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Analysis of the Effect of Gas Utilization on the Economy of Nigeria

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ABSTRACT

This research assesses the relationship between gas utilisation and the economic growth rate of Nigeria. The study was motivated by the desire to bring to the limelight, Nigeria's abundant natural gas resource which is not being optimally utilized. The methodology used to establish the relationship is a statistical tool, Regression Analysis which determined the nature of the interaction between Gross Domestic Product (GDP) and amount of gas utilized in Nigeria. A model made up of GDP as a proxy variable and Gas Produced (GP), Gas Utilized (GU), Gas Flared (GF) as independent variables was built based on Cobb-Douglas production function and analyzed using Econometric Views software (Eviews 8.0) in which annual time series data from 2004 till 2014 were used. It was found out that the coefficient of Gas Utilized is positive (α_2 = 1.934996) which implies that Gas Utilized (GU) is directly related to the GDP of the nation. The study recommends that the Nigeria Gas Master Plan be fully implemented and appropriate policies that will domesticate Nigeria's natural gas resources should be enacted by the Federal Government of Nigeria.

Keywords: Gas utilized, Gas Produced, Gas Flared, Reserves, Economy and Nigeria.

INTRODUCTION

Gas utilisation in Nigeria is a subject that has come into the limelight in recent times. This is because gas utilisation is synonymous with energy consumption which according to Alam (2006) is the indispensable force driving all economic activities. BP Statistical Review (2015) states that Nigeria's natural gas reserves stands at 180.1 trillion cubic feet, an enormous amount which if efficiently and effectively harnessed and utilised will have a direct positive impact on the nation's economy. Inspite of its importance to the nation, the amount of gas utilised is still considerably low compared to the nation's reserves. Karl (1997) concludes that the presence of natural resources (especially oil and gas) plays an important role in national development strategy. Despite this, the presence of natural resources in a nation does not necessarily ensure the economic development of the nation which is evident in Nigeria.

The main reason gas utilisation has become of paramount importance in Nigeria is because of the government's desire to create wealth, generate employment and diversify the economy which is mainly dependent on crude oil. Natural gas is rapidly gaining importance both as a source of energy and as a feedstock for industry with its utilization steadily increasing from 2004 till 2014 as shown in Table 1. This growth is being driven by a number of factors including growing energy demand from an expanding world economy, an abundant resource base, environmental pressures for the use of gas which is a relative "clean" fuel in comparison to oil or coal and improving technologies for the production, transportation and conversion of natural gas. Thus, currently, most economies of the world are diversifying

away from oil to gas as energy source (Barnes et al., 2006).

Table 1: 10 – Year Gas Production and Utilization (MMSCF)

YEAR	GAS PRODUCED (MSCF)	GAS UTILIZED (MSCF)
2004	2,082,283,189	1,195,742,993
2005	2,093,628,859	1,282,313,082
2006	2,182,432,084	1,378,770,261
2007	2,415,649,041	1,655,960,315
2008	2,287,547,344	1,668,148,489
2009	1,837,278,307	1,327,926,402
2010	2,392,838,898	1,811,270,545
2011	2,400,402,880	1,781,370,022
2012	2,580,165,626	1,991,498,902
2013	2,325,137,449	1,916,531,001
2014	2,524,268,444	2,234,668,430

Source: NNPC Annual Statistical Bulletin (2014).

