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Information Communication Technology (ICT) and Productivity vis-à-vis Economic Growth in Nigeria (2000-2015).

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ABSTRACT

The study empirically studied the effect of investment in Information Communication Technology (ICT) national productivity vis-à-vis economic growth in Nigeria. The study adopted the ex post facto design which is a design that relies essentially on secondary data. The ordinary least square technique was used for data estimation covering the study period between 2000 and 2015. The result of the study showed that investment in ICT has positive and significant effect on productivity, hence improved economic growth. In other words, the results revealed that public expenditures in ICT has a significant and positive impact on ICT output production in Nigeria, hence increased productivity for improved economic growth. In the same note, investment in ICT has significant and positive effect on foreign capital flows in Nigeria for greater productivity. But in the contrary, investment in ICT has no significant and positive effect on labour inputs as measures of national productivity in Nigeria. The implication is that foreign private capital flows boost public expenditure which makes capital available for investment in science and technology which will increase the ICT output and overall economic growth. The paper therefore suggests that if the government of Nigeria wants to enhance productivity needed for improved economic growth, there should be need for the government implementation of policies that facilitate and encourage ICT development.

Keywords: Economic Growth, ICT, Nigeria, Foreign Capital flows, Labour inputs.

INTRODUCTION

The flow of external finances into emerging economies helps a lot in bridging the gap between savings and investment gap in such economies. Such capital inflows via resources are desirable in low income countries because they add up with domestic resources to encourage investments especially by domestic entrepreneurs. This movement of capital resources from one economy to another is very rampant in developed countries and can easily be achieved through information communication technology (ICT). Though, many emerging countries have keyed into using ICT to encourage inflows of foreign capital to aid investment which is necessary for economic growth and development. Udoidem and Udofot (2013), [1], noted that the effort started in developed countries like US, UK, Germany etc in the mid 1950s and has been a continuous process, spreading into emerging economies like wide fire.

All the developed economies are parts of the move and have improved greatly in making their economies ICT-driven and friendly. Good enough, Nigeria has joined the rest of the other developing countries to formulate many policies geared towards the increase in foreign capital inflows. Today, these flows of financial resources across the globe are being made easy through the introduction of information communication technology (ICT) development in almost all the economies of the world. Both financial system activities and business activities have been globalized in recent time via ICT as every economy is now ICT-driven. This process of allowing free flows of finances, businesses and loanable funds across the globe through ICT is known as globalization. In support of this assertion, Muller-Falk, (2001), [2], explained that the process of financial globalization involves the use of information communication technology devices.

ICT device is characterized by easy usage and advancement in electronics, computers, telecommunications and internets. To buttress this fact, Lal, (1996). [3], noted that the era of globalization has brought about with it the

rapid spread and application of computers, the internet, satellite and the mobile phones innovations in the world to aid easy flows of financial products and the stuffs across the globe. This move is currently intensified particularly in Nigeria and other developing countries where communication has been difficult and technology devices were inadequate in both urban and rural areas. Now the availability of these devices made it very easy and possible for even the emerging nations' financial markets, financial institutions and businesses to interact freely at shortest possible time [4]. They aid easy and quick flows of financial and business information across the globe by making the world a global village. These electronic devices are playing vital roles in allowing foreign private capitals to flow from one country to another. Foreign direct investment (FDI) is communized through improvement in ICT devices as countries find interaction of business and financial ideas and products very easy at affordable efforts. Presently, with the introduction of electronic devices like mobile phones and internet connectivity many urban and some rural areas now have access to communication facilities and they communicate easily with the rest of the world. All and sundry both in emerging and developed economies who want to do international business now have access to foreign direct investment in any part of the world through the help of ICT development [5]. Thus, since globalization involves free flow of foreign capital, investments in the mediums of transaction become important in many developing countries including Nigeria.

