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ICT and Long Run Growth in Nigeria (1970-2008)

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Abstract: This study empirically established the relationship between ICT and long run economic growth in Nigeria using Residual-based Engle-Granger-Dickey-Fuller cointegration test. The source of the data was mainly CBN statistical bulletin. The time series properties of the variable were investigated by conducting a unit root test using annual series data for the period 1970-2008 and found that variables employed were I(1) series with I(0) residual. The result was consistent with the previous results on ICT-growth analysis which revealed a productive contribution of ICT to economic activity in Nigeria. About 1% change in ICT component will lead to a 86% change in the mean of Gross Domestic Product (GDP) over the period of study. The implication of this for the policy makers is that firms and government should increase their budgets allocation on ICT in Nigeria.

Key words: ICT, GDP, ICT-growth analysis, budgets allocation, economic growth, Nigeria

INTRODUCTION

Undoubtedly, recent studies on Information and Communication Technology (ICT) have recognised its tremendous contribution to the way of life of people and nation's economy in general by enabling the production of goods in a short amount of time with the assistance of computerised systems. ICT which is defined as a set of activities that facilitated by electronic means the processing, transmission and display of information (Estavillo, 2004) has been recently considered as a catalyst for economic growth. By enabling virtual mobility, it provides the means of undertaking many of the activities that have so far needed physical transport (Lake, 2004). ICT through the use of electronic banking, electronic mail and electronic commerce has significantly reduced expenses on physical transportation that involved banking, sending of mail and buying of goods and services and in the process it enables the consumers to save money that would have spent on transportation thereby increasing their disposable income and reduces the business transportation costs.

The components of ICT include hardware, software and telecommunication equipment (Kaiser, 2004). ICT capital is superior to non-ICT capital in enhancing economic growth; a higher level of ICT capital stock per capital allows a typical economy to achieve a higher growth rate for given levels of growth in labour and capital inputs (Vu, 2004). In line with this position maintained by Khuong Vu, it is sometimes possible to say that it may not be how much capital you invest that makes a difference but rather how you invest it. In the modern sector of every economy of today, there is no firm even government without a budget on ICT. While there have been several studies on ICT and growth in the developed countries, only fragmented evidence have been provided to date to measure and analyse the long run relationship between ICT and growth in Nigeria. Thus, the sole objective of this study therefore is to investigate the hypothesis, there is no linear combination between ICT and growth and equally examine the long run impact of ICT on growth in Nigeria over the period of study. No known study based on this approach to the knowledge has been reported in Nigeria. It is this gap the study intends to fill.

Literature review: A number of studies have investigated empirically the effect of ICT on economic growth in both developing and developed countries. For example, Avegron (1998) mentioned that there is not much evidence to indicate that ICT is growth enhancing in most the developing countries.

However, recent studies have indicated that information and communication technology is crucially foe economic growth attainment and that there is a close linkage between productivity growth and technology progress (Nicoletti and Scarpetta, 2003; Daveri and Siliva, 2004).

The empirical study of Jorgenson (2001) revealed that investment in Information Technology (IT) contributed more than one-half of the recent increase in the US economic growth. Also, Kraemer and Dedrick (1994) employed data from 43 countries, upheld the view that the growth of IT investment is correlated with productivity growth.

The study of Oulton (2002) of the United Kindom revealed that in the beginning and later part of 1990s, ICT contributed 0.36 and 0.57% to GDP growth, respectively.

General-purpose technologies like the stream engine, electricity and ICT in terms of ancillary investments in new product, processes and organisational technologies have created advantageous chance which would not have existed without the general-purpose technologies which often sustain economic growth (Lipsey and Carlaw, 2004). The empirical study of Plepys (2002) concludes that general-purpose technologies's contribution to economic growth has been due to improvements in labour resource and capital productivity and through organisational and technical innovations. Kegels *et al.* (2002) discovered that the accumulation of ICT capital in Belgium has a significant impact on output growth and average labour productivity growth. Colecchia and Schreyer (2002) study on the US and OECD countries discovered that during the second half of the 1990's, ICT's contribution to economic growth ranged between 0.3-0.9% per year.

