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Evaluation of Economic Indicators on Gross Domestic Product

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Abstract: The paper examined the effect of economic variables like Agriculture, Education, Petroleum, Transportation and Electricity in Nigeria economy. Data was extracted from the record of Central Bank of Nigeria named Satisfied Bulletin which covered a period of twenty–eight years (1981-2008). Multiple Linear Regression was employed which can be defined as the relationship between a dependent variable and two or more independent variables while F-Test at 5% level of significance was also employed to test the validity of the results obtained. The statistical model for a Multiple Linear Regression is; $Y= \beta_0+ \beta_1X_{i1}+ \beta_2X_{i2}+ \ldots\ldots\ldots\ldots\ldots \beta_kX_{ik} + E$, Where Y = Dependent variable, $X_{i,}\ X_{2\ldots\ldots\ldots}\ X_k$ = Independent variables, β_0 = Constant value and $\beta_{1,}\ \beta_{2\ldots\ldots\ldots}\ \beta_k$ = Regression coefficients. The results obtained showed that the entire coefficients are significantly different from zero, in other words, they all contribute significantly to the regression and all the economic variables are significant in Gross Domestic Product based on the application of Multiple Linear Regression for this study.

Key words: *Gross Domestic Product, Economic Indicator, Estimation, Parameter, Economic Growth*

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INTRODUCTION

The Gross Domestic Product (GDP) is one of the primary indicators used to gauge the health of a country's economy. It represents the total currency of value of goods and services produced over a specific time period, hence, the need for this study.

Gross Domestic Product (GDP) refers to the market value of all officially recognized final goods and services produced within a country in a given period. That is, International incomes are not included. It is often positively correlated with the standard of living, though, it's used as a standard tool for measuring the standard of living has come under increasing criticism and many countries are actively exploring alternative measures to GDP for that purpose.

GDP can be determined in three ways, all of which should, in principle, give the same result. They are the product (or output) approach, the income approach, and the expenditure approach. The most direct of the three is the product approach, which sums the outputs of every class of enterprise to arrive at the total. The expenditure approach works on the principle that all of the product must be bought by somebody, therefore the value of the total product must be equal to people's total expenditures in buying things. The income approach works on the principle that the incomes of the productive factors ("producers," colloquially) must be equal to the value of their product, and determines GDP by finding the sum of all producers' incomes.

All output for market is at least in theory included within the boundary. Market output is defined as that which is sold for "economically significant" prices; economically significant prices are "prices which have a significant influence on the amounts producers are willing to supply and purchasers wish to buy." An exception is that illegal goods and services are often excluded even if they are sold at economically significant prices.

It is partly excluded and partly included. First, "natural processes without human involvement or direction" are excluded. Also, there must be a person or institution that owns or is entitled to compensation for the product (Todaro and Smith, 2003).

Harper and Row (1999), finds that market reform in Nigeria improved agriculture profitability and subsequently boosted agriculture production. Much of that improvement in agriculture incentive steamed from currency devaluation, which caused farmers to plant fewer subsidized crops and more traditional crops where Cameroon enjoys a comparative advantage.

According to Stern (1991), he argued for the importance of energy sector in the socio-economic development of Nigeria, He submitted that strong demand and increased supply would increase income and higher living standards. Ukpong (1976) reiterated that electricity supply drives industrialization process. He further argued that a country's electricity consumption per – capital in kilowatt hours is proportional to the state of industrialization of that country.

In his paper, Henry (1989) elaborated on the filling of running a generator economy and its adverse effect 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. The poor nature of electricity supply in Nigeria, has imposed significant cost on the industrial sector of the economy (Adebile, 2003).

OBJECTIVES OF THE STUDY

The main objective of this study is to examine effect of some economic indicator variables on the Gross Domestic Product in an economy while specific objectives are;

i. To formulate a model for the function of some economic variables in Nigeria.

ii. To examine if there is any relationship between Nigeria GDP and some economic variables like Agriculture, Education, Petroleum, Transportation and Electricity.

METHODOLOGY

The sources of data used for this study was secondary data extracted from the record of Central Bank of Nigeria named Satisfied Bulletin which covered a period of twenty–eight years (1981-2008). The economic indicators considered were; Agriculture, Petroleum, Electricity, Transportation and Education.

