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12

DIGITAL INVESTMENT AND ECONOMIC DEVELOPMENT IN NIGERIA

AMADI C. R., COOKEY I. F., IGENEWARI E. J.

Department of Economics, Rivers State University, Nkpolu-Orowurokwo, Port Harcourt, Rivers State, Nigeria. Correspondence Author's Email: cherishdoyani@gmail.com

ABSTRACT
This study empirically analyses the effect of digital investment on economic development in Nigeria. The study covered a period of twelve years from 2012Q1 to 2023Q4. The study particularly quantified the impact of digital investment indicators—total broadband subscriptions, overall internet penetration, overall digital R&D expenditure, ratio of information technology to Gross Domestic Product, and overall telephone lines—on Nigeria's Gross Domestic Product and Human Development Index. The research utilized quarterly data derived from the Central Bank of Nigeria (CBN) Statistical Bulletin, National Bureau of Statistics (NBS) report, and World Bank Development Index/Indicators. The research utilized many econometric methods, such as the ADF unit root test, limits co-integration test, and the Autoregressive Distributed Lag (ARDL) method. The study revealed that total digital research and development expenditure, total penetration of the internet, and total broadband subscriptions have a positive and significant impact on the human development index in Nigeria in both the short and long terms. and the number of telephone lines has a positive though negligible impact on HDI in Nigeria, both short-term and long-term. The research indicates that digital investment is essential for generating, strengthening, and maintaining economic growth in Nigeria. The study recommends that Nigerian government should prioritise expanding total broadband subscriptions by investing in nationwide fiber-optic networks and 5G technology, particularly in underserved rural areas. The government improve broadband penetration can enhance productivity across sectors, from agriculture (via digital extension services) to fintech (through mobile banking). Public-private partnerships (PPPs) with telecom firms can also accelerate deployment, while subsidies for low-income users that can ensure inclusivity should be encouraged.

Key words: *digital investment, economic development, total broadband subscriptions, overall internet penetration, overall digital R&D expenditure, ratio of information technology, Gross Domestic Product, telephone lines, Human Development Index, Autoregressive Distributed Lag (ARDL).*

INTRODUCTION

Economic development encompasses a wide range of outcomes, i.e. rising living standards, decreased poverty, and new possibilities for people and communities. It necessitates systemic changes that pave the way for inclusive and long-lasting social advancement (Todaro & Smith, 2006). The historical context, cultural diversity, and wealth of natural resources of Nigeria have all played a role in the nation's complicated economic growth. The path to economic development in Nigeria, the most populous and biggest economy in Africa, has been characterised by expansion, stagnation, and transition. Indigenous peoples in Nigeria had developed sophisticated economies long before Europeans arrived. With elaborate political and social systems to back them up, these communities farmed, traded, and created goods by hand. An enormous sway on Nigeria's economic growth occurred throughout the colonial era, which lasted from the conquest of Lagos in 1861 until the nation gained its independence in 1960. Its economic growth entered a new chapter with its independence. In congruent with Bolatito and Oluwakemi (2015), the Niger Delta oil discoveries in the late 20th century fuelled optimistic economic expansion in the early post-independence era, whereas the digital revolution defined the late post-independence era.

the expansion of ICTS, or information and communication technologies, has caused a paradigm shift in economic activity, interaction, and growth, ushering in the digital revolution. Businesses, governments, and people have been able to run more smoothly and efficiently because to digital technology comprising the internet, mobile communications, cloud computing, and artificial intelligence (Olabode, 2023). In congruent with the World Bank (2020), digital technology may help the economy grow by increasing productivity, making employment more plentiful, and making services easier to obtain. In addition, the global economy's reliance on digital solutions to maintain commercial activity amid lockdowns and limitations during the COVID-19 pandemic highlighted the significance of digital infrastructure and investment. This change has hastened the incorporation of digital technology, highlighting their significance in sustaining and reviving the economy.

Digital investment has been a game-changer for Nigeria's economy, opening doors to long-term prosperity, more employment opportunities, and less poverty, claims Echegu (2024). The widespread utilisation of digital technology can boost productivity, innovation, and inclusiveness in many different areas; these are all areas in which Nigeria, the biggest economy in Africa, stands to gain greatly. Investment in digital infrastructure has many beneficial consequences but increasing GDP and economic productivity are two of the most notable. Businesses may streamline their operations, save expenses, and tap into new markets with the help of digital technology like artificial intelligence, cloud computing, and broadband internet. A 10% increase in developing nations' broadband adoption may result in a 1.38% rise in GDP growth, in congruent with the World Bank (2020). The National Bureau of Statistics reports that in the second quarter of 2022, the telecommunications sector—a major force behind digital investment—contributed 12.45% to Nigeria's GDP (National Bureau of Statistics, 2022). This shows how crucial digital infrastructure is becoming as a motor for economic expansion and modernisation. Furthermore, digital investment might provide millions of employment opportunities in Nigeria, especially for the nation's youthful populace (Miftahu and John, 2024). Jobs in software engineering, online advertising, e-commerce, and telecoms are available in the digital economy. For example, many of Nigerians have found work as delivery people, customer support agents, and information technology specialists thanks to the proliferation of e-commerce platforms i.e. Konga and Jumia. The expansion of the gig economy, which allows people to work as freelancers or independent contractors, is another consequence of digital technology. Furthermore, digital investment encourages entrepreneurship by facilitating the utilisation of digital payment systems, company management tools, and online marketplaces; this, in turn, helps small and medium-sized firms (SMEs) flourish and provide employment opportunities (Miftahu & John, 2024).

