Information and Communication Technology and Bank Performance in Nigeria: A Panel Data Analysis

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Abstract

This study examines the impact of Information and Communication Technology (ICT) on banks performance in Nigeria using annual panel data set over 2001 to 2011 periods. The data was analysed using panel unit root, panel cointegration, Fully Modified Ordinary Least Square (FMOLS) and Generalised Method of Moments (GMM) to reveals a positive impact of ICT on banks performance in the country. Therefore, the study concludes that cautious application of ICT apparatus will continue to enhance commercial banks performance in the country unless otherwise disrupted by externalities. The implication of this finding exposes the potentiality of cashless economy in Nigeria for strengthening the efficacy of financial system. Accordingly, the Central Bank of Nigeria' cashless policy is an initiative at the right direction since it will help in minimising the cost of issuing currency in the fairly performing Nigerian economy. We recommend that there is the need for orienting the populace about the benefit of ICT product on banking operation in particular and the economy in general. In order to promote more patronage of ICT equipments on the one hand and enhance banking culture on the other hand, concerted efforts must be made to translate the ICT device language into the major local languages so that client can find it user-friendly at the midst of prevailing high rate of illiteracy in the country .

Keyword: Bank, financial system panel data, information and communication technology

JEL Classifications: G210, C22, Z19

I Introduction

It is widely recognised that the financial system plays a crucial roles in promoting economic development by separating the saving and investment functions. Virtually,

investment in all sectors of the economy, particularly the real sector, made possible by the financial resources in the financial system, could increase the quantum of goods and services (Ibrahim, Muhammad and Gani, 2012). Banking institution which is a major player of the financial system is important economic agent in the payment system. Accordingly, bank facilitate economic transaction between various national and international economic units and by so doing, it encourages trade, commerce and industry on the one hand, promoting globalization by easing global access to fund without any barrier.

It is needless to say that, banking system is able to play the positive role of enhancing globalization only if it has robust Information and Communication Technology (ICT) as a backstopped. Otherwise, it would constitute bad omen to the development of global economy. This is based academics unanimity of impossibility of globalisation without global agents of payments. The increased demand for ICT in banking sector became imminent and unavoidable in the world at large and Nigeria in particular. Invariably, the future lies in the ICT driven banking systems and services. Banks have embarked on unprecedented deployment of ICT based banking products and services such as Automated Teller Machine (ATM), internet banking, mobile banking solutions, point of sale terminals, computerised financial accounting and reporting, human resources solution among others, of which plays salient roles in enhancing the performance of banks over the world (Ovia, 2005).

Eventually, the ICT became the lifeblood of any corporate organisation for growth and development thereby making the entire world moving away from traditional banking to computerised banking applications. Consequently, there has been huge investment in ICT facilities and personnel with requisite skills necessary for the operation of ICT born devices. Banks have been facing the stiff challenges of required hefty fund for investments in human capital, capacity building, deployment of equipments, designing applications, etc due to the ever rapid changing in ICT devices as a result of breakthrough on the one hand and the dynamism of the global ICT industry on the other hand (Abubakar, Gatawa and Birnin-kebbi, 2013). Over the years, banks have invested huge capital in deployment of ICT solutions for front office and back office automation alike. However the ever-increasing challenges of ICT deployment in conformity with the banking best-practice had remained a burning issue in the banking industry and so need to investigate its relevance on banks performance becomes imperative. It is against this background that this study sets to investigate the role of ICT in bank performance in Nigeria. To achieve the thrust of this study, five sections were developed including this introduction which is section one. Section reviews literature. Section is the methodology of the study. Section presents and discusses the results and the last section concludes the study.

II Literature Review

Like any other social sciences problem, findings from preceding studies on the impact of ICT on the banking sector in both developed and Less Developed Countries (LDCs) produces divergence results. For instance, Dos Santos and Peffers (1993) empirically

studied the effects of early adoption of ATM device by banks on employee efficiency using a sample of 3,838 banks covering the period 1970 to 1979 by applying multiple regression model. The finding revealed that the introduction of ATM device improve the banks performance. By extension, Beccalli (2005) investigated whether investment in Information Technology (IT) influences the performance of banking, using a sample of 737 European banks over the period 1994 – 2000. Using simple correlation coefficients, the findings revealed a negative and statistically significant correlation between profit efficiency and IT.

