Investigating Regression Parameters Stability of Agricultural and Health Sector on Growth Domestic Product of Nigeria, Using Difference and Return Series

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Abstract

The international market's dropping in oil price highlights the necessity for Nigeria's economy to be diversified in order to grow the non-oil sector, of which agriculture and health are subsectors. A large portion of the population of Nigeria earns their living through agriculture, which is well-reported in the literature. In this study, the impact of Nigeria's agriculture and health expenditures on the country's GDP is examined from 1999 to 2021. The CBN statistical bulletin was used to extract yearly data for agriculture and GDP. The Nigerian Real Gross Domestic Product was regressed on health and agricultural expenditure from 1999 to 2021. Four regression models were employed in this study (First difference, First difference of the Logarithm of the series, Return series, Return of the Logarithm of the series). Then, each individual series fluctuation were examined to determine the trend component in the series. The time plots of the data revealed the presence of upward trend in the series and suggestion of non-stationrity. The KPSS and Augmented Dickey-Fuller test conducted on the series indicates that actual and first difference series were non-stationary at the critical values of 5%, while the return and return logarithm series were stationary at 5%. Then, the ideal model was selected based on Information Criteria: AIC and SQC. The Return Logarithm series Regression Model was identified as the robust (best) model to examine the relationship between health and agricultural expenditure on GDP, when the transformed series are non-negative which no spurious regression was produced. The identified model revealed that 1% change in agricultural expenditure causes about 71.6% change in GDP and 1% change in health expenditure causes about 27.7% change in GDP. Hence, this result suggested that return series is the better method of making the series to be stationary before fitting regression model when the transformed series are non-negative.

Keywords: *regression models, Logarithm of the series, non-stationrity, Return of the Logarithm*

1. Introduction

In econometric and time series studies, difference and return series is a statistical and econometric tool that is applied to test if the series is stationary (stability), that is both the mean and the variance are constant over time. These is also known as checking the series for presence of unit root. The non-stationarity in majority of financial time series data has resulted in different methods of making the series to be stationary and different tests like Phillip Perron's (PP) and Augmented Dickey Fuller (ADF) were introduced in examining the presence of a unit root in the series (Pesaran *et al.*, 2001; Doguwa & Alade, 2015). The two common methods of making the series to be stationary (stable) will be compared in this study to determine the robust method in their regression parameters when examine the relationship between health and agriculture sector expenditure on GDP in Nigeria from 1999 to 2021.
The changing aspects of health and agricultural expenditure movements and instabilities and its consequent effect on a nation's economy has continued to gain considerable attention after major countries shifted from oil sector to non-oil sector (Yakubu & Akanegbu, 2015). The declining oil price in the international market reveals the fact that the Nigerian economy need to be diversified to develop the non-oil sector, of which agriculture is sub sector. It is well reported in the literature that agriculture in Nigeria is a major brand of the economy, providing employment for about 70% of the population(Anacbonam, 2014).
On the other hand, medical advancement represents the state of the Nigerian health sector's development and is a major factor in the country's expenditure on public health. "The most fascinating finding of our study is that provided by the regime of government, the military government spent less than civilian Government by roughly 75.59%," said Odoh and Nduka (2014) in a comparison of Nigeria's health care system under the military and civilian regimes. This demonstrates that the civilian administration is more attentive to the interests of the people with regard to both people-orientedity and health care.

Regression analysis of time series data is usually hinged on the assumption that the regression parameters are constant over time amongst others.

Many have done work on using first difference and return series, on examining the relationship between parameters variables such as that of Van-der-Ven and Smits (2011) on the relevance of age structure for economic growth. Study by Adewole (2012) revealed that population growth has a positively and significant effect on economic growth measured as Per Capita Income (PCI) and Real Gross Domestic Product (RGDP) in Nigeria between 1981 and 2007. Jhingan (2005) worked on the population growth affect on per capita income, and many more.