Granville et al. (2000), [6], acknowledged that ICT is the combination of electronics, telecommunications, software, networks, and decentralized computer network stations and the integration of information media which impact firms, industries and the economy as a whole. ICT is an umbrella term that includes device and technologies such as radio, television, cellular phones, desktop, laptop, palmtop, iPad computers, software, peripherals and connections to the internet as well as services and applications associated

with them [6]. All these devices intend to facilitate information processing and communications functions as well as internet world stats. Oleka (2012), [6], supports this fact by stating that ICT is comprised of a variety of communication equipment which includes radio, TV, and communication equipment and software. In support of this acknowledgment, Derrick et al. (2003), express that ICT investment includes investments in both computer and telecommunications as well as in related hardware and software services. They noted that the usage of information and communication technology in Nigeria has been an everyday activity in recent times unlike before. This development in ICT includes electronic trading which involves the use of mobile phones in trading which gradually replaced the NITEL old style of communication which was time consuming and energy sapping compared with what we have today [7]. Others include internet services where every day businesses turn into electronic packaging in which all transactions have become online.

Today, through the internet you order online, pay online and your good delivered online perfectly at shortest period at minimal cost. Today transactions with foreign countries are easily carried out online, messages are sent across to loved ones, emails to donor agencies for financial support with instant replies, etc. The contributions and roles of ICT development in the economy are very amazing and uncountable. With the introduction of CBNs Cashless Policy in Nigeria, there is an improvement on ICT for easy commercial and financial activities in Nigeria. Hence, investing in ICT is a welcome pack as it will not only increase the growth rate of our economy but prepare us to stand tall amidst the developed economies of the world in the ongoing financial and business globalization. On this note, Nigerian government is in the right track in investing in ICT development as such investment on ICT is very crucial for economic growth. Government investment in ICT is expected to produce efficient use of labour and foreign capital resources for greater productivity for improved economic growth [8]. Hence, such investment on ICT is a right step in a right direction as the

outcome is expected to improve economic growth and development in Nigeria. Government investment on ICT is desirable as the gain is amazing in encouraging the flows of capital into and out of countries for economic growth and development. This move is described by Okogun, Awoloye, and Siyanbola (2012), [8], as one of the ways in which the capital stocks of any country especially the emerging economies grow by enabling new technologies to enter the productive process.

Statement of the Problem

It can be seen from the studies carried out by other authors on this topic or similar topic that the data for their analyses have not covered recent estimates. Hence, the contribution of this study is to fill the gap in knowledge in terms of the estimation techniques employed, which includes dummy that incorporates the ICT reform periods in Nigeria and the data used which is extended to 2015. Equally there is a lack of consensus regarding the empirical evidence on the literature as per the relationship between ICT and economic growth. While the results of some studies provide strong support for the hypothesis, the evidence from others is either contradictory or inconclusive. These arguments have created a gap in literature as it has not been settled empirically in Nigeria whether ICT impacts negatively or positively on economic growth; hence this study is set to fill the gap.

The broad objective of this study is to examine the effect of public investment in ICT on the promotion of economic growth in Nigeria. The specific objective is to determine the effect of ICT on labour input and foreign capital inflows in Nigeria.

To achieve these objectives, the paper hypothesized that public investment on ICT has no significant and positive effect on economic growth and that investment on ICT has no significant and positive impact on labour input and foreign capital inflows in Nigeria. The remaining part of the paper is structured thus: section two reviews the related literature, section three looks

into the methodology; section four presents and interprets the data and lastly section five gives summary of findings, conclusion and recommendations.

Methodology

The study adopted the *ex post facto* design which is a design that relies essentially on secondary data. This is more appropriate for this study because of the historical and trend analysis. The study is designed to use econometric models in the analysis and as such is both a time serial and cross-sectional study therefore is designed to use panel data. The data for the empirical analysis were obtained from various issues of Statistical Bulletin published by the Central Bank of Nigeria. In this work, ordinary least square was applied as seen in the previous studies like Olalekan (2013) which employed ordinary least squares with data from 1980-2010. Our study period covers from 2000 to 2015.