STATISTICAL TOOLS

Multiple Linear Regressions In this study, Multiple Linear Regression was employed which can be defined as the relationship between a dependent variable and two or more independent variables. The statistical model for a Multiple Linear Regression is given as:

$$Y = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_k X_{ik} + E$$

Where Y = Dependent variable

$X_i, X_2 \ldots\ldots\ldots\ldots X_k$ = Independent variables

β_0 = Constant value

$\beta_1, \beta_2 \ldots\ldots\ldots\ldots \beta_k$ = Regression coefficients

Putting the model in a matrix form, we have:

$Y_1 = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_k X_{ki} + e_i$

$Y_2 = \beta_0 + \beta_1 X_{12} + \beta_2 X_{22} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_k X_{2k} + e_2$

.

$Y_n = \beta_0 + \beta_1 X_{in} + \beta_2 X_{2n} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_k X_{kn} + e_n$

Matrix Approach to Multiple Regressions:

$Y = \beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots\ldots\ldots\ldots\ldots\ldots \beta_k X_{ik} + E \qquad \forall\, i = 1,2,\ldots.,n$

The above equation can be represented in the matrix form. The matrix form of the equation is

$Y = X\beta + \varepsilon$

$$Y = \begin{bmatrix} y \\ y_2 \\ . \\ . \\ . \\ y_n \end{bmatrix}, \quad X = \begin{bmatrix} 1 & x_{11} & x_{12} & . & . & . & x_{1k} \\ 1 & x_{21} & x_2 & . & . & . & x_{2k} \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ . & . & . & . & . & . & . \\ 1 & x_{n1} & x_{n2} & . & . & . & x_{nk} \end{bmatrix}, \beta \begin{bmatrix} \beta \\ \beta_1 \\ . \\ . \\ . \\ \beta_k \end{bmatrix} \text{ and } \varepsilon = \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ . \\ . \\ . \\ \varepsilon_n \end{bmatrix}$$

Where

Y - is an (n x 1) vector of observations.

X - is an n x p matrix of the levels of the independent variable

β - is a p x 1 vector of regression coefficients

ε - is an n x 1 vector of random errors (Error terms)

Hence we have:

$$X^{11} = \begin{bmatrix} 1 & 1 & \dots & 1 \\ x_{11} & x_{12} & \dots & x_{1n} \\ x_{12} & x_{22} & \dots & x_{2n} \\ . & . & & . \\ & & \dots & \\ . & . & & . \\ & & \dots & \\ x_{k1} & x_{k2} & & x_{kn} \end{bmatrix}$$

$$X^1Y = \begin{bmatrix} 1 & 1 & 1 & \dots 1 \\ x_{11} & x_{12} & x_{13} & x_{m} \\ x_{21} & x_{22} & x_{23} & x_{2n} \\ & & & \\ x_{k1} & x_{k2} & x_{k3} & x_{kn} \end{bmatrix} \begin{bmatrix} Y_1 \\ Y_2 \\ Y_3 \\ . \\ Y_n \end{bmatrix} = \begin{bmatrix} \sum Y_i \\ \sum X_{ii}Y_1 \\ \sum X_{21}Y_2 \\ . \\ \sum X_{ki}Y_i \end{bmatrix}$$

To obtain the values of the parameters, we have

$\beta_I = (X^1X)^{-1} (X^1Y)$

$$(X^1X)^{y} = \frac{\text{Adjoint of } (X^1X)}{\text{Determinant of } (X^1X)}$$

Basic Assumptions of Multiple Linear Regressions

The basic assumptions of multiple linear regressions according to Daniel (1997) are:

i) $\ell_I \sim N(0, \delta_\ell^2)$, *($Y_i$'s are normally distributed)*
ii) $E(\ell_I) = 0$ $(E(Y_i) = [\beta_o + \beta_i X_i + \ldots\ldots + \beta_k X_k)$
iii) $Var(\ell_I) = \delta^2$ $[var(Y_i = \delta^2)]$
iv) $Cor(\ell_I\ \ell_j) = 0$ ¥ $i \neq j$ $[cor(Y_i, Y_j) = 0\, i \neq j\ ]$

ANALYSIS OF RESULTS

In this study, the econometric model is of the linear form:

