The Neutrality or Variability of the Nigerian Tax System to Comparative Econometric Models and Economic Growth

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Abstract
This study is set to compare the output of three econometric models – Linear, Log Quadratic and Transcendental Logarithm (Translog) – to evaluate the relationship between tax system and economic growth using the gross domestic product (GDP) as a proxy. The neutrality (the extent to which tax system is indifference to) or variability (the extent to which tax system is inconsistent with) the outputs of the three comparative econometric models used in evaluating the relationship between Nigeria tax system and GDP, is the main thrust of the paper. Findings revealed that the output from the Linear and the Translog models were similar, but the output from Log Quadratic model was different. The choice of an econometric model in evaluating relationship should be carefully decided rather than being arbitrary. It is recommended that two or more models may be used, were appropriate, to evaluate the relationship between variables. One of the criteria for selecting appropriate model is a pre-graphical representation of the relationships between the variables.

Keywords: Neutrality, Variability, Nigerian tax system, Comparative econometric models, Economic growth.

1.0 INTRODUCTION
The Nigerian tax system is a collective package. Of about 40 different taxes in the federal, state and local government levels with three main tax bases. The CIT and personal income tax (PIT) had their bases on income. The VAT and Excuse duties had their bases on consumption while capital gains tax (CGT) had its base on capital. Other types can be slotted into any of the three bases. The incidence of the taxes are direct or indirect. Direct taxes are CIT, PPT and CGT but VAT and Customs and Excuse taxes (CEX) are indirect. Nigeria runs a federal political structure which creates a fiscal regime operated under the same principle. About eight taxes were controlled by the federal with the CEX inclusive. The States had about 12 different taxes while the local governments scrambled for 20 different taxes. This structure resulted in tax multiplicity between local and state governments and the states and federal governments. The tax system is basically structured as a tool for revenue generation but an ideal structure, apart from revenue generation, should be used for redistribution of income and wealth, a tool for economic regulation and for achieving the harmonization objective in the single market ECOWAS philosophy. It should be noted that the tax system is not without some challenges. It is characterized by unnecessary complexity, distortionary and largely inequitable taxation laws that have limited application in the formal sector that dominates the economy (Okuru, 2012). In addition, Micah, Ebere and Umobong (2012) describe the tax system as lacking statistical data, with poor administration, lopsided and dominated by oil revenues. No tax system in our contemporary world is free from one challenge or the other. The federal government and stakeholders had discussed tax system at various fora with a view to correcting perceived flows in it. This paper focused on four major taxes which were at the exclusive legislative and administrative jurisdiction of the federal government of these taxes are VAT, CIT, PPT and CEX.

Objectives of the Paper
This paper employed three different functions – Linear, Log Quadratic and Translog functions to estimate the effects of the Nigerian Tax System on Economic Growth (GDP). Specifically,
(a). To develop econometric models from the these three functions and compare the results.
(b) To employ and examine a bi-variate analyses noting whether the independent variables are neutral or revealed varied outcomes.

2.0 THEORETICAL AND CONCEPTUAL ISSUES
Various functions can be used to estimate the parameters of the taxes (VAT, CIT, PPT and CEX) it relation to economic growth. Among these are the linear, log linear and quadratic functions. Some production functions such as Cobb-Douglas, Constant Elasticity of Substitution, Log Quadratic and Translog functions shall also be discussed.

2.1. A Function
A function is a relationship between two or more quantities, usually in the form \( Y = f(X) \); interpreted as \( Y \) is a function of \( X \) or precisely, the value of \( Y \) depends on the value of \( X \).