Model specification

It is postulated in literature that investment in ICT is expected to produce efficient use of labour and capital resources for greater productivity or technical change. The equation for this postulation can be mathematically expressed thus:

$$X = f (FC, LIT, g) \dots\dots\dots 1$$

Where: X = ICToutput; FC = foreign capital input; LIT = labour inputs; g = greater technical change.

However, the mathematical specification of the model for our study is presented below as seen in the work of Olalekan (2013) thus:

$$ICTGDP = f (ICTEXP, FCAIF, LABIPT, ICTREFORMDUMMY)\dots\dots\dots 2$$

Thus, the error correction model for this study was based on the residual based co-integration (Engel-granger approach) which can be specified as:

$$\begin{aligned} \text{LOG}(\Delta \text{RGDP})_t &= \alpha_0 + \alpha_1 \sum_{b=1}^p \text{LOG}(\Delta \text{REFORMDUMMY})_t + \alpha_2 \sum_{c=1}^p \text{LOG}(\Delta \text{ICTEXP})_t + \\ &\alpha_3 \sum_{d=1}^p \text{LOG}(\Delta \text{FCAIF})_t + \alpha_4 \sum_{e=1}^p \text{LOG}(\Delta \text{LABIPT})_t + \alpha_5 \text{ECM}_{t-1} \dots\dots\dots 3 \end{aligned}$$

$$\begin{aligned} \text{LOG}(\Delta \text{RGDP})_t &= \alpha_0 + \alpha_1 \sum_{b=1}^p \text{LOG}(\Delta \text{ICTEXP})_t + \alpha_2 \sum_{c=1}^p \text{LOG}(\Delta \text{FCAIF})_t + \\ &\alpha_3 \sum_{d=1}^p \text{LOG}(\Delta \text{LABIPT})_t + \alpha_4 \sum_{e=1}^p \text{LOG}(\Delta \text{REFORMDUMMY})_t + \alpha_5 \text{ECM}_{t-1} \\ &\dots\dots\dots 4 \end{aligned}$$

Where:

RGDP = Real Gross Domestic Product, ICTEXP = Total Expenditure on ICT, FCAIF = Foreign Capital Inflows proxied for foreign direct investment, LABIPT = Labour Input, α_0 is a constant and REFORM DUMMY = is the ICT reform dummy taking 0 for periods before the ICT reform (1981-2000) and 1 for post ICT reform period (2001-2015). If the residuals are stationary and a long run relationship is established, then the error correction estimates can be obtained from the equation. On that note, if the unit roots test indicates evidence of co-integration, then the equation translates to an error correction model (ECM).

Presentation and Analysis of Results

Unit Root Test Equation

The variables of this study were subjected to non-stationary test using the Augmented Dickey fuller (ADF) testing procedures. The unit root test regression equations with constants are;

$$\begin{aligned} \Delta (\text{RGDP})_t &= \alpha_0 + \alpha_1 (\text{RGDP})_{t-1} + \sum_{T=1}^m \rho_i \Delta (\text{RGDP})_{t-1} + \mu_t \\ &\dots\dots\dots 5 \end{aligned}$$

$$\Delta (\text{ICTEXP})_t = \alpha_0 + \alpha_1 (\text{RGDP})_{t-1} + \sum_{T=1}^m \rho_i \Delta (\text{RGDP})_{t-1} + \mu_t$$

.....6.

Table 1: ADF Unit Root Test Results

Variable	ADF test statistics at level	5% critical value	ADF test statistics at 1 st difference	5 % critical value	Order of integration
Log(GDPICT)	1.1788	-0.9886	-5.9664	-1.8688	I(1)
Log(EXPICT)	-2.3898	-2.6753	-6.2682	-1.8847	I(1)
Log(LABF)	-5.8864	-1.8626	-6.0874	-1.7732	I(1)
Log(FCAF)	-0.2424	-1.8211	-4.8488	-1.8898	I(1)
Residual	-8.1204	-1.8840	-	-	Co-integration

Source: Authors Computation 2016

From **table 1** it was revealed that using the ADF techniques, all the variables are integrated at order one as the residuals from the estimated level series of the regression models is integrated of order zero, showing co-integration.