This development has been met with several challenges, notably of them is gas flaring. One cannot discuss gas utilisation without bringing to the forefront, gas flaring. This flaring is mainly due to the lack of adequate infrastructure to handle the associated gas produced alongside crude oil during exploration and production. (Total, "Reducing the Flaring of Associated Gas," undated) stated that it could be due to safety reasons wherein gas is flared in order to relief pressure on the system in cases of emergency or during maintenance; or as part of quality assurance procedure during well tests or start-ups of new installations, where gas is flared until gas with the required properties (for transportation or re-use) is obtained. Omiyi (2004) suggests that gas flaring has continued because of limited number of reservoirs suitable for gas reinjection/storage, the cost of developing major and inter-connecting network of gas pipelines, low technological and industrial base for energy consumption in the country, limited regional and international gas market, as well as inadequate fiscal and gas pricing policies to encourage investment. The problem of flaring gas is not debatable. Ojinnaka (1998) states categorically that the problem has to do, mainly, with its adverse environmental impact on immediate communities whose corps and poultry and fishing activities are damaged due to pollution. This is part of what Stiglitz (2000) calls negative externalities. According to the U.S. National Oceanic and Atmospheric Administration (NOAA), natural gas flared in Nigeria accounted for 10% of the total amount flared globally in 2011. Nigeria remains the second largest flaring country in the world and emits around $1.8 billion worth of gas annually (Aminu and Reza, 2013). The gas flare site in Nigeria is as shown in Fig. 1.

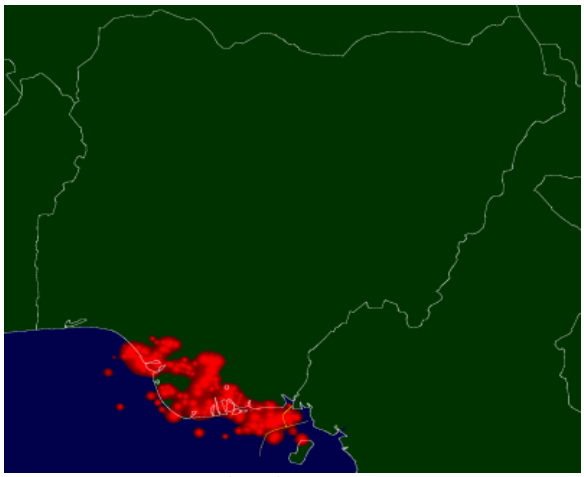

Fig. 1. Satellite picture of gas flares in the Niger Delta. Source: NOAA.

Despite the setbacks, Nigeria has made improvements in the gas industry. On February 13, 2008 the Nigerian Gas Master Plan was approved by the Federal Government to serve as a guide for the commercial exploitation and management of Nigeria's gas sector (Oghenegare, 2015). It aims at growing the Nigerian economy with gas by pursuing three key strategies which are stimulate the multiplier effect of gas in the domestic economy, position Nigeria competitively in high value export markets and guarantee the long term energy security of Nigeria. Since its inception, full implementation has not been achieved for several reasons among which are its capital intensive nature, unfavourable economic environment for investors to thrive, the political approach given to it by the different administrations have been in power in Nigeria amongst others.

In a bid to harness the abundant gas reserves in the country and reduce gas flaring with its consequent environmentally degrading effects, the country opted for LNG monetisation option in 1999 and this

has led to the exportation of 17.97 million metric tons (875 Bcf) of liquefied natural gas (LNG) in 2011, making Nigeria the 5th the largest exporter of LNG in the world (EIA, 2012). This is due to the fact that natural gas is of little value unless it can be brought from the wellhead to the customers who may be several kilometres away from the production site. Due to this monetisation option and natural gas utilization options, the amount of gas flared in Nigeria has decreased in recent years, from 540 Bcf in 2010 to 428 Bcf in 2013 (EIA, 2015) as shown in Fig. 2. There has also been some gas projects developed in the country since the inception of the LNG project. They include Escravos gas project, Escravos GTL project, Oso NGL project, Afam Integrated GTP plant, amongst others.