Time series models are applied for different purposes which includes; foretelling future outcomes, having a grasp of past outcomes, and many more. The instability of the parameters encumbers on the ability of a model stability by difference and return series. This research tries to identify the robust method between the two popular methods of making the series to be stationary in term of comparing their regression models in levels return and first differences in an economic data of Nigeria from 1999 to 2021, and if the regression parameters are significant on the dependent series "GDP". On the other hand, the researcher wants to investigate regression parameters stability of agricultural and health expenditure on growth domestic product of Nigeria, using first difference and return series, and their objectives are to evaluate and test for stability of the first difference and return series using unit root tests, to examine the relationship between health and agriculture sector expenditure on GDP using the first difference regression model, examine the relationship between health and agriculture sector expenditure on GDP using the return regression model, to determine the robust model and to compare the regression models performance for first difference and return series, using parameter estimates and Information Criteria

2. Methodology

The research methodology for this study comprises of the following subheadings: The time plot of the original series, unit roots test for first difference and return series, model specification, models selection criteria and Model Accuracy Measures

2.1 Research Design

This study adopted regression model after the series were stability using first difference and return evaluation in equations (1) to (4). This study will be designed to examine the relationship between health and agriculture expenditure on GDP in Nigeria from 1999 to 2021, annual data for health, agriculture and GDP was extracted from CBN statistical bulletin. Thus, the Nigerian Real Gross Domestic Product will be regressed on health and agricultural expenditure from 1999 to 2021 with consideration of four regression models in this study (First difference, First difference of the Logarithm of the series, Return series and Inverse, Return of the Logarithm of the series). To do this, the study will employ some statistical tools which include transformed series (first difference and return series), series plots, unit root test, regression analysis, test for significance parameters and effect of the independent variables (health and agricultural expenditure) on the dependent variable (GDP). Then, determine the robust regression model for the prediction of relationship between health and agriculture sector expenditure on GDP in Nigeria.

2.2 Difference series (DS)

For this study, we have specified the mean equation as a constant, an exogenous variable; the difference between the present year's and the previous year's (DS). The difference series $Z_t = \nabla X_t$ equation is given by

$$Z_t = (1-B)X_t = X_t - BX_t = X_t - X_{t-1} \qquad (1)$$

where X_t represent the year return at time t and X_{t-1} represent the year return at time $t-1$.

Similarly, after logarithm transformation, the difference series Z_t is

$$Z_t = \nabla(\ln X_t) = \ln X_t - \ln X_{t-1} \qquad (2)$$

where ln is represent logarithm transformed series.

2.3 Return series (RS)

The absolute value of the ratio between the present year's returns and the previous year's returns (RS). The return series (Z_t) equation is given by

$$Z_{t\,t} = \left(\frac{X_t}{X_{t-1}}\right) \quad (3)$$

where X_t represent the year return at time t and X_{t-1} represent the year return at time $t-1$.
For after logarithm transformation, then, the returns series Z_t is

$$Z_{t\,t} = \left(\frac{\ln X_t}{\ln X_{t-1}}\right) \quad (4)$$

where ln is represent logarithm transformed series.

2.4 Source of Data

The data collected was secondary data on the health expenditure, agricultural expenditure and gross domestic product (GDP) from statistical bulletins, Central Bank of Nigeria which was yearly data set from 1999 to 2021. The choice of data does not describe other variables as ineffective, rather such variables appear to relate with each other in a unique technique.

2.5 Time Plot

Making a time plot of the data is often the first stage in a study when dealing with time-series data. to analyse a simple descriptive measure of the series' key properties. The graph of health expenditure, agricultural expenditure and gross domestic product (GDP) will be plotted against time to give the overall movement of the original data over time, and also to tell whether the pattern is steady or fades over time.

