, interest rate, exchange rate and oil output from 1985-2010. The data were obtained from CBN statistical Bulletin from various issues and World Bank, E-view statistical package will be used to analyze the data. The two stage least square be employed because of the interdependency of the equations of the model.

Model specification

The theoretical form of the model is based on the endogenous growth model. It provides a theoretical framework for analyzing endogenous growth persistent GNP growth that is determined by the system that governs the production process rather than forces outside by the system. It goes further to explain the factors that determine the growth of GDP that is left unexplained and exogenous determined the Solow neoclassical growth (that is the Solow residual) Obasan and Adediran (2010:11). However, the original model will be modified by inculcating the simultaneous equation for the single equation model cannot explain the interrelationship that exist among the variables rather a simultaneous equation model is a more appropriate choice. For industry output to a large extend depends on electricity supply to the industrial sector, interest rate, exchange rate; on the other hand, the gross domestic product depends on industrial output, oil output. The econometric format from each of the two equations are specified as follows.

$INDOP = b_{10}+b_{11}elec+b_{12}int+b_{13}Exch+u_1$

$GDP = b_{20}+b_{21}\ INDOP_2+b_{22}Oilop + u_2$

Where:

INDOP = output of industrial production

ELEC = electricity supplied to the industry

INT = interest rate

EXCH = Exchange rate

GDP = Gross domestic product

OILOP = oil output

b's = the parameter to be estimated

U_1, u_2 are the random error terms

Model identification

$Y_1 = b_0+b_{11}X_1+b_{12}X_2+b_{13}X_3+u_1$ …Equation 1

$Y_2 = b_{20}+b_{21}X_1+b_{22}X_3 + u_2$ …. Equation 11

The necessary condition for equation is stated as follows

$k\text{-}m \geq G - 1$

Where K = number of variables in a particular equation

M = number of variables in a particular equation

G = total number of equations (number of endogenous variables)

For Equation 1

$Y_1 = b_0+b_{11}X_1+b_{12}X_2+b_{13}X_3 + u_1$

K = 6

M = 4

G = 2

K – M = G-1

6-4 = 2-1 = 2>1

Since the K-M > G-1, it shows that equation one may be over identified for equation two

For Equation 11

$Y_2 = b_{20}+b_{21}X_1+b_{22}X_3 + u_2$

K = 6; M = 3; G = 2

6-3 > 2-1

3>1

Equation two may be over identified
Since the two equations met the order condition, we use rank condition to judge for the rank condition.

$Y_1 = B_0 + b_{11}X_1+b_{12}X_2+b_{13}X_3 + u$
$Y_2 = b_{20}+b_{21}X_1+b_{22}X_4 + u$
$-Y_1+b_{11}X_1+B_{12}X_2+b_{13}X_3 = 0$
$-Y_2+b_2Y_1+b_{22}X_4 = 0$
We draw the second line and its non-zero coefficient may include

	Y1	Y_2	X_1	X_2	X_3	X_4
1st eqn.	1	0	b_{11}	b_{12}	b_{13}	0
2nd	0	1	0	0	0	b_{22}

We identify equation 1 by striking out the row of the coefficient for equation 1, we strike out the column in which a non zero coefficient of the equation being examined appear. For the equation one, we strike out 1st, 3rd 4th and 5th columns, what is left is the coefficient of variables that is included in the equation but contained in the other equation of the model i.e coefficient of excluded variables. The parameters of excluded variable from equation one are 1 and b22

Next, we find the determinant of order G-1 and examine their values. If at least one of the values of the determinant is not zero then, the equation is identified. And if all the determinant or the order G-1 are zero, the equation is under identified i.e. has no unique solution. Since 1 and b22 are not equal to zero, the rank condition is fulfilled.

For equation two

	Y_1	Y_2	X_1	X_2	X_3	X_4
1st	1	0	b_{11}	b_{12}	b_{13}	0
2nd	0	1	0	0	0	b_{22}

Here also we strike the 2nd row and strike off 2nd, column and we are left with 1, $b_{11,}$ $b_{12,}$ b_{13}
B_{11}, b_{12}, b_{13} are not equal to zero it means that the two equations are all over identified. According to Kousoyiannis (392), when an equation is over identified, we use two stage least square to estimate the parameters of the model.

