European Journal of Statistics and Probability

Vol.3, No.1, pp.35-41, March 2015

Published by European Centre for Research Training and Development UK (www.eajournals.org)

CO INTEGRATION: APPLICATION TO THE ROLE OF INFRASTRUCTURES ON ECONOMIC DEVELOPMENT IN NIGERIA

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ABSTRACT: *The study appraised the role of infrastructure on economic development in Nigeria measured by the gross domestic product while the infrastructure is measure with the capital expenditure on Transportation & communication (TRC), Education (EDU) and Health (HLT) respectively for a period of 32 years (1981-2013). Using least square (OLS), we find out that, the measure of coefficient of determination shows that about 95.11% of variation in GDP can be explained by infrastructure. The regression model explain that a unit increase in Transport &Communication(TRC) and Education(EDU) will increase GDP by 237% and 174% respectively, while the Health(HLT) will reduces the GDP by 31%. The residual of the regression model is stationary, when subjected to the unit root test and the Johansen co integration test show that two of the equation is co integrated. From this, it can be affirmed that the regression model are not spurious. The co integrating equation also suggesting that the GDP adjust to change in capital expenditure on infrastructures in the same time period and shows that short-run change in TRC and EDU have negative impact on short-run change in GDP but only HLT has positive impact on GDP in the short run.*

KEYWORD: co integration, Regression Model, infrastructure, Economic Development

INTRODUCTION

Co integration is a statistical property of time series variables, two or more variable are co integrated if they share a common stochastic drift. If two or more series are individually integrated but some linear combination of them as lower order of integration, then the series are said to be co integrated before 1980s many economist use linear regression on non-stationary time series data, which Nobel Laurel Clive Granger and Paul Newhold show to be dangerous approach that could produce spurious correlation, since standard detrending techniques can result in data that are still non-stationary. His 1987 paper with Nobel Laurel Robert Engle formalized the co integrating vector approach, and coin the term.

ISSN 2055-0154(Print), ISSN 2055-0162(Online)

The possible presence co integration must be taken into account when chosen a technique to test. In the earlier empirical studies, Ram (1986), Holmes & Hutton (1990) and Aschauer (1989) found positive relationship between government expenditures and growth. On the contrary, Grier & Tullock (1989) used pooled regression on five year averaged data in 113 countries to analyze the relationship between cross-country growth and various macroeconomic variables. They found that the mean growth of government share of GDP generally had a negative impact on economic growth. This finding implies that an increase in the government size as measured by a share of government expenditures to GDP hampers economic growth. Barro (1990) also discovered the negative relationship between the size of government and economic growth. Miller & Russek (1997) indicated that debt-financed increases in government expenditure retarded growth. Using the data from 43 developing countries over 20 years, Devarajan, et. al. (1996) found the positive relationship between current government expenditure and economic growth. In addition, the negative relationship between capital expenditure and per-capita growth was also observed. Recent studies employed cointegration and error correction models to study the relationship between government size and growth. Islam & Nazemzadeh (2001) examined the causal relationship between government size and economic growth using long annual data of the United States. They indicated that the causal linkage was running from economic growth to relative government size. However, Dahurah & Sampath (2001) found no common causal relationship between military spending and growth in 62 countries. Abu-Bader & Abu-Qarn (2003) investigated the causal relationship between government expenditures and economic growth for Egypt, Israel, and Syria. They found that overall government expenditures and growth exhibit bidirectional causality with a negative long-run relationship in Israel and Syria. A unidirectional negative short-run causality from economic growth to government spending was discovered in Egypt. These findings might stem from a military burden in these countries. Kalyoncu & Yucel (2006) used co integration and casuality test to investigate the relationship between defense and economic growth in Turkey and Greece. The results showed unidirectional causality from economic growth to defense expenditure in Turkey, but not in Greece. However, co integration between defense expenditure and growth existed in both countries

MATERIAL AND METHODOLOGY

The dataset for this paper is extracted from the statistical bulletin, Central Bank of Nigeria, 2013. The data is the record on aggregate real GDP at current market prices (dependent variable), and expenditure on infrastructure l.e transport & communication (TRC), education (EDU) and Health (HLT) (independent variables,) from 1981 to 2013.