Table 2: FCAF and ICT Investment Relationship for Long-run Effect

Dependent Variable: Log(ICTGDP)			
Variables	Coefficient	T-statistics	Probability
Constant	73.1251	0.3614	0.0100
REFORMDUM	1.2302	11.1122	0.0000
Log(ICTEXP)	0.1211	2.7253	0.0001
Log(FCAF)	0.3646	4.0884	0.0010
Log(LABF)	-16.1424	-1.4726	0.0132
R-squared = 0.8628			
Adj R-Squared = 0.8584			
F-Statistics =	145.385	F-prob. =	0.0000
Durbin-Watson Statistics = 1.3			
Heteroskedasticity: F-statistic =	0.38	Probability =	0.0501
Ramsey RESET test: F-statistic =	3.27	Probability =	0.2322

Source: Author's Computation 2016

Table 2 which displayed the long-run equation result, showed that the model is well fitted with R2 of 86%, indicating that 86% of the variations in log of ICT output were explained by the independent variables of foreign capital inflows. The "F" statistic is significant at 5 percent level of significance, thus confirming the overall significance of the model. The Durbin-Watson statistic is (1.3) which is very close to the '1' benchmark of autocorrelation test which therefore was an indicative that the analysis is free from autocorrelation errors. The hypothesis of omitted variables and no Heteroskedasticity is rejected, as both of them fell below 5% which is the significant level.

Table 3: FCAF-Output and ICT Investment Relationship for Short-run Effect

Dependent Variable: DLog(ICTGDP)			
Variables	Coefficient	T-statistics	Probability
Constant	-0.1357	-1.0813	0.1668
REFORMDUM	0.3553	1.3122	0.0113
DLog(ICTEXP,1)	0.3132	2.2323	0.0013
DLog(FCAF,1)	-0.2113	-1.3124	0.1511
DLog(LABF)	25.1212	0.7534	0.0000
ECM (-1)	-1.1103	-3.6623	0.0001
R-squared = 0.5411			
Adj R-Squared = 0.4836			
F-Statistics = 5.7112		F-prob. = 0.0001	
Durbin-Watson Statistics = 1.84			
Heteroskedasticity: F-statistic = 4.54		Probability = 0.1020	
Ramsey RESET test: F-statistic = 6.43		Probability = 0.1004	

Source: Author's Computation 2016

Table 3 emphasizing on the short-run equation admitted that the model is well fitted with R² of 54%, showing that 54% of the variations in log of ICT output in the short-run are explained by the independent variables labour output and foreign capital flows. The “F” statistic of (5.71) is significant at 5 percent level of significance, thus confirming the overall significance of the model. The model's DW statistic shows the model's predictive ability to be good. With DW statistic 1.84 close to 2, it implies that the model's has no first order auto correlation (that is model's error term is not serially auto

correlated) and it implies positive serial correlation. More so, the hypothesis of the omitted variables vis-à-vis no heteroskedasticity is rejected, as they both failed to be significant at 5% level. Also, the coefficient of the ICT reform dummy is positive and significant; indicating that economy has improved after the introduction of ICT reform in the country to confirm that the periods after the reform are better than periods before the reform. However, in the short-run, ICT expenditure also has a positive impact on ICT output in Nigeria. Thus, the objective of the study is achieved both in the long-run, which implies public expenditure on ICT has a significant impact on ICT output production in Nigeria.

To validate the hypotheses, the multiple regression panel data estimation model was adopted because of its adjudged appropriateness for adjusting for the presence of heteroskedasticity. Thus table 4 presented the analysis.