Following post-democracy banking reforms in Nigeria which triggered unprecedented application of ICT in banking sub-sector, Evans, (2008) investigates the role of ICT on enhancing the operations of Nigerian banks using primary data which was analyzed with cross-tabulations and regression technique to reveals a significant positive impacts of ICT on banking operations. Lin (2007) studied the impact of ICT on U. S. banking industry using a cross-sectional data of 155 banking firms for the period 1995 to 1999 by employing multiple linear regression models. Results of the study indicated that ICT contribute to the overall value-creation performance of banking firms. Moreover, Alawneh and Hattab (2009) assessed the value of e-business at the bank level in Jordan using a survey data collected from 140 employees in seven pioneered banks. The study utilised multiple linear regressions analysis, the empirical findings showed that e-banking was found to have a significant positive influence on bank performance.

Furthermore, Muhammad and Muhammad (2010) examined the impact of ICT on organizational performance using primary data collected through in-depth interviews and fields surveys of 48 manufacturing and 24 banking industry in Pakistan over the period 1994 to 2005. The data was tested using multiple linear regression model and ratio analysis. The conclusion of the research shows that ICT has positive impact on organizational performance of all sampled organisations. In a study by Akram and Hamdan (2010) examined the effects of ICT on Jordanian banking industry for the period of 2003 – 2007. The data was analyse by multiple regression model and results of the study indicated that there is a significant impact in the use of ICT in Jordanian banks on the Market Value Added (MVA), Earning Per Share (EPS), Return on Assets (ROA) and Net Profit Margin (NPM). Similarly, Ombati, Magutu, Nyamwange and Nyaoga (2010) studied the relationship between technology and service quality in banking industry in Kenya using primary data drawn from a sample of 120 customers utilising e-banking services within the Central Business District, Nairobi. The authors used both descriptive and inferential statistics such as correlation analysis, percentages and means to analyse the data. The findings of the study indicated a direct relationship between ICT and service quality in the banking industry.

ICT led bank performance hypothesis was tested in the study by Agbolade (2011). The study used primary data sourced through a structured questionnaire administered to selected banks in south-west Nigeria and the Ordinary Least Square approach econometric techniques was applied to detect the relationship that exist between banks profitability and the adoption of ICT. The results showed that a positive correlation exists between ICT and

banks profitability in Nigeria. Similarly, Uppal (2011) examined the growth of ICT in various bank groups in India using data collected over the period 2008 – 2009. The findings revealed that the growth of ICT led to high bank performance. Conversely, Abubakar *et al.,*(2013) study the impact of ICT on banks performance in Nigeria for 2001-2011 period. The study employed fixed and random effects to reveals the negative impact of ICT on banks performance.

III Methodology

In this study, secondary data in the form of panel have been used. The data was collected from the banks annual financial reports and various issues of Factbooks from Nigerian Stock Exchange covering the period 2001 – 2011. The data for relevant variables comprises net profits, Return on Equity (ROE), number of ATM devices and volume of transaction on e-banking services of the selected commercial banks.

We first used the panel unit root tests to identify the order of integration of each variable incorporated in the study. Basically, there are four different most widely used panel unit root tests in several studies and they are Levin, Lin and Chu (2002,) which will be refered to as LLC, Im, Pesaran and Shin (henceforth IPS), (2003) and Fisher-type tests using ADF and PP tests of Maddala and Wu (1999) and Choi (2001). The LLC test assumes that there is a common unit root process across the cross-sections. This test has null hypothesis of unit root, whereas the alternative hypothesis does not have a unit root. The IPS, Fisher-ADF and Fisher-PP tests assume that there are individual unit root processes across the

cross-sections. These three tests have null hypothesis of unit root, whereas the alternative hypothesis of some cross sections do not contain a unit root.

Similarly, Im *et al.* (2003) have proposed a panel unit root test statistic (t_{ips}), which is applicable to heterogeneous cross-sectional panels. The IPS statistic is based on averaging individual Dickey-Fuller unit root tests (t_i). IPS unit root specification is thus given below:

$$t_{ips} = \frac{\sqrt{N}\left(\bar{t} - E\left[t_i / \rho_i = 0\right]\right)}{\sqrt{\text{var}\left[t_i / \rho_i = 0\right]}} \rightarrow N(0,1) \quad \text{.....(1)}$$

Where N is the number of panel individual, $\bar{t} = N^{-1}\sum_{i=1}^{N} t_i$ is the mean of the computed ADF statistics for individual banks included in the panel, ρ_i is the autoregressive root. $E\left[t_i / \rho_i = 0\right]$ and $\sqrt{\text{var}}\left[t_i / \rho_i = 0\right]$ are the moments of mean and variance respectively which were obtained from Monte Carlo Simulation.