The term “Function” was first used in 1637 by the French Mathematician Rene Des Cartes (Boag gren and Singer,., 2009). Various elasticities are being estimated using Engel curves for regression. A mathematical
2.2 Functional Analysis of the Tax System and Economic Growth

Various functions can be used to estimate the effects of the tax system on gross domestic product (GDP) which is the proxy for economic growth. These include:

2.2.1 Linear Functions

A linear function is any function in the first degree. Such function (e.g. equation 1) can be restricted to a mathematical form.

\[ Y = \alpha_0 + \alpha_1 X \quad \text{... (eq 1)} \]

\[ Y = \text{Independent variable} \]
\[ \alpha_0 = \text{Constant term} \]
\[ \alpha_1 = \text{An array of the coefficients of } X; \]
\[ X_i = \text{The independent (or explanatory) variables.} \]

Equation 1 can be extended as:
\[ Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \ldots + \alpha_n X_n \quad \text{(eq 3)} \]

This function is of the type:
\[ Y = \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \ldots + \alpha_n X_n + \ldots \quad \text{(eq 4)} \]

2.2.2 The Cobb-Douglas Function

This is a production function by Cobb and Douglas (1928) in the measurement of technological relationship between the amount of output, particularly physical capital and labour, and the amount of output that can be produced by these inputs (Wikipedia n.d.). The function is represented as:
\[ Y = A \cdot L^\beta K^{1-\beta} \quad \text{... (eq 5)} \]

Where:
\[ Y = \text{Total production} \]
\[ L = \text{Labour input} \]
\[ K = \text{Capital input} \]
\[ A = \text{Factor productivity} \]
\[ \beta, 1-\beta = \text{Output elasticity of capital and labour respectively.} \]

2.2.3 Constant Elasticity of Substitution Function

The constant elasticity of substitution (CES) functions as to take care of the rigid assumption of cob-Douglas function (Upender, 2003). The C-D function has unitary value of elasticity of substitution between labour and capital.

CES production function was the original specification of Arrow, Cherery, Minhas and Solow (1961). Later, Kmenta (1967) made some adjustments to the function. The original equation was:
\[ Y = A \cdot L^\beta K^{1-\beta} + (1-\infty).L^\beta \quad \text{... (eq 6)} \]

Where:
\[ Y = \text{Output} \]
\[ A = \text{Factor productivity} \]
\[ \infty = \text{Share Parameter} \]
\[ K,L = \text{Primary Production Factors (Capital and Labour)} \]
\[ \beta = (S-1)/S \]
\[ S = 1/(1-\beta) \text{ which is the elasticity of substitution.} \]

As its name suggests, the CES production function exhibits constant elasticity of substitution between capital and labour.

The CES and C-D Functions

The C-D production function is a special case of the CES production function. If \( \beta = 1 \), there is a linear function, if \( \beta \) approaches zero, in the limit, we get the C-D function.

2.2.4 Transcendental Logarithmic Function (TLF)

This production function has severally been abridged as translog function. The initiation may be traced to Kmenta (1967) where the CES was approximated from it within a Taylor series of second-derivatives.

The TLF is more of a transformation of the C-D and the CES function. The contribution of Christesen, Dorgensen and Lawrence (1973) cannot be over-estimated in the aspect of translog production possibility frontier. Today, one of the most commonly used methods to study output, profitability, value added growth and the like is C-D function and TLF. The function assumes that any function could be expressed with a Taylor series of one or more variables (Habib, 2014). The generalized form of the TLF which takes into account a number of an inputs can be expressed as:
\[ L_nY = \alpha_0 + \sum_{i=1}^{n} \alpha_1 L_nX_i + \frac{1}{2} \sum_{i=1}^{n} \beta_1 (L_nX_i)^2 + \sum C_iN(L_nX_i)(L_nX_N) \quad \text{(eq 7)} \]

This function is transformed into:
\[ L_nGDP = A + \alpha_0 \ln(VAT_t) + \alpha_1 \ln(CIT_t) + \alpha_2 \ln(PPT_t) + \alpha_3 \ln(CEX_t) + e_t \quad \text{...... (eq 8)} \]

The TLF is a flexible functional form for the production function. It has not assumed rigid premises of C-D function such as perfect or “Smooth” substitution between production. Factor or perfect competition on the production factors market (Klacek, Vosvida and Schlsser, 2007).