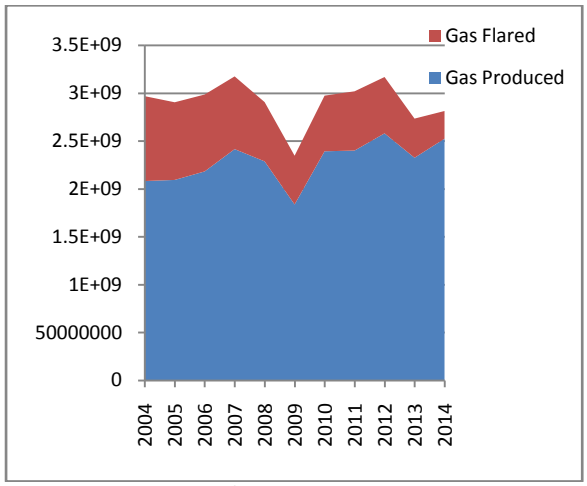

Fig. 2. Ten Year Trend of Natural Gas Production and Flaring in Nigeria. Source: NNPC Statistical Bulletin (2014)

Globally, the price of crude oil has constantly been on the decline in recent years and this poses a problem to a nation like Nigeria whose main source of foreign exchange earnings is from the sales of crude oil. This unfortunate development has made the diversification of the economy an inevitable task. As such, this paper intends to carry out a systematic analysis of the effect of gas utilisation on Nigeria's economy. It also proposes ways through gas flaring can be brought to a minimum in the country and how it can increase its growth rate. Furthermore, recommendations will be made on how gas utilisation will be improved in the country in a view of making the nation's economy one of the largest in the world.

The impact of gas utilisation on the economy of a nation has been analyzed by several authors. Ikechukwu A. *et al*., (2013) empirically carried out a study using a multiple linear regression analysis which established that gas production and flaring impact negatively on the economic growth of Nigeria, thus corroborating the "resource curse" arguments. Adegbemi O.O. *et al*., (2013) stipulated that increased energy consumption is a strong determinant of economic growth in Nigeria and should therefore be given more relevance by exploiting the opportunities in the sector to increase economic growth. Olusegun O. *et al*., (2009) asserted that there exists a positive relationship between energy consumption and economic growth. Ojide Makuachukwu *et al*., (2012) revealed that gas utilization has significant positive impact on the economy and it is also sustainable. Ogbonna, (1999) asserts that against the massive economic loss, natural gas should and can play some vital roles in the Nigerian economy. In a view of this, this researcher intends to corroborate the fact that there exists a positive relationship between gas utilization and the economic growth of nation (a case study of Nigeria).

MATERIALS AND METHODS

Data Sources:

The time series of the analysis were confined to the period 2004-2014 due to data availability. In this research, data were sourced from secondary sources. The data on Gross Domestic Product (GDP) were obtained from National Statistical of Bureau (NBS), the data on Gas Produced (GU), Gas Utilized (GU) and Gas Flared (GF) were obtained from Nigerian National Petroleum Corporation (NNPC) Annual Statistical bulletin of 2014.

Model Specification:

The study analyses the effect of gas utilisation on the economy of Nigeria (using GDP as a proxy) using an econometric

analysis based on the Cobb-Douglas non-linear production function built around gas production and utilization. The model relates a dependent variable - economic growth (GDP) with independent variables such as Gas Produced (GU), Gas Utilized (GU) and Gas Flared (GF). The importance of the model development is to determine the relative influence each of the independent variables have on the dependent variable – Gross Domestic Product (GDP). The model is developed using the Cobb-Douglas (1928) version of the production function. This function is popular in applied research because it is easier to handle mathematically (D. Canning, 1999). The production function is stated below;

$Q = f(K, L)$ (1)

Where

Q = Output; K = Capital Input; L = Labour input

According to Cobb and Douglas (1928), the above equation was expanded and transformed to as shown below;

$Q = AK^{\alpha}L^{\beta}\mu$ (2)

Disintegrating Equation (2), it yields Equation (3) below;

$Q = AK_1^{\alpha 1}K_2^{\alpha 2}L^{\beta}\mu$ (3)

Where

Q = Output; A = Technical efficiency; K_1 = Gas produced and utilized; K_2 =Capital inputs which is proxied by the nation's gross fixed capital formation

Further expansion of Equation (3) will yield Equation (4) below;

$Q = AK_{11}^{\alpha 11}K_{12}^{\alpha 12}K_{13}^{\alpha 13}K_2^{\alpha 2}L^{\beta}\mu$ (4)

Due to the fact that the Cobb-Douglas production function exhibits a non-linear relationship, it will be necessary to take logarithms of the variables during the transformation of the equation.

