Evaluation of Economic Indicators on Gross Domestic Product

1 Abdulazeez, K.A., 2Lasisi, K.E. and 2Lintima, B.L.
1Federal College of Freshwater Fisheries Technology, Baga, P.M.B. 1060, Maiduguri Borno State.
2Mathematical Sciences Department, Abubakar Tafawa Balewa University, P.M.B. 0248, Bauchi, Nigeria

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; \[ Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \ldots + \beta_kX_k + E \], Where \( Y \) = Dependent variable, \( X_1, X_2, \ldots, X_k \) = Independent variables, \( \beta_0 \) = Constant value and \( \beta_1, \beta_2, \ldots, \beta_k \) = 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

Correspondence e-mail: kazeemade2@gmail.com

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:

\[ Y = \beta_0 + \beta_1X_{i1} + \beta_2X_{i2} + \ldots + \beta_kX_{ik} + E \]

Where \( Y \) = Dependent variable

\( X_{i1}, X_{i2}, \ldots, X_{ik} = \) Independent variables
\[ \beta_0 = \text{Constant value} \]
\[ \beta_1, \beta_2, \ldots, \beta_k = \text{Regression coefficients} \]

Putting the model in a matrix form, we have:
\[ Y_1 = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + e_i \]
\[ Y_2 = \beta_0 + \beta_1 X_{12} + \beta_2 X_{22} + \ldots + \beta_k X_{2k} + e_2 \]
\[ \vdots \]
\[ Y_n = \beta_0 + \beta_1 X_{1n} + \beta_2 X_{2n} + \ldots + \beta_k X_{kn} + e_n \]

Matrix Approach to Multiple Regressions:
\[ Y = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + E \quad \forall i = 1, 2, \ldots, n \]

The above equation can be represented in the matrix form. The matrix form of the equation is
\[ Y = X\beta + \varepsilon \]

Where
\[ Y = \begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}, \quad X = \begin{bmatrix} 1 & x_{11} & x_{12} & \ldots & x_{1k} \\ 1 & x_{21} & x_2 & \ldots & x_{2k} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ 1 & x_{n1} & x_{n2} & \ldots & x_{nk} \end{bmatrix}, \quad \beta = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \vdots \\ \beta_k \end{bmatrix}, \quad \varepsilon = \begin{bmatrix} e_1 \\ e_2 \\ \vdots \\ e_n \end{bmatrix} \]

\[ Y \] - is an (n x 1) vector of observations.
\[ X \] - is an n x p matrix of the levels of the independent variable
\[ \beta \] - is a p x 1 vector of regression coefficients
\[ \varepsilon \] - is an n x 1 vector of random errors (Error terms)

Hence we have:
To obtain the values of the parameters, we have

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

Basic Assumptions of Multiple Linear Regressions

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

i) $\ell_i \sim N(0, \delta^2)$, (Yi’s are normally distributed)

ii) $E(\ell_i) = 0$ (E(Yi) = [\beta_o + \beta_1X_1 + \ldots + \beta_kX_k])

iii) $\text{Var}(\ell_i) = \delta^2$ \{\text{Var}(Y_i = \delta^2)\}

iv) $\text{Cor}(\ell_i, \ell_j) = 0 \ \forall \ i \neq j \ \{\text{cor}(Y_i, Y_j) = 0 \ i \neq j \}$

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
\( X_2 = \text{Transportation} \)

\( X_3 = \text{Electricity} \)

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

Using matrix approach, the linear regression model is;

\[ Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \epsilon \]

The model in matrix form is given by,

\[ \begin{align*}
Y &= X \beta + \mu \\
\end{align*} \]

Where:

\[ \begin{align*}
Y &= \text{Column matrix of value of } Y \\
X &= \text{ } T \times (K+1) \text{ matrix} \\
\beta &= \text{Column matrix of the parameter estimated} \\
\mu &= \text{Column matrix of estimated } \beta \\
\end{align*} \]

Let \( b \) be a column matrix of estimated \( \beta \).

Therefore, \[ b = (X'X)^{-1}X'Y \]

The data collected was analyzed by employing Statistical Package for Social Sciences (SPSS) and Microsoft excel and the estimated parameters are as follows:
\[ N = 28 \quad \Sigma Y = 9242.526 \quad \Sigma X_1 = 3425.557 \]
\[ \Sigma X_2 = 158.5695 \quad \Sigma X_3 = 228.278 \quad \Sigma X_1Y = 1397662 \]
\[ \Sigma X_2Y = 81327.88707 \quad \Sigma X_1X = 33754.61969 \]
\[ \Sigma X_3Y = 89678.63363 \quad \Sigma X_2X_3 = 2077.99717 \quad \Sigma X_1^2 = 55143.2 \]
\[ \Sigma X_2^2 = 2593.888 \quad \Sigma X_3^2 = 2273.92346 \quad \Sigma Y^2 = 3598175.979 \]