### 2.2.5 The Log Quadratic Function [LQF]

A log quadratic function used by Sargant (1971) defined a condition of relaxing the constraints imposed to the parameter in the Kmenta function in order to test the homotheticity assumptions, and was written as:
\[ L_nY = L_nA_{KL} + \alpha_1 K + \alpha_2 L + \alpha_3 N + \beta_2 L^2 + \beta_3 K + \beta_4 L N + e_t \quad \text{...... (eq 9)} \]

This function of two input variables may be adjusted to, say, four input variables in the form:
\[ L_nY = L_nA_{KLMM} + \alpha_1 K + \alpha_2 L + \alpha_3 M + \alpha_4 N + \beta_2 L^2 + \beta_3 K + \beta_4 L N + \beta_5 M + \beta_6 M^2 + \beta_7 N + \beta_8 N^2 \quad \text{...... (eq 10)} \]

In estimating an economic function such as Tax and GDP, this function is of the type:
\[ L_nGDP = A_{VCPX} + \alpha_1 \ln(VAT_t) + \alpha_2 \ln(CIT_t) + \alpha_3 \ln(PPT_t) + \alpha_4 \ln(CEX_t) + \beta_2 L_n^2 + \beta_3 K + \beta_4 L N \quad \text{...... (eq 11)} \]

### 2.2.6 Econometric Model

Econometrics deal with the measurement of economic relationship, a combination of economic theory, mathematical and statistics, but completely distinct from each of these three branches of science (Koutsoyiamis, 2001). An econometric model possesses an important weapon in fulfilling the estimation function. This is the addition of a random term to indicate that it may not be possible for a set of variables to explain another valuable relationship 100 percent exact. Hence an econometric model of equation 1 would be:
\[ Y = \alpha_0 + \alpha_1 x_1 + \varepsilon_i \quad \text{...... (eq 12)} \]

Where
- \( Y \) = Dependent variable
- \( \alpha_0 \) = Constant term or intercept
- \( x_i \) = Independent variables
- \( \alpha_i \) = Independent variables’ coefficients
- \( \varepsilon_i \) = The stochastic error term assumed to be independent and normally distributed with zero mean and constant variance i.e. \( \varepsilon_i \sim N(0, \sigma^2) \). It is the addition of the error term that makes econometric models different from functional, mathematical or statistical relationship. An implied summary of the various functions discussed would be a focus on three equations. First was equation 4 on linear function, equation 8 on translog function and equation 11 on log quadratic functions. These functions were already in the form of econometric models. We shall use these three models to estimate the tax system in relation to GDP. This would help to analyze the neutrality or variability of each of the functional estimators.

### 3.0 METHODOLOGY

#### 3.1 Data Collection

Table 1: The GDP 1994 – 2011, and the Respective Taxes [VAT, PPT, CEX, and CIT]