$\ln Q=\ln A+\alpha_{11}K_{11}+\alpha_{12}K_{12}+\alpha_{13}K_{13}+\alpha_2\ln K_2+\beta\ln L+\mu$

where

lnQ = log of output proxied by nation's GDP; lnA = log of technical efficiency; K_{11} = Gas produced; K_{12} = Gas utilized; K_{13} = Gas flared; $\ln K_2$ = log of capital inputs; lnL = log of labour input; $\alpha_{11} - \alpha_{13}$ = Estimation parameters associated with gas produced and gas utilized; α_2 = Estimation parameters associated with capital input; β = Estimation parameters associated with labour; μ = Error term

The a-priori expectation regarding the relationship among the independent variables (K_{11}, K_{12}, K_{13}, K_2, L) and the dependent variable (Q) is that;

$\alpha_{11} > 0$, $\alpha_{12} > 1$, $\alpha_{13} < 0$, $\alpha_2 > 0$,

In estimating the model, a multiple regression analysis will be carried out with the aid of Eviews 8.0 software in order to determine the explanatory nature of the variables.

RESULTS AND DISCUSSIONS

The summary of the result of the regression analysis carried is presented in Table 2 (see Appendix for the details of the data).

The estimated regression result from the model shows that the coefficient of gas produced appears with positive sign (α_{11} = 1.053615), meaning that there is a positive relationship between gas produced and gross domestic product in Nigeria during the period of study. In other words, if the country continues to produce its natural gas resources at an increment rate at which it produces in recent years, the country will continuously experience an increase in its GDP, thereby growing its economy.

The coefficient of gas utilized appears with a positive sign (α_{12} = 0.021347), meaning that there is a positive relationship between GU and GDP in Nigeria during the period of study. This agrees with the apriori (theoretical) expectation. By this estimate, the GDP will increase with increase in gas utilization. The coefficient of gas flared is negative (α_{13} = -0.691919), meaning that there is a negative relationship between GF and GDP in Nigeria during the period under review. This also agrees with the apriori (theoretical) expectation.

Table 2: Summary of regression analysis result

Dependent Variable: LOG(GDP)
Method: Least Squares
Date: 12/30/15 Time: 20:08
Sample: 2004 2014
Included observations: 11

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.925896	31.55661	0.251164	0.8117
LOG(GFCF)	0.269803	0.143239	1.883586	0.1183
LOG(TLF)	0.344966	1.855667	0.185899	0.8598
LOG(GP)	1.053615	1.455485	0.723893	0.5016
LOG(GU)	0.021347	1.223028	0.017454	0.9867
LOG(GF)	-0.691919	0.292697	-2.363942	0.0644

R-squared	0.985483	Mean dependent var	30.95010
Adjusted R-squared	0.970966	S.D. dependent var	0.565166
S.E. of regression	0.096300	Akaike info criterion	-1.540237
Sum squared resid	0.046369	Schwarz criterion	-1.323203
Log likelihood	14.47130	Hannan-Quinn criter.	-1.677047
F-statistic	67.88511	Durbin-Watson stat	2.397747
Prob(F-statistic)	0.000136		

Source: Auto Computation from Eviews 8.0

The coefficients of capital and labour both appear with positive signs respectively ($\alpha_2 = 0.269803$; $\beta = 0.344966$) signifying that there is a positive relationship between capital inputs proxied by GDP and the total labour with GDP growth rate.