Furthermore, digital investment might provide millions of employment opportunities in Nigeria, especially for the nation's youthful populace (Miftahu and John, 2024). Jobs in software engineering, online advertising, e-commerce, and telecoms are available in the digital economy. For example, many of Nigerians have found work as delivery people, customer support agents, and information technology specialists thanks to the proliferation of e-commerce platforms i.e. Konga and Jumia. The expansion of the gig economy, which allows people to work as freelancers or independent contractors, is another consequence of digital technology. Furthermore, digital investment encourages entrepreneurship by facilitating the utilisation of digital payment systems, company management tools, and online marketplaces; this, in turn, helps small and medium-sized firms (SMEs) flourish and provide employment opportunities (Miftahu & John, 2024).

Furthermore, in congruent with Enock and Lusekelo (2024), digital investment has been essential in expanding access to fiscal services in Nigeria, especially with the rise of mobile money and other forms of electronic payment. Since more than 60% of the populace does not have access to traditional banking services, digital fiscal services have become an essential instrument in addressing this issue. Paga, Opay, and Flutterwave are just a few of the platforms that have facilitated the transfer of funds, the payment of bills, and the acquisition of credit for Nigerians, even in more rural regions. The expansion of digital fiscal services is primarily responsible for the 64% rise in the proportion of individuals in Nigeria who had access to fiscal services in 2020 compared to 58% in 2018, as reported in the Enhancing Financial Innovation and Access (EFInA, 2020) survey. Because more people and companies can access and use formal fiscal services, which boosts investment, reduces poverty, and increases savings, this has far-reaching consequences for economic development.

STATEMENT OF THE PROBLEM

Digital investment is crucial in promoting economic development, as the world is quickly turning into a digital economy. Digital transformation is highly believed to help Nigeria, Africa's biggest economy, achieve sustainable development, poverty alleviation, and help overcome systemic issues like inequality and unemployment. Programs like the National Digital Economy Policy and Strategy (NDEPS) 2020–2030 indicate that the Nigerian government is conscious of the potential; the objectives delineated in the strategy are the utilization of digital technology for the diversification of the economy and the generation of new avenues for jobs. However, there are still great challenges to be overcome before Nigeria can fully reap the benefits of digital investment. A long-standing digital divide exists between rural and urban regions, low digital literacy, less developed internet infrastructure, and restricted access to affordable internet services. As a result of these obstacles, digital technologies are unable to reach so many individuals as they could potentially be and therefore can't contribute fully to economic development. This begs the issue of how well existing digital investment methods are working and what sway they are having on vital economic metrics like GDP growth, job creation, and poverty reduction.

The disparity in the availability of internet and related services throughout the nation is a major problem. There is a substantial disparity in the availability of internet and digital services between rural regions and more populous cities like Abuja and Lagos. Nearly 70% of metropolitan regions in Nigeria have access to broadband services, whereas just 40% of rural populaces have it (NCC, 2022). Because those without access to digital technology are unable to take advantage of the possibilities presented by the digital economy, this digital gap worsens preexisting socio-economic disparities. Many Nigerians, especially those living in poverty, still find it difficult to afford digital gadgets and internet access. A substantial number of Nigerians cannot afford even 1 GB of mobile data since, in congruent with the Alliance for Affordable Internet (2021), the price is almost 5% of the average monthly salary. Considering these difficulties, it is critical to fund specific digital infrastructure projects and enact policies that increase marginalised communities' access to cheap digital services. Another major problem is that most Nigerians do not know how to use computers or smartphones, which means that companies and people cannot take utilisation of digital technology to its maximum potential. Only over 30% of Nigerians have basic digital abilities, i.e. being able to communicate online or applying online services, in congruent with the National Bureau of Statistics (National Bureau of Statistics, 2021). Digital investment has the potential to be more inclusive, but there is a substantial skills gap that affects women, young people, and rural communities. Policymakers and regulators have additional problems due to the quickening speed of technological change. They must strike a balance between encouraging innovation and protecting citizens from digital disruption-related dangers comprising job loss, cybersecurity breaches, and invasions of personal data. Some are worried that conventional industries may see a decline in employment because of the proliferation of digital platforms and automation. This is especially true in nations like Nigeria, where many people rely on informal work arrangements. Considering these difficulties, digital investment must consider not only technological and physical aspects, but also the social, legal, and institutional aspects that affect its effect on economic growth. This research aims to investigate the consequence of digital investment on Nigeria's economic growth, specifically in relation to the human development index.