The empirical study of CEPII (2003) on France showed that in the early 1990s to the mid 1990s, the contribution of ICT to capital growth is increased from 0.25-0.45%. Jonas and Gibbs (2003) conducted studies in the Cambridge sub region of the UK also revealed that there is a link between the existence of a cluster of Information Communication Technology (ICT) based companies in the sub region and the area's fastest growth rate and the lowest unemployment rate in the Eastern region. The study of Seo and Lee (2000) in Asia on Korea found a significant contribution from ICT investment. They maintained that given the enabling socio-economic environment, ICT would provide the platforms on which the growth in productivity, innovation and social well-being can be constructed. Van Ark (2002) revealed three main channels of ICT-led economic growth namely, the effect of productivity growth of ICT-producing firms, the adoption of ICT and its productive use in the other sectors of the economy and the spin-offs from ICT in term of the inventions and innovations that emerge in the wake of ICT diffusion. Dewan and Kraemer (2000) gathered data from 36 countries for 1987-1993 and concluded that IT capital is positively correlated with labour productivity in developed countries but not in the developing countries. Daveri (2001) conducted an empirical study for 18 OECD and European Union (EU) countries and found that IT's contribution to GDP growth in the 1990s was significant but the contribution in EU countries was not greater than that of the industrialized countries. As demonstrated by Kim *et al.* (1997) warned that telecommunication infrastructure is also a little different from other infrastructure as a determinant of economic growth because of the existence of network externalities, a phenomenon that increases the value of a service with increase in the number of users. As a result, the impact of telecom infrastructure on economic development is more pronounced as compared to other traditional infrastructure. They did an analysis of online service competition and found that there exists a negative network externality which was fallout from congestion and this affects the subscription level of telecom services at the particular moment, although it forces service providers and regulators to accelerate the investment in telecom infrastructure.

While it is accepted generally that the acquisition of necessary technology is important for improving productivity and growth, the problem of unemployment that emanated from its introduction in the business process has been recognised as one of the defects of the rapid adoption of ICT in the developing countries (Meng and Li, 2002).

MATERIALS AND METHODS

Model specification: Despite the empirical support for the positive relationship between ICT and economic growth, the measurement method of ICT in terms of its growth and contribution to economic growth have raised a lot of question (Van Ark, 2002).

Following the previous studies, the appropriate model in the context of endogenous growth model as the interest of this study lies in the long run impact of ICT on growth is specified. The number of capital is narrow down to only three; physical capital, human capital and ICT capital. Production is assumed to follow a Cobb-Douglas production function of the form:

$$Y_t = f(X_t) \quad (1)$$

Expressing Eq. 1 specified above in linear form gives:

$$Y_t = \alpha+\eta X_t+u_t \quad (2)$$

Obtaining logarithmic transformation of Eq. 2 yields:

$$\log Y_t = \alpha+\eta \log X_t+u_t \quad (3)$$

Equation 3 is written alternatively as:

$$y_t = \alpha+\eta x_t+u_t \quad (4)$$

Where:

y_t = Growth elasticity in t period
x_t = Elasticity of ICT capital which captured the share of telecommunication in t period
α = The intercept
u_t = Residual in t period
η = Measures parameter efficiency and the aprori expectation is $\eta>0$

Table 1: ADF test

	At level			At 1st difference			
Variables	Intercept	Intercept with trend	None	Intercept	Intercept with trend	None	Order of integration
Log Y	0.10791	-1.576390	7.08400	-5.35053	-5.28933	-2.89479	I(1)
Log X	1.93298	0.036371	4.09805	-5.25138	-5.87780	-4.26447	I(1)
Lresid	-	-	-2.12917*	-	-	-	I(0)

*Denotes significance at 5% level of significant

Table 2: Long run regression analysis (dependent variable, Log Y)

Variables	Coefficient	SE	t-statistic	Prob.
Constant	7.714924	0.432361	17.84370	0.00000
Log X	0.863193	0.068241	12.64926	0.00000

R^2 = 0.81218; Adjusted R^2 = 0.80711; F-statistic = 160.0037; Prob. (F-statistic) = 0.000; Schwarz criterion = 3.24040; Durbin Watson stat. = 1.56464