Table 4 -Correlation Results of Investment in ICT and National Productivity

		ICTEX P	LOGR GDP	LOGF CAF	LOG LABI P	LOG RDU MM Y	ICTE XP/R GDP	ICTE XP/F CAF	ICTE XP/ LABI P
ICTEX P	Pearson Correlation	1	-	-	.638	-	-.040	-	-
	Sig. (1-tailed)		.000	.000	.000	.000	.121	.007	.133
			.655**	.539**	**	.209		.087*	.038
					**	**		*	
LOGR	Pearson	-	1	.404**	-	.527	-.010	.003	.011
	n				.880				

GDP	Correl ation	.544**			**	**			
	Sig. (1- tailed)	.000	.000	.000	.000	.178	.341	.155	
LOGFC AF	Pearso n Correl ation	- .428**	.404**	1	- .404**	- .126**	.033	.138* *	.025
	Sig. (1- tailed)	.000	.000	.000	.000	.001	.158	.001	.112
LOGLA BIP	Pearso n Correl ation	.527**	- 880**	- .404**	1	- .520**	-.018	.006	- .011
	Sig. (1- tailed)	.000	.000	.000	.000	.000	.187	.311	.160
LOGR DUMM Y	Pearso n Correl ation	- .108**	.527**	- .126**	- .520**	1	.012	- .112* *	.026
	Sig. (1- tailed)	.000	.000	.001	.000	.148	.000	.143	

ICTEX	Pearson	-.030	.010	.033	-	.012	1	.012	.886
P/RGD	n				.018				**
P	Correlation								
	Sig. (1-tailed)	.121	.148	.158	.187	.148		.153	.000
ICTEX	Pearson	-	.003	.138**	.006	-	.012	1	-
P/FCA	n	.076**				.112			.030
F	Correlation					**			
	Sig. (1-tailed)	.007	.340	.001	.310	.000	.152		.120
ICTEX	Pearson	-.027	.011	.025	-	.026	.886*	-.030	1
P/LABI	n				.011		*		
P	Correlation								
	Sig. (1-tailed)	.033	.155	.102	.160	.143	.000	.020	

Source: Authors' Computation 2016

**Correlation is significant at the 0.05 level (1-tailed).

It should be re-emphasized that the sign of the correlation coefficient indicates the direction of the relationship either positive or negative. While the absolute values of the correlation coefficient indicate the strength of the relationship the larger absolute values indicate stronger relationships. The significance level or **p-value** shows the probability of obtaining results as extreme as the one observed. If the significance level is very small (less than 0.05) then the correlation is significant and the variables are linearly related. But when the significance level is relatively large, then the correlation is not significant; and the variables are not linearly related. Even if the correlation between the variables is not significant, the variables may be correlated but the relationship is not linear.

Therefore, it could be seen from **table 4** that the influence which investing in ICT has on real gross domestic product is significantly negative (-0.010) but linear as shown with their correlation coefficients thus: -0.010, 0.003 and 0.011 for ICTEXP/RGDP, ICTEXP/FCAF and ICTEXP/LABIP respectively. This means that though investment in ICT may improve labour input and foreign capital flows but the noticed impact on the real gross domestic product proves nearly the contrary.

However, the relationships between the investment on ICT and foreign capital flows invariably indicates that there is a stronger positive relationship between investment in ICT and foreign capital flows which is a variable used to proxy foreign direct investment. This is an indication that the government expenditure in ICT is not a waste as it has brought about increase in foreign capital accumulation as shown by positive correlation coefficients of the variables in use. Though, the result showed that the relationship between the expenditure on ICT and foreign capital flows is stronger than that of labour input via ICT. This was more noticeable in the greater productivity or technical changes that have taken place in the economy as a result of ICT initiative, thereby showing a significant relationship with national

productivity. This is arguably so, since the government expenditures on ICT are supposed to be able to improve labour inputs and attract foreign capital into the country for greater productivity.

From the result, it was revealed that the more the inflows of foreign capital through ICT investment, the higher the level of national productivity. Overall, the relationship between labour input as a measure of national productivity and investment in ICT is significantly positive and linear as shown with their correlation coefficients of: 0.033, 0.138 and 0.025

for ICTEXP/RGDP, ICTEXP/FCAF and ICTEXP/LABIP respectively.