<table>
<thead>
<tr>
<th>Year</th>
<th>GDP at Year Cpp</th>
<th>VAT</th>
<th>PPT</th>
<th>CEX</th>
<th>CIT</th>
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<tr>
<td>1994</td>
<td>946</td>
<td>7.3</td>
<td>43</td>
<td>18.3</td>
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<td>43</td>
<td>57.4</td>
<td>21.8</td>
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<tr>
<td>1996</td>
<td>2799</td>
<td>31</td>
<td>76.7</td>
<td>55</td>
<td>22</td>
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<tr>
<td>1997</td>
<td>2907</td>
<td>34</td>
<td>68.6</td>
<td>63</td>
<td>26</td>
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<td>1999</td>
<td>3312</td>
<td>47</td>
<td>164</td>
<td>88</td>
<td>46</td>
</tr>
<tr>
<td>2000</td>
<td>4717</td>
<td>58.5</td>
<td>525</td>
<td>101.5</td>
<td>51</td>
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<td>4910</td>
<td>91.8</td>
<td>639</td>
<td>171</td>
<td>69</td>
</tr>
<tr>
<td>2002</td>
<td>7128</td>
<td>108.6</td>
<td>392</td>
<td>181.4</td>
<td>89</td>
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<tr>
<td>2003</td>
<td>8743</td>
<td>136.4</td>
<td>683</td>
<td>196</td>
<td>113</td>
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<tr>
<td>2004</td>
<td>11674</td>
<td>159.5</td>
<td>1183</td>
<td>217</td>
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<tr>
<td>2005</td>
<td>14735</td>
<td>178.1</td>
<td>1905</td>
<td>233</td>
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<tr>
<td>2006</td>
<td>18710</td>
<td>230.4</td>
<td>392</td>
<td>181.4</td>
<td>89</td>
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<tr>
<td>2007</td>
<td>20941</td>
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<td>1601</td>
<td>241</td>
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<td>2008</td>
<td>24665</td>
<td>404.5</td>
<td>2150</td>
<td>281.3</td>
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<tr>
<td>2009</td>
<td>25256</td>
<td>562.9</td>
<td>1944.7</td>
<td>309</td>
<td>658</td>
</tr>
<tr>
<td>2010</td>
<td>34495</td>
<td>562.9</td>
<td>1944.7</td>
<td>309</td>
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<tr>
<td>2011</td>
<td>38151</td>
<td>649.5</td>
<td>3976.3</td>
<td>438</td>
<td>701</td>
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</tbody>
</table>

Source: CBN Statistical Bulletin (2011: 99, 117 – 119). All Naira values are in N'000M.

3.2 Models Specification

Three comparative models would be specified from the various functions discourse especially equation 4, equation 8 and equation 11 for Linear model, Log Quadratic Model and the Trans-log model are specified:

**Model Specification 1 [Linear Model]**

$$GD_{P_t} = a_0 + \alpha_i VAT_t + \alpha_i VAT_t + a_3 CIT_t + a_4 CEX_t + e_t \text{ (eq 13)}$$

Where:

- $GD_{P}$ = The gross domestic product which is a proxy for economic growth and as the dependent variable.
- $a_0 = \text{The constant term or the intercept.}$
- $a_i = \text{The array of coefficients of the independent variables VAT, CIT, PPT, CEX.}$
- $e_t = \text{Stochastic error term.}$

**Model Specification 2 [Log Quadratic Model]**

$$L_n GDP = A_{VCPX} + \alpha_1 L_n VAT_t + \alpha_1 L_n CIT_t + \alpha_1 L_n PPT_t + \alpha_1 L_n CEX_t + \beta_1 L_n^2 VAT_t + \beta_2 L_n^2 CIT_t + \beta_3 L_n^2 PPT_t + \beta_4 L_n^2 CEX_t + e_t \text{ (eq 14)}$$

Where

- $L_n GDP = \text{Natural Logarithm of the gross domestic product as the dependent variable and a proxy for economic growth.}$
- $A_{VCPX} = \text{A constant or intercept}$
- $\alpha_1, \alpha_2, \alpha_3 \text{ and } \alpha_4 = \text{The array of the coefficients of the } L_n VAT_t, L_n CIT_t, L_n PPT_t\text{ and } L_n CEX_t \text{ respectively.}$
- $\beta_1, \beta_2, \beta_3 \text{ and } \beta_4 = \text{The array of the coefficients of the } L_n^2 VAT_t, \ L_n^2 CIT_t, L_n^2 PPT_t\text{ and } L_n^2 CEX_t \text{ in the second degree respectively.}$
- $e_t \text{ = Stochastic error term.}$

$A_{VCPX} = \text{The coefficient of the product of, } L_n VAT_t, L_n CIT_t, L_n PPT_t\text{ and } L_n CEX_t \text{ represented by } VCPX \text{ [V=L_n VAT, C=L_n CIT, P=L_n PPT, X=L_n CEX] }$