Ordinary Least Square Estimation

The regression model of GDP on infrastructure is

$$GDP_t = \beta_0 + \beta_1 TRC_t + \beta_2 EDU + \beta_3 HLT + U_t$$

……………………………………*(i)

Long-run relationship

The long-run relationship between the GDP and expenditure on infrastructure can be determined by the co integration vector. The long-run relationship (co integration) exist if the errors from the regression (i) is stationary series although the Independent and dependent variables are non-stationary

The estimated residuals $\hat{U}_t$ from *(i) is subjected to unit root analysis, using Dickey–Fuller (DF) Test

The actual procedure of implementing the DF test involves three main version of test, it is noted that a random walk process may have no drift, or it may have drift or it may have both deterministic and stochastic trends. To allow for the various possibilities, the DF test is estimated in three different forms, that is, under three different null hypotheses.

i. **Res*t* is a random walk:**

$$\Delta \mathrm{Re}\, s_t = \alpha_1 \mathrm{Re}\, s_{t-1} + \varepsilon_t \quad \text{(ii)}$$

ii. Res***t* is a random walk with drift:**

$$\Delta \mathrm{Re}\, s_t = \beta t + \alpha_1 \mathrm{Re}\, s_{t-1} + \varepsilon_t \quad \text{(iii)}$$

iii. Res***t* is a random walk with drift around a stochastic trend:**

$$\Delta \mathrm{Re}\, s_t = \alpha_0 + \beta t + \alpha_1 \mathrm{Re}\, s_{t-1} + \varepsilon_t \quad \text{(iv)}$$

Where α is a constant, β is the coefficient of trend and t is the time or trend variable or trend variable. In each case, the *null hypothesis* is that $\delta = 0$; that is, there is a unit root—the time series is non-stationary. The alternative hypothesis is that δ is less than zero; that is, the time series is stationary. If the null hypothesis is rejected, it means that *Ut* is a stationary time series.

Here, we will focus on a vector autoregression (VAR) as a description of the system to be investigated. In a VAR, each variable is 'explained' by its own lagged values and the lagged values of all other variables in the system. To see which questions can be asked within a co integrated VAR, we have four VAR model for the expenditure on infrastructure, TRC_t, EDU_t, and HLT_t together with the GDP_t, the proxy for economic development We restrict the analysis to one lagged change for simplicity, and allow for 3 co integration relations. Then the system can be written as:

$$\begin{bmatrix} \Delta GDP_t \\ \Delta TRSCOM_t \\ \Delta EDU_t \\ \Delta HLT_t \end{bmatrix} = \begin{bmatrix} \alpha_0 \\ \alpha_1 \\ \alpha_2 \\ \alpha_3 \end{bmatrix} - \begin{bmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{23} \\ \beta_{31} & \beta_{32} & \beta_{32} & \beta_{34} \\ \beta_{41} & \beta_{42} & \beta_{43} & \beta_{44} \end{bmatrix} \begin{bmatrix} \Delta GDP_{t-1} \\ \Delta TRSCOM_{t-1} \\ \Delta EDU_{t-1} \\ \Delta HLT_{t-1} \end{bmatrix} - \begin{bmatrix} \gamma_{11} & \gamma_{12} & \gamma_{13} \\ \gamma_{21} & \gamma_{22} & \gamma_{23} \\ \gamma_{31} & \gamma_{32} & \gamma_{33} \\ \gamma_{41} & \gamma_{42} & \gamma_{43} \end{bmatrix} \begin{bmatrix} GDP_{t-1} - TRSCOM_{t-1} \\ TRSCOM_{t-1} - EDU_{t-1} \\ EDU_{t-1} - HLT_{t-1} \end{bmatrix} - \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \varepsilon_{3t} \\ \varepsilon_{4t} \end{bmatrix}$$

ISSN 2055-0154(Print), ISSN 2055-0162(Online)

Where $\dot{\varepsilon}_t$ is assumed $IN_4[\mathbf{0};\delta_{\dot{\varepsilon}}]$, and $\delta_{\dot{\varepsilon}}$ is the (positive-definite, symmetric) covariance matrix of the error process. When the four variable are I(1), whereas (GDP_t ,-TRC_t) (TRC_t -EDU_t) and(EDU_t -HLT_t) are I(0), then the latter describe co integrated relations, i.e., relations that are stationary even when the variables themselves are non-stationary. Co integration between the variables means that the four variables follow the same long run trends,

RESULT AND INTERPRETATION

Result

Regression Analysis

$$GDP_t = 312.7106 + 2.3762 Trc_t + 1.7382 EDU - 0.3076 HLT$$

$p-value =$ (0.0000) (0.0000) (0.0004) (0.6821)