The ADF Fisher panel unit root test proposed by Maddala and Wu (1999) combines the p-values of the test statistic for a unit root in each cross-sectional unit. The Fisher test is nonparametric and distributed as a chi-squared variable with two degrees of freedom. The test statistic is given as:

$$\lambda = -2\sum_{i-1}^{N} \ln p_i \quad \text{.....(2)}$$

The *P*-test is distributed as χ^2 with degree of freedom twice the number of cross-section unit yielding 2N under null hypothesis. Moreover, Choi (2001) considers also different *p*-

values combination tests and suggests that the inverse-normal combination test based on the fact that under which null has the best overall performance, where convergence again holds for fixed N and T→∞. The advantages of the p value combination approach derive from its simplicity, the flexibility in specifying a different model for each panel unit, the ease in allowing the use of unbalanced panels, the possibility of using any unit root test, and the fact that the convergence results are proved using (fixed-N) T– asymptotic (Lippi, 2011).

$$Z = \frac{1}{\sqrt{N}} \sum_{i=1}^{N} \Phi^{-1}(p_i) \xrightarrow{d} N(0,1) \quad \text{.....(3)}$$

Given that each variable is integrated of order one, the tests suggested by Pedroni (1999, 2000) were employed for panel cointegration in this study. These tests extend the Engle and Granger (1987) two-step strategy to panels and rely on the ADF and PP principles. The panel cointegration tests were designed in form of Panel test and Group test. The former consist of four of the statistics which are pooled within-dimension based statistics. The four panel cointegration statistics test are given below:

Panel v-statistic

$$Z_v = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_i^{2}{}_{,t-1} \right)^{-1} \quad \text{.....(4)}$$

Panel ρ-statistic

$$Z_\rho = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2} \right)^{-1} \sum_{i=1}^{N} \sum_{t-1}^{T} \hat{L}_{11i} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \quad \text{.....(5)}$$

Panel non-parametric (PP) t-statistic

$$Z_{pp} = \left(\sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t-1}^{T} \hat{L}_{11i}^{-2} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{i,t} - \hat{\lambda}_i \right) \text{.....(6)}$$

Panel parametric (ADF) t-statistic

$$Z_t = \left(\hat{s}^{*2} \sum_{i=1}^{N} \sum_{t=1}^{T} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{i=1}^{N} \sum_{t=1}^{i} \hat{L}_{11i}^{-2} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{1,t}^{*} \text{.....(7)}$$

The latter (group test) is made-up of three statistics which dwell between-dimension panel statistics. In turn is the exposition of group mean panel cointegration statistics test:

Group ρ-statistic

$$\tilde{Z}_p = \sum_{i=1}^{N} \left(\sum_{t-1}^{T} \hat{e}_{i,t-1}^{2} \right)^{-1} \sum_{t-1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{it} - \hat{\lambda}_t \right) \text{.....(8)}$$

Group non-parametric (PP) statistic

$$\tilde{Z}_{pp} = \sum_{i=1}^{N} \left(\hat{\sigma}^2 \sum_{t-1}^{T} \hat{e}_{i,t-1}^{2} \right)^{-1/2} \sum_{t-1}^{T} \left(\hat{e}_{i,t-1} \Delta \hat{e}_{it} - \hat{\lambda}_t \right) \text{.....(9)}$$

Group parametric (ADF) t-statistics

$$\tilde{Z}_t = \sum_{i=1}^{N} \left(\sum_{t-1}^{T} \hat{s}_i^{-2} \hat{e}_{i,t-1}^{*2} \right)^{-1/2} \sum_{t-1}^{T} \hat{e}_{i,t-1}^{*} \Delta \hat{e}_{it}^{*} \text{.....(10)}$$

Where $\hat{L}_i$ is used to adjust for autocorrelation in the panel parametric model. $\hat{\sigma}^2$ is the pooled long-run variance for the nonparametric model given as $1/N \sum_{i=1}^{N} \hat{L}_{11i}^{-2} \hat{\sigma}_{i,}^{2} \hat{\lambda}_i = 1/2 \left(\hat{\sigma}_i^2 - \hat{s}_i^2 \right)$, $\hat{e}_{it}$ *and* $\hat{e}_{it}^{*}$ are the estimated residuals from the

parametric and nonparametric models, respectively $\hat{\sigma}_i^2$ and s_i^* are the long-run and contemporaneous variances for individual *i*. Each of the panel test statistics is distributed asymptotically as a normal distribution. The null hypothesis of no cointegration against the alternative of cointegration is tested using the seven statistics. Rejection of the null hypothesis means that the variables are cointegrated.

