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Impact of ICT Synergy and Financial Development on Economic Growth in Nigeria

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Abstract:
This study analyzed the long-run impact of ICT synergy and financial development on economic growth in Nigeria. The study adopted the Autoregressive Distributed Lag (ARDL) model, using disaggregated approach on a time series data spanning 1990-2021. Data for all variables were sourced from World Bank database (WDI). The dependent variable is Gross Domestic Product (GDP) which serves as a proxy for economic growth, while the explanatory variables are mobile cellular subscriptions (MCS), individuals using internet (IUI), market capitalization (MC); money supply (MS), and domestic credit to private sectors (DCPS). Major findings reveled the existence of cointegrating association between ICT synergy, financial development and economic growth. Further investigations revealed that while economic growth responded significantly to financial development, ICT synergy was found to have a negligible impact on growth in Nigeria during the period investigated. The paper concluded that financial development indices are more robust in influencing Nigeria's economic growth through the financial channel with an implication that further growth of the Nigerian economy could be stimulated through financial sector friendly policies by ensuring market liquidity and efficiency as well as ensuring greater capital asset security.

Keywords: ICT Synergy, financial development, economic growth, Nigeria

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KIUT KAMPALA INTERNATIONAL UNIVERSITY IN TANZANIA
EXPLORING THE HEIGHTS

1. INTRODUCTION

The interconnected world of the new millennium has made the synergy of Information and Communication Technology (ICT) a crucial growth and development catalyst across various sectors. It has facilitated seamless trade, improved supply chain management, and promoted e-commerce, thereby fostering economic productivity and competitiveness (Adeleye & Eboagu, 2019). Furthermore, the digitalization of financial services has attracted foreign direct investment (FDI) into Nigeria's financial sector. International investors recognize the vast potential of the Nigerian market, driven by its growing population, expanding middle class, and increasing smartphone penetration.

The integration of ICT in the financial sector has not only improved investor confidence but has also positioned Nigeria as a regional hub for Fintech innovation in Africa. Synergy in finance development, ICT and economic growth in Nigeria is undeniable. Through the widespread adoption of ICT in finance, Nigeria has experienced increased financial inclusion, stimulated innovation and entrepreneurship, and enhanced overall economic productivity. However, as Nigeria continues to embrace the digital revolution, it must address challenges such as cybersecurity, infrastructure development, and regulatory frameworks to sustain and maximize the benefits of ICT adoption for long-term economic growth (Adeleye & Eboagu, 2019).

The integration of ICT into the financial sector in Nigeria over the years brought numerous benefits as well as a new set of problems and challenges for financial sector development. The continuous reliance on digital platforms to achieve effectiveness and efficiency in financial system, has increased the risk of cyber threats and attack by internet fraudsters. The increasing risks of cyber threat and attacks is exemplified by the prevalence of internet financial fraud by fraudsters who are notoriously known as 'Yahoo Boys'. The activities of these fraudster have undermined public trust in digital financial services, thus hindering the growth of the economy (Habibi & Zabardast, 2020).

With a growing global demand in digital finance for efficient international trade and market competitiveness, Nigerian's are scrambling to acquire the knowledge and technical skills for ICT usage in order to leverage on the international financial market's competitiveness and ensure optimal return on investment in the long run. On account of a lack of basic infrastructure such as electricity, good road networks, internet services and so on, a significant portion of the population in Nigeria lacks access to digital financial services. This infrastructure is supposed to make the financial system effective. Policies are believed to fail on account of the inability of rural communities to access inability to access financial houses coupled with the absence of other financial inclusiveness

parameters that would have operated to make the policy successful. In rural communities, access to financial assets linked to technology remains out of reach for most residents.

In a nutshell, inadequate ICT infrastructure, poor internet connectivity and inefficient power systems impede the effective deployment of digital financial services, as the volume of online banking and electronic payment transactions were negligible (Asongu & Nwachukwu, 2019). Nigeria's financial services lack enough robust institutional and legal frameworks that guarantee financial development (FD). This exposes consumers to a lot of financial transaction risks, thereby, making ICT and financial sector development to lose financial integrity and the confidence of the society. The financial burden of managing the synergy between ICT adoption and financial sector development has disheartened communities. Additionally, frequent hidden fees imposed by financial providers have raised concerns, resulting in low usage of financial data services. This has hindered broader societal understanding and utilization of ICT as a means to promote financial development in Nigeria.