2.6 Test for Stationarity

2.6.1 Unit root tests

The two unit root tests considered in this research are Augmented Dickey-Fuller (ADF) unit root test and Kwiatkowski, Phillips, Schmidt and Shin (KPSS) test.

2.6.1.1 Kwiatkowski Phillips, Schmidt and Shin (KPSS) test

The KPSS test statistic sometimes called the Lagrange multiplier (LM) is used for testing $\sigma_\varepsilon^2 = 0$ against the alternative that $\sigma_\varepsilon^2 > 0$ and is given by

$$KPSS = \frac{\sum_{t=1}^{T} \hat{S}_t^2}{T^2 \hat{\lambda}^2} \quad (5)$$

where $\hat{S}_t = \sum_{j=1}^{t} \hat{u}_j$; $\hat{u}_j$ is the residual of the regression of y_t on D_t. t is time and $\hat{\lambda}^2$ is a consistent estimate of the long-run variance of u_t and $\hat{u}_t$.

Since time series data are often non-stationary, the data must be differentiated to account for non-stationarity that manifests itself as a pattern. Since the stationarity of a series can have a significant impact on its behaviour, using non-stationary data can lead to erroneous regression. Dickey Fuller, the Philip Peron test, and the correlograms; Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) are all used to test for stationarity. However, this study adopted the Augmented Dickey-Fuller test.

2.6.1.2 Augmented Dickey-Fuller Test

Augmented Dickey-Fuller test is used to test for the unit root of a time series, say X_t. Mathematically the Augmented Dickey-Fuller test is presented in Equations 3.1 to 3.3 below.

$$\Delta HealthExpP_t = \beta_0 + \beta_1 HealthExp_{t-1} + \sum_{T=1}^{m} pi\, \Delta HealthExp_{t-1} + \varepsilon_t \quad (6)$$

$$\Delta AgricExp_t = \beta_0 + \beta_1 AgricExp_{t-1} + \sum_{T=1}^{m} pi\, \Delta AgricExp_{t-1} + \varepsilon_t \quad (7)$$

$$\Delta GDP_t = \beta_0 + \beta_1 GDP_{t-1} + \sum_{T=1}^{m} pi + \varepsilon_t \quad (8)$$

where: ε_t = Random terms

Δ = Difference operator

ρi = Coefficient of the previous observations

$t-1$ = Past observation

m = Number of lags and β is the parameter to be estimated

The role of the lagged dependent variables in the Augmented Dickey-Fuller (ADF) autoregressive equations is to ensure that ε_t is white noise. Following the specification given in Equations above, we checked the series for presence of unit root.

A multiple linear regression model is the process of associating a random response Y to a set of predictor variables $X_1, X_2, \ldots, X_k$ an equation of the form

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 . + \ldots + \beta_k X_k + e_i \quad (9)$$

where Y_i is a random variable called response dependent variable; $\beta_0, \beta_1, \ldots, \beta_k$ are constants/parameters (the k parameters coefficient estimates of the model) whose exact values are not known and hence must be estimated from experimental data; $X_1, X_2, \ldots, X_k$ are mathematical variables called regressors/covariates/predictors/independent non-random variables, whose values are controlled or at least accurately observed by the experimenter and e_i is a random variable representing an error term which accounts for unexplained random variation in response.

The basic regression model can be given as;

$$Y_t = X_i' \beta_i + \varepsilon_i, \quad (10)$$

where Y_t is the response at time t, X is a covariate vector, β_i is a vector of regression parameters and ε_i is the error term.