Basically, once cointegration has been established among the relevant variables, a model could be estimated utilizing the (FMOLS) technique. According to Pedroni (2000), standard OLS estimation of a panel will lead to an asymptotically biased estimator because the estimates will be dependent on the nuisance parameters that are associated with the dynamics of the underlying system. He argues that only in the case of exogeneity of the regressors and homogenous dynamics across the individual members of the panel, is it possible for the OLS estimator to be unbiased (Ramirez and Sharma, 2008). The superiority of FMOLS estimator lends credence by its ability to account for both serial correlation and potential endogeneity problems, and hence is preferable to simple OLS estimation in case cointegration relation exists among the variables. One of the advantages of using FMOLS techniques is that it allows for the country-specific fixed effects to be heterogenous while estimating the long-run relationships (Pedroni, 2000). The FMOLS used in this study is specified below:

$$netprofit = \alpha_{it} + \beta ROE_{it} + \beta E - banking_{it} + \beta ATM_{it} + \mu_{it} \quad \text{.....(11)}$$

Where

netprofit = net profit (a proxy of bank performance)

α_i	=	allows for the country specific fixed effects
β	=	cointegrating vector if variable are integrated of order 1
ROE	=	Return on Equity
ATM	=	ATM usability
E-banking	=	e-banking services
μ	=	Error term

The time and the number of panels employed in this study satisfied the necessary condition for the application of FMOLS. According to Pedroni (2000) FMOLS estimator is consistent and can performs reasonably well even in small samples as long as the time period under consideration is not smaller than the number of cross sections.

This study further uses Generalized Method of Moments (GMM) for panel data analyses, proposed by Arellano and Bond (1991) to detect the contemporaneous effect of ICT on bank performance in Nigeria. The technique is specified below:

$$s_{it} = \phi s_{i,t-1} + \lambda x_{i,t} + \eta_i + \varepsilon_{it} \quad \text{.....(12)}$$

Where S is the proxy of banks performance (net profit), X represents the vector of explanatory variables, $\eta_i + \varepsilon_{it}$ denotes unobserved group-level effect and the error term, respectively. And they based on the assumption of being independent for each i over all t, and that there is no autocorrelation in the ε_{it} The specification above exhibit evidence of endogeneity since S_{it} is correlated with η_i which may lead to inconsistent and biased

estimators. To ameliorate endogeneity problem from the group-specific effects, we resort to difference of the above equation.

$$s_{it} - s_{i-t} = \phi(s_{i,t-1} - s_{i,t-2}) + \lambda(x_{i,t} - x_{i,t-1}) + (\varepsilon_{it} - \varepsilon_{it-1}) \text{.....(13)}$$

Even though the difference operator eliminates the group-specific effects, but it does at the expense of re-introducing a new correlation between S_{it-1} (lagged dependent variable) and ε_{it-1}. To eradicate these problems, instrumental variables must be set. Adusei (2013) argued that the lagged explanatory variables can be used as instrumental variables. To these end we utilized lagged explanatory variable instrumental variables.

IV Results and Discussion

The results of LLC, IPS, Fisher-ADF and Fisher-PP panel unit root for each of the variable is reported in the Table 1 below and from it one could observe that all of the variables exhibit unit root at level form under 1% probability level. However, ROE is stationary at level under 10% level of significance.

Table1: Panel unit root test results

Series	Level				1st Difference			
	LLC	**IPS**	**ADF Fisher**	**PP Fisher**	**LLC**	**IPS**	**ADF Fisher**	**PP Fisher**
ROE	-1.769 (0.038)*	-0.469 (0.319)	2.504 (0.286)	5.526 (0.063)*	-3.426 (0.000)** *	-1.626 (0.0519)*	6.998 (0.030)**	11.73 (0.002)***
Net Profit	-1.08 (0.140)	0.161 (0.564)	1.132 (0.568)	1.132 (0.568)	-5.21 (0.000)** *	-2.89 (0.000)** *	10.50 (0.000)***	20.60 (0.000)***
E-banking	-324 (0.374)	0.487 (0.687)	0.690 (0.708)	0.670 (0.716)	-2.482 (0.006)** *	0.301 (0.381)	2.900 (0.234)	3.460 (0.179)
ATM	-0.771 (0.220)	-5.588 (0.278)	2.821 (0.244)	3.00 (0.223)	-2.591 (0.004)** *	-1.345 (0.089)*	5.530 (0.630)	8.363 (0.015)**

*** **& * denote statistical significance at the 1% , 5% and 10% level respectively

The first difference value of the each variable in the panel root test reveals that the variable were stationary leading to the rejection of null hypothesis at the 1% level of significance. Therefore, we gain ground to assert that the variables were I(1) order and thereby lending credence for the application of Pedroni panel cointegration test.