The relationship between investment in ICT and labour input as a measure of national productivity is negative but linear with coefficients of -0.018, .006 and -.011 for ICTEXP/RGDP, ICTEXP/FCAF and ICTEXP/LABIP respectively. The result showed that Investment in ICT has negative but significant impact on labour input. It was also noticed that the relationship between investment in ICT and foreign capital flows as measures of national productivity is positive and significant. Thus, these are indicatives that investment in ICT contributes to increase in foreign capital inflows in Nigeria but the impact is not felt much on labour inputs as measures of national productivity. In other words, the result found that the relationship between expenditure in ICT and foreign capital inflow as a measure of FDI was stronger than that of investment on ICT and labour inputs.

DISCUSSION OF FINDINGS

The overall result revealed that there are significant relationships whether negative or positive which investing in ICT has with the different economic performance measures applied in this work for the period under study. The result showed that all the variables except labour inputs have a significant impact on log of ICT investment in Nigeria for the periods under review. The outcomes met our apriori expectations with only an unexpected outcome of labour inputs which is negative but linear. Equally the result revealed that the

coefficient of expenditure in ICT in Nigeria is positive and significant at 5% levels of significance thereby meeting up with our apriori expectation which expected ICT investment to be an important determinant of increased national productivity vis-à-vis economic growth in Nigeria which the result upholds.

Also, the coefficient of the ICT reform dummy is positive and significant; indicating that ICT outputs has improved after the introduction of ICT reform in the country to confirm that the periods after the reform are better than periods before the reform. This finding is in line with the result of the work of Jhingan (2000), [9] which found out that public expenditure makes capital available for investment in science and technology which would increase productivity and overall economic growth. Hence, investment in ICT is expected to produce efficient use of labour and private capital resources for greater productivity. In further agreement with our findings is the empirical study of Solow which revealed that disembodied technical change in inputs augmentation in an ICT-driven economy is more productive under efficient use of foreign capital flows and labour inputs. Though, his finding is in total contrast with the findings of many authors which faulted the introduction and usage of ICT on the ground that it has with it its numerous advantages which have been a source of most advanced frauds that impede economic growth of many countries. They argued that most of government secrets plans and programmes are hacked by the use of ICT devices to the extent that government efforts and plans are thwarted even at the bud stage. These and others are charges levelled against ICT which made many authors to argue that ICT has negative effect on economic growth and development. Yet others refuted this by arguing that ICT has significant and positive effect on productivity, hence improved economic growth. For instance, the empirical study of Chowhury, (2000), [10], argues that there is no direct relationship between foreign capital inflow, ICT investments and national productivity; therefore ICT has no significant and positive effect on economic growth during the period studied. But the results of the study of Harchaoui, Tarkhani, Jackson, & Armstrong (2002), [11], disagreed with this and have

argued that there could be a link where external capital inflows boost investment in ICT vis-à-vis productivity, hence improved economic growth. Our own findings are summarized as shown under the sub-heading '**summary of findings**' thus:

CONCLUSION AND RECOMMENDATIONS

The study empirically studied the relationship between investment in ICT and productivity vis-à-vis economic growth in Nigeria. The ordinary least square technique was used for data estimation and the result revealed that public investment in ICT has significant and positive effect on private capital input as measures of productivity in Nigeria. The implication is that private capital inputs boost public expenditure which makes capital available for investment in science and technology which will increase the ICT outputs, hence increased productivity needed to improve the overall economic growth. The paper suggests that if Nigeria wants to improve productivity to enhance the economic growth, there should be need for the government implementation of policies that should facilitate and encourage the more ICT development. This recommendation is worthwhile since the ICT investments made by the public sector seem to have contributed significantly to the country's growth via improved private capital inputs for productivity. However, in order to sustain such economic growth leveraged against ICT, more concerted efforts need to be made to increase ICT investment diffusion in the country. Such initiatives will ensure that the value potential of ICT investments in the economy is maximized, due to greater ICT-enabled potential that can translate to economic growth. Summarily the major policy recommendation that emerges from this study is the need for government to put in place the policies that would promote stable and conducive macroeconomic environment, which would encourage foreign capital inflows into Nigeria through ICT driven economy.

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