2.7 Model Specification

The models for this study are assumed to have the form:

First Difference Regression Model:

$$\nabla GDP_t = \beta_0 + \beta_1 \nabla Heath_t + \beta_2 \nabla Agric_t + \varepsilon_t \quad (11)$$

First Difference Logarithm Regression Model:

$$\nabla \ln(GDP_t) = \beta_0 + \beta_1 \nabla \ln(Heath_t) + \beta_2 \nabla \ln(Agric_t) + \varepsilon_t \quad (12$$

Return Regression Model:

$$RsGDP_t = \beta_0 + \beta_1 RsHeath_t + \beta_2 RsAgric_t + \varepsilon_t \quad (13)$$

Return Logarithm Regression Model:

$$Rs\ln(GDP_t) = \beta_0 + \beta_1 Rs\ln(Heath_t) + \beta_2 Rs\ln(Agric_t) + \varepsilon_t \quad (14)$$

2.8 Model Accuracy Measures

2.8.1 The Mean Square Fitting Error (MSE)

This is one of the model selection or good of fit of any model in estimation. The MSE simulate the fault data and the difference between the expected data and the observed data. It is given by

$$MSE = \sum_{i=1}^{n} \frac{(\text{Exp.Value} - \text{observed value})^2}{n} \quad (15)$$

where n is the number of observation.

2.9 Coefficient of Multiple Determination (R^2)

This model selection measure can be used to justify whether a significant trend exist in a given model and determine or judge the adequacy of the regression or nonlinear growth model to observe simple values of x & y, and it measures measures the percent of the variation about the mean accounted for the fitted plot. It ranges in value from 0 to 1; denoted by

$$R^2 = 1 - \frac{residual\ SS}{Connected\ SS} \quad (16)$$

R^2 measures the total variation in y by the use of t as explanatory variables. It is a measure of adequacy of the model.

According to Box and Drape 1998, the coefficient of determination is given by

$$R^2 = \frac{SS_{reg}}{SS_{total}} = \frac{SSR}{SST} = 1 - \frac{SSE}{SST} \quad (17)$$

where

$o < R^2 \leq 1$

$$SST = \text{sum of square total} = \sum y_i^2 - \frac{(\sum y_i)^2}{n} \quad (18)$$

$$SSE = Sum\ of\ square\ Error = \left[\sum y_i^2 - \frac{(\sum y_i)^2}{n}\right] - b_i\left[\sum t_i\, y_i - \frac{\sum t_i \sum y_i}{n}\right] \quad (19)$$

$$SSR = Sume\ of\ Square\ Regression = b_i\left[\sum t_i\, y_i - \frac{\sum t_i \sum y_i}{n}\right] \quad (20)$$

y= Dependent variable which is the rate of stroke occurrence in the young.

b= Parameter

n = number of entries of the independent variable, t.

3.10 Adjusted R-Squares (R^2adj)

Maximizing the number of regression in a given model may lead to an increase in R^2. If that be the case, we cannot fully rely on R^2 alone. The adjusted R^2-square (R^2adj) clearly explain the percentage of variation explained by the independent variable and which may affect the dependent addition independent variable that do not belong to the model.

The adjusted R-square may be define as

$$R^2 = \frac{SSE/(n-p)}{SS_{T/(n-1)}} \quad (21)$$

$$= 1 - \frac{n-1}{n-p} \quad (22)$$

where

SSE = Sum of square error, SS_T = Sum of square total, P = Number of model parameters, and N = Number of sample size

3.7 Model Selection Criteria

The most frequently used information standards are: (i) Akaike Information Criterion (AIC) and (ii) Schwarz Information Criterion (SIC). The Information Criteria and their formula are shown below.

3.7.1 The Akaike Information Criterion (AIC)

This is a way of selecting model adequacy of a given set data. It can be described as a trade-off bias and variance in model construction. It is given by;

$$AIC = n \, In(MSE) - 2k \qquad (23)$$

where, k = number of parameters
n is the number of observations
MSE = Mean sum of square error for the estimated model.

3.7.2 The Schwarz Information Criterion or Bayesian Information Criterion (SIC or BIC)

Bayesian Information Criterion for model adequacy selection is given as

$$SIC = n \, In(MSE) - k \ln n \qquad (24)$$

where, all the parameters are defined as in Equation (3.18), Chris, (2008).