Table 2: Pedroni panel cointegration test results

	Panel Statistics			**Group Statistics**	
Panel	**Statistics**	**Probability**	**Group**	**Statistics**	**Probability**
v-statistics	3.051	0.001***	rho-statistics	2.299	0.989
rho-statistics	0.751	0.774	PP-statistics	-17.071	0.000***
PP-statistics	-14.457	0.000***	ADF-statistics	-2.36	0.009***
ADF-statistics	-2.744	0.003***	-	-	-

*** denote statistical significance at the 1%

It could be seen from the Table 2 the coefficients of panel statistics for v, panel PP, and group PP statistics and group ADF were significant at 1% level of significant. As such the null hypothesis proposing no cointegration relation among the variables is rejected in all cases for panel v, panel PP, and group PP as well as group ADF statistics except panel ρ and group ρ whom were not statistically significant. Therefore, the panel cointegration tests point to the existence of a long-run relationship among the variable, under which FMOLS is Best Linear Unbiased Estimator (BLUE).

Table 3: Panel FMOLS results

Variable	Coefficient	Probability
ROE	7.27	0.7003
E-banking	7.27	0.1079*
ATM	7.80	0.0275**
R^2		0.76
Long-run variance		3.53
Hansen parameter instability test	LC statistics 0.469 (0.2)	

**& * denote statistical significance at the 5% and 10% level respectively

It could be seen from the above Table 3 above, the long-run coefficient of E-banking is positive and statistically significant at 10% probability level. The positive sign of the parameter is showing the prospect of E-banking in Nigeria and there is a possibility of Nigerian economy to imbibe the culture of cashless society. Moreover, the coefficient of ATM is also positive and statistically significant at 5% probability level, which is showing the strength of ATM on enhancing banks performance in the country. On the other hand, the estimated coefficient of ROE is positive but not significant.

Further post-estimation tests reveals that the equation has a good fit. For instance the R^2 value is 0.76 indicating that 76% variation of the bank performance is jointly account by ICT and ROE. Hansen parameter instability test was also applied in the study and the test has a null hypothesis claiming series are cointegrated. The result of this test cannot show any evidence of rejecting the null hypothesis since the LC statistics is not significant even at 10% level of significance.

Table 4: Panel GMM

Variable	Coefficient	Probability
ROE	-20.23	0.0413**
E-banking	94.71	0.0873*
ATM	90.16	0.0015***
R^2	0.73	
j-statistics	2.115 (0.1459)*	
Instrument rank	4	

*** **& * denote statistical significance at the 1% , 5% and 10% level respectively

The result of GMM is presented in Table 4. It could be discerned from it that the coefficients of the ICT proxies (E-banking and ATM) were positive and statistically significant. This finding is in accord with the theoretical postulation of Ovia, (2005) and the empirical findings of Evans, (2011) and that of Agbolade, (2011) which hold that positive correlation exist between ICT and Banks performance. However, the finding refutes the revelations of Lin (2007) and Abubakar *et al*., (2013). Moreover, the study further finds that ROE is statistically significant and the negative sign of the coefficient indicates a negative relationship between ROE and bank performance in Nigeria. This finding means that ROE has a tendency of affecting banks performance adversely. When banks are making huge amount of profit, its share price (both primary and secondary issues) will rise as a result of increase in its demand. More shareholders imply more payments of dividend and thereby reducing the ploughing back of profit for investment motive, as such performance of banks will be adversely affected.

V Conclusion

This study examines the impact ICT on banks performance in Nigeria using a panel data set sourced from NSE factbook of various issues. The data was analysed using FMOLS and GMM among others to reveals that ICT do improve banks performance in the country. Surprisingly, it has been established in this study that ROE has a significant negative influence on bank performance in the short-run while its impact on banks performance was positive but insignificant in the long-run. Therefore, the study concludes that cautious application of ICT apparatus will continue to improve commercial banks performance in Nigeria. The policy implication of this finding is pointing out the potentiality of cashless economy in Nigeria. Therefore, CBN cashless policy is a sound initiative at the right direction since it will help in minimising the cost of issuing currency in the fairly performing Nigerian economy. Emphasis should be given on efficient utilisation of the ICT equipment such as credit, Points of Sales (POS), phone banking, electronic payment debit, cash withdrawal machines, to mention but few. However, for banks and populace alike to actually reap the benefit of ICT more campaigns and orientation of clients need to be vigorously pursued to create awareness for them to patronise the facilities. It is worthy noting, the success of this policy will depends on the level of financial literacy and degree of poverty in the country.

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