$L_n VAT_t, L_n CIT_t + L_n PPT_t \text{ and } L_n CEX_t = \text{Independent variables of the first degree logarithm.}$

$L_n^2 VAT_t, L_n^2 CIT_t, L_n^2 PPT_t \text{ and } L_n^2 CEX_t = \text{Independent variables of the second degree logarithm.}$

$L_{n VAT_t}, L_{n CIT_t}, L_{n PPT_t} \text{ and } L_{n CEX_t} = \text{The product of the logarithms of the independent variables. These variables are represented by (VCPX).}$

$e_t = \text{Stochastic error term.}$
Model Specification 3 [Translog Model]

\[ L_n GDP_t = A + \beta_0 VAT_t + \beta_1 CIT_t + \beta_2 PPT_t + \beta_3 CEX_t + e_t \]  

(eqn 15)

Where:

- \( L_n GDP_t \) = Natural logarithm of gross domestic product as the dependent variable, and a proxy for economic growth.
- \( A \) = The constant or intercept
- \( \beta_0, \beta_1, \beta_2, \beta_3 \) = Array of coefficients of the independent variables
- \( e_t \) = Stochastic error term

RESULTS AND DISCUSSION

The econometric equations 13, 14 and 15 were used to estimate the coefficients of the independent variables. Table 2 showed the GDP estimation model of equation 13 in the following results.

\[ GDP = 423.4 + 68VAT - 19.51CIT + 1.86PPT + 12.74CEX \]  

(eq. 16)

Table 2 showed the GDP estimation model of equation 13 in the following results.

\[ L_n GDP = 3.37 + 0.475 L_n VAT_t + 0.371 L_n PPT + 0.584 L_n CEX_t + 0.031 L_n^2 VAT_t + 0.256 L_n^2 CIT_t + 0.027 \ln PPT_t - 0.121 L_n^2 CEX_t + 0.002 \text{ (VCPX)} \]  

(eq 17)

In Table 3, \( L_n CIT \) was positively significant at 10 percent, \( L_n^2 CIT \) was negatively significant at 10 percent and product of the \( L_n \) variables, \( L_n \) (VCPX) was positively significant at 10 percent. This model support CIT as being significant as against model I where VAT was supported significant. The adjusted \( R^2 \) was 0.994 showing that the independent variables jointly explained 99.4 percent of the variation in \( L_n GDP \). Other indices such as the d.w. statistics was 2.139, F ratio was 331 showing a well fitted regression and the standard error of estimate was 0.094. Apart from \( L_n CEX \), all the standard error of coefficients were less than unitary.

Model 3

Table 4 showed the GDP estimation model of equation 15. The resulting equation was:

\[ L_n GDP = 4.996 + 0.668 L_n VAT_t + 0.190 L_n CIT_t + 0.065 L_n PPT_t - 0.084 L_n CEX \]  

(eq 18)

Only \( L_n VAT \) was positively significant at 5 percents \( L_n CIT \) and \( L_n PPT \) were positively related to \( L_n GDP \) but \( L_n CEX \) was negatively related. The adjusted \( R^2 \) was 0.996 showing that 99.6 percent of the variation in \( L_n GDP \) was explained by the joint independent variables. The d.w. statistics was a bit low, being 1.028 but the F ratio of 327 and standard error of estimate of 0.141 showed that the regression was well fitted around the estimated \( L_n GDP \). This model supports \( L_n VAT \) as being significant. The result was in agreement with model I to a reasonable extent.

The Comparative Econometric Models

The three important indices to be compared on the basis of Neutrality (N) or Variability (V) in the three models are the significance of the variables, the Adjusted \( R^2 \) and the F ratios. For the purpose of comparison, VAT, \( L_n VAT \) were just VAT and \( L_n CIT, L_n^2 CIT \) were just CIT.