$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \mu$

Where

Y = Gross Domestic Product

X_1 = Agriculture

X_2 = Transportation

X_3 = Electricity

S/N	Year	Gross domestic product(Y)	Agriculture (X_1)	Transportation (X_2)	Electricity (X_3)
1	1981	205.2221	57.98967	0.80193	7.98185
2	1982	199.6852	59.45083	0.88771	6.29203
3	1983	185.5982	59.00971	0.85363	5.44876
4	1984	183.563	55.91817	0.90235	5.02344
5	1985	201.6363	65.74844	1.01922	5.98756
6	1986	205.9714	72.13523	0.66593	5.267
7	1987	204.8065	69.60806	0.69657	5.26871
8	1988	219.8757	76.75372	0.70213	5.32091
9	1989	236.7296	80.87804	0.75942	5.33218
10	1990	267.55	64.34461	0.82796	5.43884
11	1991	265.3791	87.50353	0.82796	5.62068
12	1992	271.3655	89.34525	0.92346	5.88047
13	1993	274.8333	90.59646	0.93741	6.1438
14	1994	275.4505	92.83295	1.00679	6.17931
15	1995	281.4074	96.22067	0.99068	6.28954
16	1996	293.7454	100.2142	1.01247	6.45761
17	1997	302.0225	104.514	1.00637	6.68592
18	1998	310.8901	108.8141	0.94094	6.97429
19	1999	312.1835	114.5707	0.95317	7.05078
20	2000	329.1787	117.9451	0.97224	7.50813
21	2001	356.9943	122.5223	11.68485	7.85841

22	2002	433.2035	190.1334	13.31807	9.22637
23	2003	477.533	203.4099	15.39881	9.33802
24	2004	527.576	216.2085	18.25254	13.9937
25	2005	561.9314	231.4636	19.43966	14.88269
26	2006	595.8216	248.5989	20.34444	15.91146
27	2007	590.1702	265.6518	20.4068	16.71132
28	2008	672.2026	283.1754	22.03595	18.20424

Source: Central Bank of Nigeria Satisfied Bulletin (1981- 2008).

The data is reduced by 1000 for easy computation.

Estimation of Parameters

Using matrix approach, the linear regression model is;

$Y=\beta_0+\beta_1X_1+ \beta_2X_2+ \beta_3X_3+ e$

The model in matrix from is given by,

$Y = \underline{X}\beta + \mu$

Where:

Y= Column matrix of value of Y

X= T x (K+1) matrix

Where:

T= Sample number

K=Number of explanatory variables

β= Column matrix of the parameter estimated

μ = Column matrix of estimated β

Let **b** be a column matrix of estimated **β**,

Therefore, $b= (X^1X)X^1Y$

The data collected was analyzed by employing Statistical Package for Social Sciences (SPSS) and Microsoft excel and the estimated parameters are as follows;

$N = 28$ $\sum Y = 9242.526$ $\sum X_1 = 3425.557$

$\sum X_{2\,=}\ 158.5695$ $\sum X_3 = 228.278$ $\sum X_1Y = 1397662$

$\sum X_3Y = 89678.63363$ $\sum X_2Y= 81327.88707$ $\sum X_1X=33754.61969$

$\sum X_1X_3 = 34956.9972$ $\sum X_2X_3 = 2077.99717$ $\sum X_1^2=55143.2$

$\sum X_2^2 = 2593.888$ $\sum X_3^2 = 2273.92346$ $\sum Y^2 = 3598175.979$

$$S_{11} = \sum X_1^2 - \frac{(\sum X_1)^2}{n} = -363943.97$$

$$S_{12} = \sum X_1X_2 - \frac{\sum X_1 \sum X_2}{n} = 14355.02$$

$$S_{13} = \sum X_1X_3 - \frac{\sum X_1 \sum X_3}{n} = 6669.16$$

$$S_{22} = \sum X_2^2 - \frac{(\sum X_2)^2}{n} = 1695.88$$

$$S_{23} = \sum X_2X_3 - \frac{\sum X_2 \sum X_3}{n} = 785.208$$

$$S_{33} = \sum X_3^2 - \frac{(\sum X_3)^2}{n} = 412.823$$

$$S_{1y} = \sum X_1Y - \frac{\sum X_1 \sum Y}{n} = 266919.16$$

$$S_{2y} = \sum X_2Y - \frac{\sum X_2 \sum Y}{n} =28985.65$$

$$S_{3y} = \sum X_3Y - \frac{\sum X_3 \sum Y}{n} = 14326.29$$

$$S_{yy} = \sum Y^2 - \frac{(\sum Y)^2}{n} = 547308.59$$

Recall that:

$\beta = (X^IX)\, X^IY$

Where:

$$X^1X = \begin{pmatrix} n & \sum X_1 & \sum X_2 & \sum X_3 \\ \sum X_1 & \sum X_1^2 & \sum X_1X_2 & \sum X_1X_3 \\ \sum X_2 & \sum X_2X_1 & \sum X_2^2 & \sum X_2X_3 \\ \sum X_3 & \sum X_3X_1 & \sum X_3X_2 & \sum X_3^2 \end{pmatrix}$$

$$X^1Y = \begin{pmatrix} \sum Y \\ \sum X_1Y \\ \sum X_2Y \\ \sum X_3Y \end{pmatrix}$$

But because the 4 x 4 matrix (x^1x) cannot be operated upon using a calculator, therefore the short cut method suggested by Omotosho (2007).