The R square at 0.985483 shows 99% variation in the GDP which is explained by the explanatory variables (GP, GU and GF). This shows a goodness of fit as only 1% is accounted for by the error term in the model (which are the variables in the study that cannot be included in the model because of certain qualitative features). The F – Statistics value of 67.88511 is greater than the F – tabulated of 3.36. With this result, the hypothesis signifies that the slope parameters are statistically significant and different from zero. Therefore, it is valid for recommendation and policy formulation. It should be noted here that F – Statistics shows overall significance of the slope parameter in the model.

Following the value of the coefficient of GU ($\alpha_{12} > 0$), the researcher accepted the fact that gas utilisation has a positive impact on the GDP growth of Nigeria and as such, will have a positive effect on the economy of the country.

CONCLUSION AND RECOMMENDATIONS

In view of the energy challenges in Nigeria and the dwindling economy that is faced by a drastic drop in crude oil prices, there is need to take advantage of the abundant natural gas resources as it will have a multiplier effect on the economy of the country. The supply of natural gas should be increased for domestic consumption by the government through full implementation of the existing gas policies especially the Nigerian gas Master Plan. In cases where no clear cut policies exist, appropriate policies should be enacted.

Certain recommendations will be made that would ensure an increased gas consumption in the country so as to grow the economy of the country to become the top twenty (20) largest economies in the world (Vision 20:20:20). The recommendations are as follows;

1) Government should fully implement the existing gas to energy policies or enact adequate ones where these policies are non-existence, as this will reduce gas flaring, over dependence on crude oil and ensure the diversification of the energy sector with emphasis on the development and expansion of the

natural gas sector and its auxiliary activities.

2) There should be increased supply of natural gas to the domestic market for local consumption as it has a direct effect on the growth rate of the Gross Domestic Product of the economy of the nation.
3) There should be efforts by the government to provide enhanced and sustained energy infrastructure which would not only involve good maintenance of existing infrastructure but also ensure that there is increase in such infrastructure through licenses to private sector for operation of such facilities. Regulatory barriers should also be reduced.
4) Government should increase research and development in the energy sector in order to find ways through the abundant natural gas resource of the country can be effectively utilized. There is an urgent need for increased funding of research by researchers so these researches are mostly capital intensive.

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APPENDIX

DATA USED

YEAR	Gross Domestic Product (Billion Naira)[1]	Gross Fixed Capital Formation (Billion Naira)[3]	Total Labour Force[3]	Gas Produced (MSCF)[2]	Gas Utilized (MSCF)[2]	Gas Flared (MSCF)[2]
2004	11,411.07	798.77	42,063,952	2,082,283,189	1,195,742,993	886,540,196
2005	14,610.88	730.54	43,250,245	2,093,628,859	1,282,313,082	811,315,777
2006	18,564.59	1485.17	44,459,832	2,182,432,084	1,378,770,261	803,661,823
2007	20,657.32	1859.16	45,659,878	2,415,649,041	1,655,960,315	759,688,726
2008	24,296.33	1943.71	47,008,096	2,287,547,344	1,668,148,489	619,398,854
2009	24,794.24	2975.31	48,330,258	1,837,278,307	1,327,926,402	509,651,905
2010	33,984.75	5777.41	49,706,559	2,392,838,898	1,811,270,545	581,568,354
2011	37,409.86	5985.58	51,167,238	2,400,402,880	1,781,370,022	619,032,858
2012	40,544.10	6081.61	52,600,554	2,580,165,626	1,991,498,902	588,666,724
2013	42,396.77	6355.46	54,199,112	2,325,137,449	1,916,531,001	409,311,430
2014	85,276.5[3]	13644.24	55,784,248	2,524,268,444	2,234,668,430	289,600,014

Source: [1]National Bureau of Statistics (2014) [2]NNPC Annual Statistical Bulletin (2014).
[3]http://data.worldbank.org/indicator

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