The collection and utilization of a vast amount of personal and financial data in digital transactions which raise great concerns to individuals, retard the incorporation of ICT in developing the financial sector of Nigeria. Small and medium-sized enterprises (SMEs) find it challenging to bear these costs, thereby limiting their ability to participate fully in digital financial services (Adeleye & Eboagu, 2019). Many Nigerians lack the necessary financial literacy and technical skills, which creates a knowledge gap. This vulnerability exposes their financial information to the public domain, resulting in loss of funds, account hacking, unauthorized withdrawals, and providing ample opportunities for fraudsters to exploit.

Often times, over reliance on digital platforms may create system risks, such as technical glitches, network outages and cyber-attacks, causing financial instability. Despite considerable investments in ICT infrastructure and an increase in digital financial services, Nigeria continues to grapple with challenges such as low financial inclusion, inadequate ICT infrastructure in rural areas, and a significant digital divide. The relationship between ICT synergy, financial development, and economic growth in Nigeria is complex and multifaceted. There is a gap in empirical research that examines how ICT investments interact with financial systems to influence economic outcomes in Nigeria's diverse socio-economic landscape. This problem statement seeks to explore the synergy between ICT development and financial sector growth in Nigeria, and how this synergy can be harnessed to foster sustainable economic growth.

2. THEORETICAL LITERATURE

2.1 Theory of Innovation

Joseph Schumpeter's theory of innovation, often referred to as "Creative Destruction," posits that economic development occurs through a process where old technologies and business models are constantly replaced by new ones. This continuous cycle of innovation is essential for economic progress. ICT is a powerful force for Schumpeterian innovation, enabling the development of new products, services, and processes that disrupt traditional industries. Financial development is crucial in this process, as it provides the necessary capital and financial services that support innovative ventures. The interaction between ICT and financial development thus facilitates creative destruction, leading to economic growth as new technologies and industries emerge.

2.1.1 Financial Intermediation Theory

Financial Intermediation theory explores how financial intermediaries, such as banks and financial markets, facilitate the efficient allocation of resources by reducing transaction costs and information asymmetry. ICT enhances the efficiency of financial intermediaries by providing better tools for information processing, risk assessment, and transaction execution. This, in turn, leads to improved financial development, which supports broader economic growth. The theory suggests that ICT can strengthen the role of financial intermediaries in economic development by enabling more effective financial services.

2.1.2 Network Theory

Network Theory examines how interconnected nodes, such as individuals, organizations, or systems, interact within a network to share information, resources and support. In economic contexts, networks facilitate collaboration, innovation, and the diffusion of technologies. ICT networks, such as the internet and mobile communication networks, are foundational to modern economies. These networks enable the seamless flow of information and financial transactions across geographical boundaries, fostering economic growth. Financial development is also influenced by the strength and reach of these networks, as they determine the efficiency and accessibility of financial services. Network Theory underscores the importance of robust ICT infrastructure in supporting financial systems and, by extension, economic growth.

2.2 Empirical Review

Employing a two-step system GMM, Raifu et al. (2023) investigated the impact of regulatory quality on ICT and finance in 38 African countries from 2003 to 2020. The

study revealed that the development of finance depends on ICT under high-quality regulations. Financial development and ICT respond positively to regulatory quality, suggesting that regulatory quality moderates this relationship. ICT enhances financial accessibility and depth but degrades stability and efficiency across a range of financial development metrics. While ICT and robust regulations generally yield positive outcomes, they can adversely affect financial stability and depth when financial efficiency is compromised.