4.0 Results And Discussions

4.1 Plots and Descriptive Measures of the Time Series Variables

In achieving the objectives of this study, yearly series on Real Gross Domestic Product, are the expenditures on Health and the agricultural sector of Nigeria from 1999 – 2021 were plotted as shown in the figures (1 to 14) to describe the series behaviors (23 observations).

Figure 1: Is the time plot of Gross Domestic Product at level; where the vertical axis represents series while the horizontal axis represents the time (years). The time plot of Gross Domestic Product at levels showed an upward (positive) trend movement which is an indication of the non-stationary process that exists in the series. The series shows continuous upward in an exponential or quadratic trend manner across the time of the observations.

Figure 2: Show the time plot of Health expenditure series at level. The vertical axis represents series while the horizontal axis represents the time (years). The time plot of the health expenditure at levels showed an upward (positive) trend, this is an indication of the non-stationary process that exists in the series. This exhibit a constant upward movement across the time of the observations.

Figure 3 showed similar upward trend like Figures 1 and 3. Also in the Agricultural expenditure series plot in Figure 3, the vertical axis represents series while the horizontal axis represents the time (years). The Agricultural expenditure series at levels showed a constant upward trend movement. The constant fluctuation in the series is an indication of the non-stationary process that exists in the process.

Table .1 presents the descriptive statistics which include, mean, variance, standard deviation, skewness and kurtosis statistic for individual series. The sample mean of all the indicators have positive signs which means they are positive mean returning, but their corresponding standard deviation of the return series is much higher for the first difference series. Also, the skewness statistics are all positive first difference series while they are negative sign for return series (-0.445556). This simply signifies that the series is skewed to the left (extreme loss) than the right tail (extreme gain). There is evidence that data sets suggesting the presence of fat tail and they are all statistically significant.

The time plots in fig 4 to fig 14 are first difference and first difference logarithm series of the time series variables (the expenditures on Health, Agricultural sector and GDP). Figures4 to 9 shows no evidence of seasonality in the series but a slight significant trend at the beginning, with an evidence of stationary after differencing.

However, the time plots in 10 to 15 are return and return logarithm series of the time series variables above shows no evidence of seasonality in the series but a white noise process across the series, suggesting an evidence of stationary after differencing.

Next, the return and first differences of the three series in Figure 5 to 15, test for stationarity were determine using unit root test.

4.2 Stationarity Test

The four model values from the variables were tested for stationery using KPSS and Augmented Dickey-Fuller (ADF) test. Detail in Table2 represents the result of KPSS and ADF p-values test at the level for return and first differences series were estimated. Note that the probability values in are parenthesis (p-values in brackets). The ADF probability values (p-values) at a level is greater than 0.05 (p-values >0.05) showed the presence of unit root at the level.

Table 2: KPSS and Augmented Dickey-Fuller (ADF) Unit Roots Test

Variable	KPSS at Levels	Remark	(ADF p-value)	Remark
Actual GDP	0.8104	Non-stationary	(1.0000)	Non-stationary
Actual Health Expenditure	0.8385	Non-stationary	(0.9986)	Non-stationary
Actual Agric. Expenditure	0.8337	Non-stationary	(1.0000)	Non-stationary
First Difference GDP	0.7294	Non-stationary	(0.8797)	Non-stationary
First Difference Health	0.4979	Non-stationary	(0.6262)	Non-stationary
First Difference Agric.	0.6367	Non-stationary	(0.8275)	Non-stationary
First Difference ln(GDP)	0.7111	Non-stationary	(0.7767)	Non-stationary
First Difference ln(Health)	0.4131	**Stationary**	(0.0000**)	**Stationary**
First Difference ln(Agric.)	0.3680	**Stationary**	(0.0020**)	**Stationary**
Return GDP	0.7099	Non-stationary	(0.2835)	Non-stationary
Return Health	0.3963	**Stationary**	(0.0000**)	**Stationary**
Return Agric.	0.3554	**Stationary**	(0.0011**)	**Stationary**
Return ln(GDP)	0.7410	Non-stationary	(0.2400)	Non-stationary
Return ln(Health)	0.4511	**Stationary**	(0.0000**)	**Stationary**
Return ln(Agric.)	0.4078	**Stationary**	(0.0000**)	**Stationary**