Estimation techniques: Since data employed are time series, we therefore used an Ordinary Least Square (OLS) method of estimation. In other to avoid spurious result, we 1st test for the order of integration of the individual series by conducting unit root test for stationarity. According to Engle and Granger (1987), a non-stationary series is said to be integrated of order d if it can be made stationary by differencing it d times; expressed as X_t~I(d). After confirming firstly that the series are generated by 1st order autoregressive process, i.e., AR(1) of the form:

$$y_t = y_{t-1} + \varepsilon_t \quad (5)$$

Because of the possible autocorrelation, the Eq. 5 is extended to allow for AR(n) process yielding Augmented Dickey Fuller (ADF) test of the term:

$$\Delta y_t = \beta y_{t-1} + \sum_{i-1}^{n} \beta_i \Delta y_{t-i} + \varepsilon_t \quad (6)$$

Where:

y_t = A particular variable
β = Parameter
ε_t = Error terms assumed to be white noise, i.e., ε_t~IID $(0, \sigma^2)$

The interest of the study is to establish a linear combination of ICT and growth and equally examine the long run impact of ICT on growth in Nigeria, therefore the study adopts Engle-Granger-Dickey-Fuller (EGDF) cointegration test. This cointegration test was developed by Engle and Granger (1987) and they show that if after using either Dickey-Fuller (DF) or Augmented Dickey-Fuller (ADF) unit root test, the variables in the regression model are I(1) and the residual component obtained from the regression is I(0), there is a linear combination (long-run relationship or equilibrum) between or among the variables in the model. For y_t and x_t to be cointegrated, u_t must be I(0); otherwise the regression is spurious. Thus, the basic idea behind the Engle-Granger cointegration test is to test, whether u_t is I(0) or I(1). After the application of ADF unit root tests on the variables in Eq. 2, we then perform OLS on the equation and obtain the residuals as shown as:

$$\hat{u}_t = y_t - \theta - \tau x_t \quad (7)$$

and then apply ADF unit root test to $\hat{u}_t$ which assumes AR(1) and is of the form :

$$\Delta\hat{u}_t = \delta\hat{u}_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta\hat{u}_{t-1} + \varepsilon_t \quad (8)$$
$$(i = 1, ..., p; \delta < 0; H_0 : \delta = 0)$$

The null hypothesis expressed in Eq. 8, test for no cointegration. Thus, if δ is statistically different from zero, we may reject the null hypothesis suggesting that there is cointegration between the two variables; otherwise, we may not reject it. If the null hypothesis is rejected, the regression is regarded as a cointegrating regression β is known as the cointegrating parameter. If the variables are cointegrated, the regression is no longer spurious despite the fact that the variables are I(1). However, if these series are not cointegrated the resulting regression will be spurious.

Unit root tests and regression analysis: Taking into consideration, the steps suggested in the previous section, we start by testing for the order property of the variables of our interest, Augmented Dickey Fuller was employed. All variables are regarded as non-stationary at their levels since each reported absolute t-value is not >5% critical values of ADF with a sample size of 39. The null hypothesis of non-stationary is not rejected for all the series investigated in level. Summarily, the results of these tests are shown in Table 1, these suggest that there is the presence of a unit root in each of the variable investigated but the residual generated is stationary at level as shown in Table 1 and 2.

CONCLUSION

The main focus of this study was to examine the impact of ICT on long run growth in an opened economy, Nigeria. The study made used of secondary data which were obtained from statistical bulletin published by

Central Bank of Nigeria form 1970-2008. In the empirical analysis, the Residual-Based Engle-Granger-Dickey-Fuller test procedure was employed to show that there is a long-run relationship between growth and ICT.

RECOMMENDATIONS

Given the non-stationary of the series, the study found that the residual is stationary at level. This suggests that the null hypothesis; no linear combination between growth and ICT components in Nigeria is not accepted. The study therefore, proceeded by regressing growth on ICT component, the result showed a positive relationship between ICT and growth in Nigeria over the period of study. About 1% change in ICT component will lead to a 86% change in the mean of Gross Domestic Product (GDP). The coefficient of determination, R^2 which gives the proportion or percentage of the total variation in the dependent variable GDP explained by the regressor, ICT. Thus, the close is R^2 to one; the better the fit of the model which is 81%. Durbin-Watson is approximately 2 which suggest absence of 1st order serial correlation. The implication of this is that Nigerian government increase its budget on ICT as it is crucial for attainment of long run economic growth. However, within the time and data constraint, the study provides a platform for further empirical research in determining the effects of information and communication technology at its component level and adopting broader variable proxies for the ICT sector.

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