Kumari and Singh (2022) investigated the impact of financial inclusion, trade openness and ICT on economic growth in low-income and high-income countries from 2000 to 2019 period. The study used multiple panel techniques such as pooled OLS, fixed and random effect as well as modified GMM. Major findings from this study revealed a significant positive impact of financial development and ICT infrastructure on economic growth in both low-income and high-income countries during the period investigated. Research conducted by Cheng et al. (2021) investigated the relationship between financial development, ICT diffusion and economic growth between 2000 and 2015. The researchers employed principal component analysis (PCA) and GMM to analyze panel data from 72 countries, which were then aggregated into three index categories. According to their findings, finance and growth have a substantial association that has a big impact on higher income countries. In high-income countries, ICT is the main driver of economic growth. In middle and low-income nations, the picture is less clear. The research concludes that high-income countries benefit more from the interplay between ICT and finance in terms of economic growth than middle-class and low-income nations benefit.

Using panel data on current and non-contemporary quantile regressions, Asongu and Odhiambo (2020) investigated the effects of information sharing, mobile phones and growth on finance in Africa between 2004 and 2011. The study shows the importance of mobile phones in sharing information and advancing the financial sector. Chatterjee (2020) utilized fixed effect panel data from 41 countries to investigate financial inclusion; the spread of ICT, and economic growth. According to the report, ICT and financial inclusion contribute positively to economic growth. ICT applications, such as the internet and mobile phones, are being used more and more in the banking industry. The study also demonstrated how financial inclusion, which is fueled by increased ICT penetration, contributes to national development. The study suggests that financial inclusion, mobile technology, and the internet can boost per capita growth, and that it is crucial to invest more in educating the public about the use of ICT in the formal banking sector.

Using PMG, Raheem et al. (2020) investigated the impact of ICT and financial development and economic growth for G7 countries during 1990 to 2014. According to the study, FD is a modest driver of emissions, whereas ICT impacts positively on economic growth in the long-term. Negative coefficients are produced by the interacting term

between FD and the ICT. Economic growth has been demonstrated to be adversely affected by ICT and FD. The study also showed that there is a mixed influence on economic growth, with a short-term positive effect and a long-term negative effect. In a different study, Asongu and Acha-Anyi (2017) used current and non-contemporary quantile regressions to investigate the relationship between ICT, access to finance and intermediation in 53 African nations between 2004 and 2011. The study revealed a positive net impact of ICT on financial activities in the banking sector with a consistent positive threshold.

While the negative consistency observed in the informal financial sector negatively affects the performance of the financial sector, the positive consistency associated with formal financial activities enhances the effectiveness of financial intermediation in the development of the financial sector. In order to improve the efficiency of the financial system's financial intermediation function, the study suggests measures that would foster relationships between formal and informal financial services. The nexus between the adoption of ICT, FD and economic growth have generated interesting empirical findings with mixed outcomes. Applying cross-section data from 61 countries, between 1990 and 2002, Shamim (2007) investigated the existing association between the ICT environment, financial sector, and economic growth. The study used the generalized method of moments (GMM). The impact of e-finance on economic growth in developed and developing countries is examined in this study. Improved connectivity, driven by an increase in the number of mobile phone subscribers, was found to significantly improve financial depth, lower supplier and consumer information costs, and increase the availability of financing services in the countries.

2.3 Theoretical Framework - Interactions and Feedback Analysis of ICT, Financial Development and Economic Growth

As the economy grows, increased wealth and resources allow for more substantial investments in the ICT and financial sectors, further enhancing their development. Financial development enables more significant investments in ICT infrastructure and technology-driven businesses, creating a virtuous cycle of growth. ICT acts as a catalyst for financial development by enabling the creation of new financial products and services, which in turn support broader economic activities.

3. METHODOLOGY

In order to ascertain if the synergy of ICT and the development of the financial sector have an impact on economic growth in Nigeria, this paper obtained annual time series data from the World Bank database for the 1990-2021 period. In addition to considerations of data availability, the study considered the period synonymous to when

Nigeria started to experience crises that affected the financial sector beginning from the 1990's. The model for this paper is adapted from the work of Kumari and Singh (2022) with major modifications. The model by Kumari and Singh (2022) is stated in equation 1.

$$EG_{it} = f(ICT_{it} + FD_{it} + TO_{it}) \quad 1$$

Where: EG is economic growth, ICT is information and technology adoption and TO is trade openness. The model was parameterized as:

$$EG_{it} = \beta_0 + \beta_1 ICT_{it} + \beta_2 FD_{it} + \beta_3 TO_{it} + \delta_{it} + \varepsilon_{it} \quad 2$$