Test critical values for KPSS:	
1% level	0.701
5%level	0.451
10% level	0.356

Footnote: **= Sig. at 5% for ADF

The ADF probability values estimated for actual and first difference series are non-stationary, since the p-values at a level is greater than 0.05. However, ADF probability values for first difference logarithm of health and agricultural series are stationary, since the p-values at a level is less than 0.05. In addition, the ADF probability values estimated for the return and return logarithm of health and agricultural series are stationary except the gross domestic product.
The KPSS result at level also confirmed that actual and first difference series are non-stationary at the critical values of 5%. While all the return and return logarithm series are stationary at 5%. These results in Table 4.2 confirmed the series plotted above, that the return and return logarithm series are stable (or stationary) than first difference series. This results seem to suggest that return series is the better method of making the series to be stationary before fitting regression model in econometric and time series study.

4.3 Regression Models

Next, the four return and first difference regression models were estimated to examine the relationship between health and agriculture sector expenditure on GDP using equations (11) to (14) and Table 3. Then, comparisons were made among the regression models coefficients performance for first difference and return series, using parameter estimates and Information Criteria to determine the robust model.

Table 3: Return and First Difference Regression Models and their Information Criteria

Dependent Variable	Independent Variable	Coefficients	Estimates(p-value)	Remark	R^2	Adj R^2	AIC	SQC
Actual GDP	Constant	β_0	-5967.20 (0.0000**)	Not Sig.	99.81%	99.80%	425.0995	428.5060
	Actual Health Expenditure	β_1	63.4615 (0.0000**)	Sig.				
	Actual Agric. Expenditure	β_2	2.9475 (0.0000**)	Sig.				
First Difference GDP	Constant	β_0	178.811 (0.8618)	Not Sig.	82.56%	80.72%	399.7589	403.0420
	First Difference Health	β_1	54.0454 (0.0132**)	Sig.				
	First Difference Agric.	β_2	2.9705 (0.0000**)	Sig.				
First	Constant	β_0	0.0752	Sig.	51.6	46.5	-	-

Difference ln(GDP)			(0.0031**)		0%	0%	63.9721	60.6989
	First Difference ln(Health)	β_1	0.2461 (0.0138**)	Sig.				
	First Difference ln(Agric.)	β_2	0.3293 (0.0007**)	Sig.				
Return GDP	Constant	β_0	0.6375 (0.0000**)	Sig.	52.41%	47.40%	-55.9736	-52.7005
	Return Health	β_1	0.1948 (0.0164**)	Sig.				
	Return Agric.	β_2	0.2650 (0.0006**)	Sig.				
Return ln(GDP)	**Constant**	$\boldsymbol{\beta_0}$	**0.5922 (0.0000**)**	**Sig.**	**61.69%**	**57.65%**	**-162.7954**	**-159.5223**
	Return ln(Health)	$\boldsymbol{\beta_1}$	**0.1241 (0.0025**)**	**Sig.**				
	Return ln(Agric.)	$\boldsymbol{\beta_2}$	**0.2910 (0.0002**)**	**Sig.**				

Footnote: **= Sig. at 5% and the robust (best) model is Return Logarithm Series Model, since it have the Information Criteria least values

Hence, the Identified Return Logarithm Regression Model:

$$Rs\ln(GDP_t) = 0.0011 + 0.2769\, Rs\ln(Heath_t) + 0.7156\, Rs\ln(Agric_t) \quad (25)$$

The estimated return logarithm regression model is given in (4.1) revealed that both independent variables (health and agricultural sector expenditure) are positively related to GDP in Nigeria. The model further revealed that 1% change in agricultural expenditure causes about 71.6% change in GDP and 1% change in health expenditure causes about 27.7% change in GDP. This means that agricultural expenditure contributed about 71.6% to the GDP in Nigeria between the periods under consideration, while health expenditure contributed about 27.7%. This result is close to the results of studied of Aminu & Anono (2012); Adenomon & Oyejola (2013) and Anacbonam (2016) etc.