\[ S_{11} = \frac{\Sigma X_1^2 - (\Sigma X_1)^2}{n} = -363943.97 \]
\[ S_{12} = \frac{\Sigma X_1X_2 - \Sigma X_1 \Sigma X_2}{n} = 14355.02 \]
\[ S_{13} = \frac{\Sigma X_1X_3 - \Sigma X_1 \Sigma X_3}{n} = 6669.16 \]
\[ S_{22} = \frac{\Sigma X_2^2 - (\Sigma X_2)^2}{n} = 1695.88 \]
\[ S_{23} = \frac{\Sigma X_2X_3 - \Sigma X_2 \Sigma X_3}{n} = 785.208 \]
\[ S_{33} = \frac{\Sigma X_3^2 - (\Sigma X_3)^2}{n} = 412.823 \]
\[ S_{1Y} = \frac{\Sigma X_1Y - \Sigma X_1 \Sigma Y}{n} = 266919.16 \]
\[ S_{2Y} = \frac{\Sigma X_2Y - \Sigma X_2 \Sigma Y}{n} = 28985.65 \]
\[ S_{3y} = \frac{\sum X_3 Y - \sum X_3 \sum Y}{n} = 14326.29 \]

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

Recall that:

\[ \beta = (X^tX)^{-1}X^tY \]

Where:

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

\[ X^tY = \begin{pmatrix} \sum Y \\ \sum X_1Y \\ \sum X_2Y \\ \sum X_3Y \end{pmatrix} \]

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

Hence, from computer analysis,

\[ (X_1^t X_2 X_3) = \begin{pmatrix} X_1^t X_1 & X_1^t X_2 & X_1^t X_3 \\ X_2^t X_1 & X_2^t X_2 & X_2^t X_3 \\ X_3^t X_1 & X_3^t X_2 & X_3^t X_3 \end{pmatrix} \]


\[
X^\top X = \begin{bmatrix}
14355.02 & 50287.4 & -363943.97 \\
14355.02 & 1695.88 & 785.208 \\
6669.16 & 785.208 & 412.823
\end{bmatrix}
\]

\[
(X^\top X)^{-1} = \begin{bmatrix}
-0.000001978 & -0.00007946 & 0.0001752 \\
0.000001632 & 0.01149812 & -0.0238583 \\
0.0000009096 & -0.00090330 & 0.01949278
\end{bmatrix}
\]

\[
X^\top Y = \begin{bmatrix} X_1^\top \\ X_2^\top \\ X_3^\top \end{bmatrix} \quad Y = \begin{bmatrix} X_1^\top Y \\ X_2^\top Y \\ X_3^\top Y \end{bmatrix}
\]

\[
X^\top Y = \begin{bmatrix} X_1^\top Y \\ X_2^\top Y \\ X_3^\top Y \end{bmatrix} = \begin{bmatrix} 266919.16 \\ 28985.65 \\ 114326.29 \end{bmatrix}
\]

\[
\beta = (X^\top X)^{-1} X^\top Y = \begin{bmatrix} \beta_1 \\ \beta_2 \\ \beta_3 \end{bmatrix} = \begin{bmatrix} 1.846736 \\ -0.41069 \\ 4.039933 \end{bmatrix}
\]

\[
Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3
\]

\[
\beta_0 = \bar{Y} - \beta_1 \bar{X}_1 - \beta_2 \bar{X}_2 - \beta_3 \bar{X}_3
\]
\[ \beta_0 = 330.0902 - 1.846736 (122.341) + 0.41069 (5.66319) - 4.039933 (8.152785) \]

\[ \beta_0 = 73.54726 \]

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)

H\(_1\): \( \beta_1 \neq \beta_2 \neq \beta_3 \neq 0 \) (At least one or all the coefficients significantly different from zero)

At 5% level of significance.

**ANOVA TABLE**

<table>
<thead>
<tr>
<th>Source of variation</th>
<th>Sum of Square</th>
<th>D.F</th>
<th>Mean sum of square</th>
<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression ((x_1 x_2 x_3))</td>
<td>( \beta_1 S_{1y} )</td>
<td>k-1</td>
<td>( \beta_1 S_{1y}/k-1 )</td>
<td>( \frac{\beta_1 S_{1y}/k-1}{S_{yy} \beta_1 S_{1y}/n-k} )</td>
</tr>
<tr>
<td>Residual error</td>
<td>( S_{yy} - \beta^2 S_{1y} )</td>
<td>n-k</td>
<td>( S_{yy} - \beta^1 S_{1y}/n-k )</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>( S_{yy} )</td>
<td>n-1</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**ANOVA TABLE**

<table>
<thead>
<tr>
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<th>F ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression ((x_1 x_2 x_3))</td>
<td>5.392*10^11</td>
<td>3</td>
<td>1.797*10^11</td>
<td>531.516</td>
</tr>
</tbody>
</table>
**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.

**REFERENCES**