$t-statistic =$ (27.3316) (5.0210) (4.0945) (-0.4142)

R-Square = 0.9511, Adjusted R-Square = 0.9455

F-statistic = 168.5231, P(F-statistic) = 0.0000

Unit root test on the residual of the regression model

Version of the Test	**model**	**t-statistic**	**P-value**
Random walk	$\Delta \mathrm{Re}\, s_t = -0.4726 \mathrm{Re}\, s_{t-1}$	-3.2046	0.0034
Random walk with drift	$\Delta \mathrm{Re}\, s_t = 2.4237t + -0.4738 \mathrm{Re}\, s_{t-1}$	-3.1621	0.0329
Random walk with drift and trend	$\Delta \mathrm{Re}\, s_t = 0.3224 - 3.3514t - 0.5005 \mathrm{Re}\, s_{t-1}$	-2.9480	0.1632

Co integration Test

Trace test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.759580	84.15714	47.85613	0.0000
At most 1 *	0.671209	44.24680	29.79707	0.0006

ISSN 2055-0154(Print), ISSN 2055-0162(Online)

At most 2	0.328660	13.10148	15.49471	0.1111
At most 3	0.067075	1.944048	3.841466	0.1632

Maximum Eigenvalue test

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.759580	39.91034	27.58434	0.0008
At most 1 *	0.671209	31.14531	21.13162	0.0014
At most 2	0.328660	11.15744	14.26460	0.1465
At most 3	0.067075	1.944048	3.841466	0.1632

Co integration Equation

$$GDP_t = -50.3609 Trc_t - 18.8467 EDU_t + 41.5289 HLT_t$$

Interpretation

The R square (0.9511) is the coefficient of determination. This measure of coefficient of determination showed that about 95.11% of variation in GDP can be explained by infrastructure. The adjusted R square (0.9455) is also the same with the R square. But the only difference is the fact that adjusted R-square is standardized measures which control the effects of any difference that may due to chance. that about 94.55% of what happened in the Economic Development (GDP) can be accounted for by the infrastructures while the remaining percentage is unaccounted for regression line and it's attributed to the factor included in the disturbance variable U_t. Examine the overall regression it is observed that the model is statistically significant at 5% level of significant, which shows that there is a relationship between the proxy of economic development variable and the capital expenditures on infrastructure. Also it can be find out that among the proxy of infrastructures that health is not statistically significant at 5% level of significant. The model s show that a unit increase in Transport &Communication and Education will increase GDP by 237% and 174% respectively but Health will reduces the GDP by 31%.

The result from the unit root test specified that the residual of the regression line is stationary at random walk only and random walk with drift but not stationary at random walk with drift and

ISSN 2055-0154(Print), ISSN 2055-0162(Online)

trend. From this, we can say, the regression model is not spurious. The co integration test show that the proxy of the Economic development and the capital expenditure on infrastructures has long run relationship (co integrated) since both trace and Eigen value test indicated that at least two equations are co integrated.

Statistically, the equilibrium error is zero, suggesting that GDP adjust to change in capital expenditure on infrastructures in the same time period. The co integration equation shows that short-run change in TRC and EDU have negative impact on short-run change in GDP and HLT has positive impact on GDP
One can interpret -50.3609 and -18.8467 (from co integrating equation) as short-run TRC and EDU; while the long-run TRC and EDU are given by the estimated equilibrium relation (from the regression model) as 2.3762 and 1.7382.

SUMMARY, RECOMMENDATION AND CONCLUSION

Though infrastructure is included as part of demand management policies, the focus of this study is to examine the role of infrastructure on economic development. The result from this study show that infrastructure impose highly significant impact on Nigeria economic development. Therefore to improve the qualities of life and to ensure increase in productivity, effective infrastructural delivery system in Nigeria should be put in place. It is, therefore, recommended that government should invest more on infrastructure in order to revitalize the existing facilities and services to wider segment of the state economy.

It can be concluded that the residuals from the regression of GDP and infrastructure is stationary. Hence, the regression model is not spurious. Individually, both GDP and measure of infrastructure are non-stationary. Therefore the regression model is a co integrating regression and its parameters can be interpreted as long-run parameters and hence, the model specified for their relationship will be suitable for prediction. For the correction of error with the co integrating equation, it can be observed that the short-run changes in infrastructure have a negative change on the short run changes in GDP.

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ISSN 2055-0154(Print), ISSN 2055-0162(Online)