Although the model by Kumari and Singh (2022) was anchored on the same set of assumptions as this study; which is, the possibility of a joint impact of ICT and financial development on economic growth, the differences with respect to scope and objectives necessitate the modification of the Kumari and Singh (2022) model to suit the peculiarities of our study. While the Kumari and Singh (2022) model is specified in a panel frame with an inclusion of trade openness as an objective of their study, this paper's ambition is to approach the analysis of the joint impact of ICT and financial development on economic growth from a disaggregated approach where several indicators of ICT adoption and financial development are separately considered. To this end, the baseline model of this paper as adapted and modified from Kumari and Singh (2022) is stated in equation 3.

$$EG_t = f(ICT_t + FD_t) \quad 3$$

From equation 3, the disaggregated model which introduces important indicators of ICT adoption and financial development is stated in equation 4.

$$GDP_t = \beta_0 + \beta_1 MSC_t + \beta_2 IUI_t + \beta_3 MS_t + \beta_4 MC_t + \beta_5 DCPS_t + \mu_t \quad 4$$

Where GDP is gross domestic product which serves as a proxy for economic growth. MCS is mobile cellular subscriptions, IUI is individuals using internet. MC is market capitalization; MS is money supply and DCPS is domestic credit to private sectors. While MCS and IUI are indicators of ICT adoption, MC, MS and DCPS are indicators of financial development. In this model, the constant term represents the intercept, the parameters correspond to the explanatory variables, and μ denotes the error term.

The model in equation 4 is stated in consistence with the ARDL bound test approach proposed by Pesaran et al. (2001), as in equation 5.

$$\Delta GDP_t = \phi + \pi_1 (GDP)_{t-1} + \pi_2 (IUI)_{t-1} + \pi_3 (MC)_{t-1} + \pi_4 (MCS)_{t-1} + \pi_5 (MS)_{t-1} + \sum_{i=1}^{p} \alpha \Delta GDP_{t-i} + \sum_{i=0}^{q1} \beta \Delta IUI_{t-i} ++ \sum_{i=0}^{q2} \lambda \Delta MC_{t-i} + \sum_{i=0}^{q3} \delta \Delta MCS_{t-i} + \sum_{i=0}^{q4} € \Delta MS_{t-i} + \mu_t \quad 5$$

The first part of the model reveals its long-run dynamics, while the second section's short-term impacts are displayed together with a summing sign, while Δ is the first difference operator. The long-run multipliers are represented, and ϕ denotes the drift.

4. RESULTS AND DISCUSSION

This section discusses empirical results on the impact of ICT adoption and financial development on economic growth in Nigeria.

Table 1 presents a descriptive statistic of variables employed.

4.1 Descriptive Statistics

Table 1

Descriptive Statistics

	GDP	DCPS	IUI	MC	MCS	MS
Mean	2.88E+11	11.29848	9.982744	3.31E+10	56842250	19.18556
Median	3.39E+11	11.15756	6.770000	3.22E+10	39808757	22.36683
Maximum	5.74E+11	19.62560	33.20000	8.49E+10	1.54E+08	27.37879
Minimum	2.78E+10	6.174444	0.000000	2.14E+09	9049.000	9.063329
Std. Dev.	1.87E+11	3.512288	10.16806	2.42E+10	57930802	6.317502
Skewness	-0.213536	0.560656	0.740775	0.440684	0.456873	-0.376581
Kurtosis	1.509755	2.898044	2.401714	2.345311	1.636072	1.481568
Jarque-Bera	2.502255	1.320559	2.659306	1.255654	2.807532	2.992593
Probability	0.286025	0.516707	0.264569	0.533750	0.245670	0.223958

Source: Author's Computation Using EViews software 9.0

Descriptive statistics on table 1 showed that the average value of GDP, domestic credit to the private sector, individuals using internet, market capitalization, mobile cellular subscription and money supply are 2.88E+11, 11.29848, 9.982744, 3.31E+10, 56842250 and 19.18556 respectively. The standard deviation shows that GDP, market capitalization and mobile cellular subscribers were the most volatile. The normality assumption is also fulfilled.