Out of the three statistical indices tested, each model combination had two indices in common. The most important of the indices was the significance or otherwise of the independent variables to the GDP. Using the three criteria, one would tend to conclude that only models 1 and 3 satisfied all the three criteria and therefore the tax system was neutral to models 1 and 3 because VAT and \( L_n VAT \) were both significant. Model 2 presented a different tax relationship entirely; \( L_n CIT \) and \( L_n^2 CIT \) were significant. If log quadratic had been used, the attention of the economic policy makers would have shifted from VAT to CIT.

CONCLUSION AND RECOMMENDATION

This study had examined the neutrality or variability of the Nigerian tax system to the linear; log quadratic and trans log functions. These analyses showed that the tax system is averagely neutral to linear and translog models. There is a variation in the case of log quadratic model.

The study therefore recommends that two or more different functions can be used to evaluate the relationship between the dependent and the independent variable(s). This would guide economic policy makers as to the outcome to be used. Also, a graphical representation of the dependent and independent variables would be an added advantage and “on the spot” check on the type of functions and econometric models to be
used.

Table 2: The Linear Model

<table>
<thead>
<tr>
<th>Coefficients</th>
<th>Model</th>
<th>Unstandardized Coefficients</th>
<th>Standardized coefficients</th>
<th>T</th>
<th>Sig</th>
<th>Ar²</th>
<th>d.w</th>
<th>F ratio</th>
<th>STE</th>
</tr>
</thead>
<tbody>
<tr>
<td>B</td>
<td>Std. Error</td>
<td>Beta</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 (Constant)</td>
<td></td>
<td>-623.410</td>
<td>783.364</td>
<td>-796</td>
<td>.439</td>
<td>0.987</td>
<td>1.595</td>
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<td>CEX</td>
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<td>12.737</td>
<td>12.635</td>
<td>135</td>
<td>1.008</td>
<td>.329</td>
<td>-</td>
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a. Dependent Variable: GDP

Table 3: The Log Quadratic Model

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<th>Standardized coefficients</th>
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<td>.671</td>
<td>.0994</td>
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<td>.527</td>
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<td>.142</td>
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<td>-.854</td>
<td>.413</td>
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a. Dependent Variable: lnGDP

Table 4: The Trans Log Model

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<th>Coefficients</th>
<th>Model</th>
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<th>Standardized coefficients</th>
<th>T</th>
<th>Sig</th>
<th>Ar²</th>
<th>d.w</th>
<th>F ratio</th>
<th>STE</th>
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<td>Beta</td>
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<td></td>
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<td>1 (Constant)</td>
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<td>4.996</td>
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<td>-</td>
<td>13.703</td>
<td>.000</td>
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<td>327</td>
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<td>lnVAT</td>
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<td>.754</td>
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a. Dependent Variable: lnGDP

SPSS 16 OUTPUT
Table 5 Summary of the Three Models

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<thead>
<tr>
<th>Variable</th>
<th>Model</th>
<th>t-value</th>
<th>AR²</th>
<th>d.w.</th>
<th>F ratio</th>
<th>Std error of estimate (STE)</th>
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<tr>
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<td>Ln(VAT)</td>
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<td>1.028</td>
<td>327</td>
<td>0.141</td>
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Extract from Tables 2 - 4

Table 6; The Bi-variate Analyses

Table 6a Models 1 and 2

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<tr>
<th>S/N</th>
<th>Particulars</th>
<th>Model 1</th>
<th>Models 2</th>
<th>N or V</th>
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<td>CIT</td>
<td>V</td>
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<td>0.994</td>
<td>N</td>
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</table>

Table 6b Models 1 and 3

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<td>VAT</td>
<td>N</td>
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<tr>
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<td>Adjusted R²</td>
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<td>0.986</td>
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<td>F ratio</td>
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Table 6c Models 2 and 3

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</thead>
<tbody>
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<td>Significance of Variables</td>
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<td>3</td>
<td>F ratio</td>
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<td>327</td>
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