Hence, from computer analysis,

$$X^1X = \begin{pmatrix} X^1{}_1 \\ X^1{}_2 \\ X^1{}_3 \end{pmatrix} (X_1\ X_2\ X_3) = \begin{pmatrix} X_1{}^1X_1 & X_1{}^1X_2 & X_1{}^1X_3 \\ X_2{}^1X_1 & X_2{}^1X_2 & X_2{}^1X_3 \\ X_3{}^1X_1 & X_3{}^1X_2 & X_3{}^1X_3 \end{pmatrix}$$

$$X^1X = \begin{pmatrix} 14355.02 & 50287.4 & -363943.97 \\ 14355.02 & 1695.88 & 785.208 \\ 6669.16 & 785.208 & 412.823 \end{pmatrix}$$

$$(X^1X)^{-1} = \begin{pmatrix} -0.000001978 & -0.00007946 & 0.0001752 \\ 0.000001632 & 0.01149812 & -0.0238583 \\ 0.0000009096 & -0.00090330 & 0.01949278 \end{pmatrix}$$

$$X^IY = \begin{pmatrix} X^1{}_1 \\ X^1{}_2 \\ X^1{}_3 \end{pmatrix} \qquad Y = \begin{pmatrix} X_1{}^1Y \\ X_2{}^1Y \\ X_3{}^1Y \end{pmatrix}$$

$$X^1Y = \begin{pmatrix} X_1{}^1Y \\ X_2{}^1Y \\ X_3{}^1Y \end{pmatrix} = \begin{pmatrix} 266919.16 \\ 28985.65 \\ 114326.29 \end{pmatrix}$$

$$\beta = (X^1X)\, X^1Y = \begin{pmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{pmatrix} = \begin{pmatrix} 1.846736 \\ -0.41069 \\ 4.039933 \end{pmatrix}$$

$$Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3$$

$$\beta_0 = \overline{Y} - \beta_1\overline{X}_1 - \beta_2\overline{X_2} - \beta_3\overline{X_3}$$

β_0 = 330.0902 – 1.846736 (122.341) + 0.41069 (5.66319) - 4.039933 (8.152785)

β_0 = 73.54726

Therefore, the linear regression model is;

$\hat{Y}$= 73.54726 +1.846736X_1 - 0.41069X_2 + 4.039933X_3

TEST OF SIGNIFICANCE OF REGRESSION EQUATION

In testing for the significance of the entire equation, the statistical test applied was F-test.

HYPOTHESIS;

H_0: $\beta_1 = \beta_2 = \beta_3 = 0$ (All the coefficients are not significantly different from zero)

H1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq 0$ (At least one or all the coefficients significantly different from zero)

At 5% level of significance.

ANOVA TABLE

Source of variation	**Sum of Square**	**D.F**	**Mean sum of square**	**F ratio**
Regression (x_1 x_2 x_3)	$\beta_1 S_{1y}$	k-1	$\beta_1 S_{1y}$/k-1	$\underline{\beta_1 S_1 / \text{k-1}}$ $S_{yy}\beta_1 S_1$y/n-k
Residual error	$S_{yy} - \beta^1 S_{1y}$	n-k	S_{yy}-$\beta_1 S_{1y}$/n-k	
Total	S_{yy}	n-1		

ANOVA TABLE

Source of variation	**Sum of Square**	**D.F**	**Mean sum of square**	**F ratio**
Regression (x_1 x_2 x_3)	5.392*10^11	3	1.797*10^11	531.516

Residual error	8.116*10^9	24	3.381*10^8	
Total	5.473*10^11	27		

Decision Rule:- Since F_{cal} is greater that F_{tab}, we reject the null hypothesis (H_0) and accept the alternative hypothesis (H_1).

Conclusion: - The entire coefficients are significantly different from zero, in other words, they all contribute significantly to the regression and all the explanatory variables are significant.

CONCLUSION

This study was based on the application of multiple regression analysis on the data collected on some economic variables in term of their contributions to Nigeria Gross Domestic Product. The variables in the multiple regression analysis involved were Agriculture, Transportation and Electricity while the data was extracted from the Statistical Bulletin of the Central Bank of Nigeria. Test of significance (F- test) employed in this study indicated that all the parameters contributed significantly to the Nigerian Gross Domestic Product.

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