4.2 Econometric Estimation Results
Unit Root Test

To avoid a spurious result, it is imperative to conduct a unit root test. The test result report, is stated below.

Table 2
Augmented Dickey-Fuller & Phillip Perron Unit Root Test Result

	Level Stage					
Variables	Constant		Constant and Trend		No Constant and No Trend	
	ADF	PP	ADF	PP	ADF	PP
GDP	-3.511406 [0.0166] *	-0.452628 [0.8875]	-3.49336 [0.0629]	-1.928284 [0.6159]	-2.199458 [0.0295] *	1.148486 [0.9316]
DCPS	-2.735026 [0.0800]	-1.664670 [0.4386]	-3.99580 [0.0199] *	-2.029285 [0.5631]	0.453991 [0.8060]	0.767875 [0.8744]
IUI	-2.624520 [0.1015]	-0.802351 [0.8045]	-2.62555 [0.2730]	-1.951564 [0.6038]	-2.76490 [0.0077] *	-0.48617 [-0.4971]
MC	-1.917606 [0.3186]	-1.814583 [0.3640]	-2.75991 [0.2249]	-2.811211 [0.2081]	-0.59417 [0.4484]	-0.08896 [0.6418]
MS	-1.056060 [0.7201]	-0.865109 [0.7857]	-3.05542 [0.1349]	-1.902457 [0.6292]	0.583372 [0.8370]	1.302038 [0.9478]
MCS	-3.487571 [0.0175] *	-1.153280 [0.6815]	-4.28049 [0.0127] *	-2.200306 [0.4729]	-3.201626 [0.0026] *	-0.391069 [0.5348]
	First Difference Stage					
	Constant		Constant and Trend		No Constant and No Trend	
GDP	====	-4.33829 [0.0019] *	0.710450 [0.9993]	-4.260647 [0.0109] *	====	-4.117141 [0.0002] *
DCPS	-4.899044 [0.0005] *	-5.38197 [0.0001] *	====	-5.365745 [0.0007] *	-4.851548 [0.0000] *	-3.986460 [0.0003] *
IUI	-2.084093 [0.2521]	1.272715 [0.999]	-0.94686 [0.9346]	1.272715 [0.9999]	====	-1.802638 [0.0684]
MC	-2.384759 [0.1650]	-5.86935 [0.0001] *	-3.16508 [0.1465]	-5.63035 [0.0011] *	-2.577994 [0.0149] *	-5.964918 [0.0000]
MS	-4.484212 [0.0013] *	-6.00374 [0.0000] *	-4.41565 [0.0076]	-6.11193 [0.0001] *	-4.477262 [0.0001] *	-4.432823 [0.0001] *
MCS	====	0.357851 [0.9775]	====	0.569260 [0.9990]	====	-1.081372 [0.2466]

Note: * represents stationarity at 5% level of significance.

Source: Author's Computation Using EViews software 9.0

From table 2, the ADF and PP tests for both levels and first differenced equations are reported. The results confirm that, at the level stage, many variables are not stationary, but after taking their first difference, stationarity was achieved. Therefore, at the first difference, null hypothesis of presence of unit root is rejected at 5% level of significance. At the level stage only, gross domestic product (GDP), individuals using internet (IUI) and mobile cellular subscribers (MCS) was found to be stationary in the level stage, while DCPS, MC and MS were found to be stationary at the first difference. This combination of stationarity at different levels suggests the correctness of ARDL Bound Cointegration.

Table 3
ARDL Bound Test Result

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif	I (0)	I (1)
F-statistic	4.214038	10%	2.08	3
K	5	5%	2.39	3.38
		2.5%	2.7	3.73
		1%	3.06	4.15

Source: Author's Computation Using EViews software 9.0

Table 3 shows that the F-statistic for ARDL bound test which is 4.214038 confirms the existence of a cointegrating relationship among our variables. This is so because F-statistic is greater than the lower and upper bound critical values of 10%, 5% and 2.5. This finding informs us to expect ICT synergy and financial development to have a long-run impact on economic growth in Nigeria. This expectation is consistent with findings from Chatterjee (2020) and Cheng et al. (2021).