Test for the validity of the model
To test for the validity of the model in order to avoid spurious relationship, we used Augmented Dickey fuller (ADF) unit root test; Johensen co-integration test for long-run equilibrium and Granger causality for causality test.
According to Johensen and Juselius (1990) most economic time series variable that exhibit strong trend are non stationary, yet they are being treated as though they are stationary by most economists. Akpokodje (2002) opined that failing to find co-integration is an indication that spurious correlation may by present and thus the validity of inference drawn from such correlation cannot be reliable.
Duru opined that failing to test for unit root and co-integration may mean that spurious correlation may or may not exist; this will lead to guess work, and econometric models have over the years outlived guess works.

Data analysis and discussion of findings
Table 1: Unit Root Test

Variable	At level	At 1st	2nd difference	Level of integration
Gdp	3.350276			1 (0)
Idman	-2.433525	-2.431331	-3.812105	1 (2)
Elcon	-0.602412	-2.734786	-4.807155	1 (2)
Intr	-2.221325	-4.631794		1 (1)
Exch	-0.372574	-3.028971		1 (1)
Oilop	-1.735377	-3.845095		1 (1)

Critical	1% =	5% =	10% =
	-3.7497	-2.9969	-2.6381

Test for long-run equilibrium Johansen co-integration
Series: IDMAN
Exogenous series: ELEC EXCH INTR

Warning: Critical values were derived assuming no exogenous series
Lags interval: 1 to 1

Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(S)
0.324841	9.034572	3.76	6.65	None ***

Series: GDP
Exogenous series: OILOP IDMAN

Warning: Critical values were derived assuming no exogenous series
Lags interval: 1 to 1

Eigenvalue	Likelihood Ration	5 Percent Critical Value	1 Percent Critical Value	Hypthesized No. of CE(s)
0.324400	9.019547	3.76	6.65	None ***

Table 2: Test for Granger Causality

IDMAN does not Granger cause ELEC	23	0.09813	0.90701
ELEC does not Granger Cause IDMAN			

Equation 1 of the two stages least square result
INDOP = 80.323 + 0.0147ELCON + 2.458INT – 0.040644EXCH
T_{cal} = (5.599) (1.830) (4.574134)
(-0.608)
$\overline{R}^2$ = 0.442
F_{cal} = 11.4602

The result of the unit root test shows the GDP is integrated at order zero, exchange rate, interest rate, oil output are integrated at first difference while industrial output and electricity generation are integrated at their second difference. The variables are co-integrated in a long-run from the Johansen test. While industrial output and electricity consumption does not Granger cause each other at 5% level of significance.

The result of equation one of the simultaneous model shows that there is a positive relationship between electricity, interest rate and industrial output. There is an inverse relationship between exchange rate and industrial output. The t-test shows that only interest rate is significant while electricity consumption and exchange rate are not significant.

The adjusted coefficient of determination shows that the explanatory variables included in equation 1 accounted for 44.2% variations in the dependent variable. The F-calculated value shows that the variables included in the model jointly affect industrial output. While from equation two of the model, the result shows that there is a positive relationship between oil output and industrial output, while an inverse relationship exist between manufacturing output and gross domestic product. The t-test shows that output of oil significantly affects GDP while manufacturing output does not. The F-test shows that they jointly affect GDP. The adjusted R^2 shows that the regressands accounted for 39.4% variation of the GDP.

Conclusion

The study captioned "power sector reform, industrial transformation and vision 20:20:20; an econometric investigation has been x-rayed in line with variables of the Nigerian economy. The conclusion reached from the study indicated that among other things is that power sector has crumbled real industrialization and to continue fuel abject poverty in Nigeria despite the acclaimed reforms that have taken place in the power sector. The work finds out empirically that there is no significant relationship between electricity consumption and industrial output. This work is in line with Myrdal (1968), Nwosu (2000), Afolabi and Adebayo (2012).

Recommendations

The study recommends among other things proper monitoring of the recommendations of power sector reform to ditto. Proper electricity billing using prepaid meter. Real public-private partnership in the power sector by total over-hauling and building of more thermal, solar, wind, coal to support the existing thermal and hydro power. Training and retraining of the electricity staffs and showing the corrupt staffs out of the way. When these policies are implemented, we can then be thinking of achieving vision 20:2020, otherwise it will be a mirage.

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