5.0 Summary And Conclusion

5.1 Summary

This study examined the relationship between health and agricultural expenditure on GDP in Nigeria from 1999 to 2021 Annual data for agriculture and GDP was extracted from CBN statistical bulletin. The Nigerian Real Gross Domestic Product was regressed on health and agricultural expenditure from 1999 to 2021. Four regression models were employed in this study (First difference, First difference of the Logarithm of the series, Return series and Inverse, Return of the Logarithm of the series). Then, each individual series fluctuation were examined to determine the trend component in the series. The time plots of the data revealed the presence of upward trend in the series and suggestion of non-statationrity. The KPSS and Augmented Dickey-Fuller test conducted on the series indicates that actual and first difference series were non-stationary at the critical values of 5%, while the return and return logarithm series were stationary at 5%. These results confirmed the series plotted behaviour, that the return and return logarithm series are stable (or stationary) than first difference series. The four return and first difference series regression models was used for the analysis with help Gretl statistical software. The best model was selected based on Information Criteria: AIC and SQC. The Return Logarithm series Regression Model was identified as the robust (best) model to examine the relationship between health and agricultural expenditure on GDP, when the transformed series are non-negative. Hence, this result suggested that return series is the better method of making the series to be stationary before fitting regression model when the transformed series are non-negative in econometric and time series study.

This study further revealed that both independent variables (health and agricultural sector expenditure) have positively related to GDP in Nigeria and in all the models built. The identified model further revealed that 1% change in agricultural expenditure causes about 71.6% change in GDP and 1% change in health expenditure causes about 27.7% change in GDP. This means that agricultural expenditure contributed about 71.6% to the GDP in Nigeria between the periods under consideration, while health expenditure contributed about 27.7%. This result is close to the results of studied of Aminu & Anono (2012); Adenomon & Oyejola (2013) and Anacbonam (2016)

5.2 Conclusion

This study focused on the identification of a robust regression model for examining the relationship between health and agricultural expenditure on GDP in Nigeria. The variables involved in this study were tested for stationarity since the variables of the study cannot be applied for analysis unless it is established that the variables are stationary (stable). Data on each series were tested for stationarity to avoid the problem of spurious regression. The KPSS and Augmented Dickey-Fuller (ADF) tests were used to test for unit root on each of the variables.

ADF probability values for first difference logarithm of health and agricultural series are stationary, since the p-values at a level is less than 0.05. In addition, the ADF probability values estimated for the return and return logarithm of health and agricultural series are stationary except the gross domestic product. The KPSS result at level also confirmed that actual and first difference series are non-stationary at the critical values of 5%. While all the return and return logarithm series are stationary at 5%.

The Augmented Dickey-Fuller (ADF) test at the level for actual and first differences series probability values in brackets, the probability values (p-values) at level is greater than 0.05 (p-values >0.05), the result showed the presence of unit root since the series is non-stationary. Since the data is non-stationary, this will produce spurious regression, therefore is a need for using the return and return logarithm series. The p-value for all the return variables were stationary using KPSS.

The Akaike Information Criterion (AIC),) and Schwarz Information Criterion (SIC) were used to determine the robust models as Return Logarithm series Regression Model, since its have the minimum information criteria.

The identified model revealed that 1% change in agricultural expenditure causes about 71.6% change in GDP and 1% change in health expenditure causes about 27.7% change in GDP.

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