Table 4
Long Run Estimates

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob**
DCPS	-1.71E+10	1.16E+10	-1.469061	0.0160
IUI	1.75E+09	8.41E+09	0.208162	0.8376
MC	4.810049	1.819226	2.644008	0.0171
MCS	132.5242	1522.831	0.087025	0.9317
MS	1.68E+10	6.91E+10	2.426621	0.0266

Source: Author's Computation Using EViews software 9.0

The result on table 4 suggests that in the long-run, financial development proxies have significant impact on economic growth in Nigeria during the period investigated. Specifically, the coefficient of domestic credit from the private sector implies that an increase in private sector domestic credit led to a 1.7% fall in economic growth in Nigeria

during the period investigated. Hence, private sector domestic credit has an elastic impact on economic growth of Nigeria. This supports the argument of a slow pace of growth and performance of the Nigerian credit sector due mainly to poor credit worthiness, low oversight and unfriendly credit policies as highlighted in the literature (Asongu & Nwachukwu, 2019). This finding however contradicts that of Cheng et al. (2021) who found economic growth to be a positive function of credit development.

The magnitude and sign of coefficient of market capitalization suggests a significant positive impact of capital market capitalization on economic growth in Nigeria. An increase in Nigerian stock market capitalization by one unit has increased economic growth by 4.8% which suggests a highly elastic response of GDP to capital market capitalization. This finding suggests that the steady growth in Nigerian capital market since early 1990s is well absorbed and transmitted in Nigeria's economic growth through real sector development. Moreover, this finding is in line with that of Cheng et al. (2021) and Raheem (2021) who also found the capital market to positively influence economic growth.

Moreover, similar to the capital market, findings on the coefficient of money supply, which is the money market indicator of financial development, adopted by this study also reveal that economic growth is a positive function of financial development in Nigeria through the money market. the coefficient of money supply therefore suggest that a one Naira increase in money supply increased economic growth by 1.6% during the period under investigation at 10% level of significance. Hence, money supply has a marginal impact on economic growth. This finding supports that of Kumari and Singh (2022) who also found a favorable impact of financial development and ICT on economic growth. This finding however, contradicts that of Asongu and Nwachukwu, (2019) who found a weak impact of money market financial development on the growth of Nigeria's economy.

Table 5

Error Correction Mechanism Results

Variable	Coefficient	St. Error	t-Statistic	Prob
CointEq(-1)	-0.496425	0.110052	-4.510833	0.0004
R-squared	0.509041	Mean dependent var	1.50E+10	
Adj. R-squared	0.464408	S.D dependent var	4.69E+10	
S.E of regression	3.43E+10	Akaike criterion	51.46681	
Sum squared resid	2.59E+22	Schwarz criterion	51.61308	
Log likelihood	-640.3352	Hannan-Quinn criter	51.50738	
Durbin-Watson	1.578752			

Source: Author's Computation Using EViews software 9.0

On table 5, the ECM and primary diagnostics are displayed. The ECM coefficient implies a high-speed of adjustment from the short-run to the long-run. Hence, in case of disequilibrium, the speed of adjustment back to equilibrium is 50%. R-square and adjusted R-squared suggest that the model has good a fit, since an estimate of 50% variation in economic growth is jointly explained by variables considered in the regression model of this study. For the overall significance, the F-statistic implies that the model is correctly specified. Moreover, the DW statistic implies the absence of first-order negative serial correlation in the data.

5. CONCLUSION AND POLICY IMPLICATION

This paper analyzed the long-run impact of ICT synergy and financial development on economic growth in Nigeria from 1990 to 2021. The major finding from this paper revealed the existence of cointegrating association between ICT synergy, financial development and growth. A further finding is that while economic growth responded fairly significantly to financial market development, ICT synergy was found to have no significant impact on growth in Nigeria during the period investigated. Considering the magnitude of impact of finance indicators used, we conclude that capital market development is more robust in impacting upon Nigeria's economic growth through financial channels. This implies that further growth of the Nigerian economy can be stimulated through capital market investor friendly policies. This can be achieved by ensuring market liquidity and efficiency as well as greater capital asset security.

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