OBJECTIVES OF THE STUDY

The objectives of the study are to:

i. determine the effect of total broad band subscription on economic development in Nigeria.
ii. evaluate the effect of total internet penetration on economic development in Nigeria.
iii. examine the effect of total digital research and development expenditure on economic development in Nigeria.
iv. ascertain the effect of share of information and technology to GDP on economic development in Nigeria.
v. analyse the effect of total number of telephone lines on economic development in Nigeria.

THEORETICAL LITERATURE

The study adopted the Diffusion of Innovation theory. In 1983, Rogers came up with the theory of the diffusion of innovations. Innovations spread across social systems via a process known as diffusion, which involves specific routes of communication. The transmission of what are essentially novel ideas is the focus of the communication phenomenon known as diffusion (Rogers, 1983). The public views this concept as novel, as an addition to the system that will facilitate better communication within a particular community. Technological progress alters our perceptions, thoughts, and social interactions daily. Technologies like this have simplified many aspects of human life, comprising transportation, finance, security, and communication. As noted in Moga (2010), relative benefit, compatibility, complexity, trialability, and observability are the imperative criteria that affect the acceptance of an invention at the general level. Diffusion of innovations rests on the transmission of new ideas; in other words, communication is the act of producing and exchanging knowledge amongst individuals with the goal of achieving mutual comprehension (Rogers, 1983). A client may approach a business owner with a problem or need, and the owner may suggest the business's innovation as a solution, all because of the intricate nature of doing business. Alternatively, the owner may come up with new innovations to help their business and expand its audience. A theory that attempts to explain the spread and effects of new technology on social and economic systems is the Diffusion of Innovations hypothesis. Relative benefit, compatibility, complexity, trialability, and observability are the five main elements that this theory identifies as affecting the acceptance of innovations. By removing obstacles to adoption and fostering an atmosphere conducive to innovation, digital investment is essential in hastening the spread of digital technology. Electronic commerce, telemedicine, and mobile money have all played important roles in Nigeria's economy and made services that were previously inaccessible more accessible than ever before. For instance, Paga and Opay, both mobile money operators, have rapidly gained acceptance as a means of payment over banking services as the preferred mode of payment in rural areas of Nigeria. One of the reasons digital technologies have gained such widespread popularity is the way they fit into preexisting monetary and cultural norms. New technology does not diffuse around that quickly because of issues with digital literacy and inadequate infrastructure, particularly in rural areas. Investment in digital infrastructure and human capacity development can help Nigeria overcome these humps so that the country can accelerate the diffusion of digital technologies and maximize their economic payoffs. The Theory of Diffusion of Innovations explains how investments in information infrastructure led to economic growth by enabling large-scale consumption of revolutionary technologies.

EMPIRICAL REVIEW

Enock and Lusekelo (2024) scrutinized how digital financial inclusion affected GDP growth in Africa. For women, the economically disadvantaged, the uneducated, and the jobless in the area, digital financial inclusion means having access to and making utilisation of digital financial gadgets and mobile money accounts. Over the course of three years (2014, 2017, and 2022). 35 African nations contributed to the panel data. The study employed the Generalised Method of Moments (GMM) and the Fixed Effect (Fe) Model. The results demonstrate that all economically disadvantaged communities in Africa may benefit greatly from applying digital fiscal services. This encouraging discovery highlights the possibility that digital financial inclusion might propel development and prosperity in the economy.

Miftahu and John (2024) explored how the rise of the internet affected the young unemployment rate in Nigeria. applying National Bureau of Statistics (NBS) temporal data from 2000–2023, the study uses an ex post facto research approach. The study uses data analysis tools like regression analysis and descriptive statistics to look for patterns in the relationships between the factors. The results show that the digital economy substantially affects young unemployment in Nigeria; in fact, it explains almost 67.3% of the variance in youth unemployment.

Marshal (2024) examined the dynamic interaction between digital payment channels and economic growth in Nigeria. This study employed financial time series methods, namely OLS and Granger Causality Techniques, to analyse quarterly data from the Central Bank of Nigeria's Statistical Bulletin (2022). Different digital payment methods have different effects on GDP growth, in congruent with the results. The study found that transactions processed via ATMs and MBAs have a positive and arithmetically significant affect, but POS transactions do not significantly impact anything and EWT transactions have a negative effect.

Olubukola, Ikpefan, Akinrinola, and Itai (2023) scrutinized how digital fiscal services affected the nation's economy. An expo-facto data analysis was carried out on independent factors of digital fiscal services: The dependent variable in this regression is the GDP, while the independent factors are the volume of ATM transactions (VATM), POS transactions (VPOS), WEBPAY transactions

(VWBP), and mobile banking (VMOB). The study employed OLS regression to extract them from the 2017 CBN Statistical Bulletin. As per the study's results, the Nigerian economy benefits from higher volumes of mobile banking, point-of-sale transactions, and ATM volume, with ATM volume having the greatest outcome on GDP as a measure of economic growth in Nigeria. On the other hand, web service volume hurts GDP in Nigeria.

Olabode (2023) investigated how the digital economy and good institutions affected the development of the economies of four nations: Nigeria, Ethiopia, Kenya, and Bangladesh. This research uses yearly panel data from 1985–2017 and the practical generalised least squares approach. Corruption, socioeconomic factors, and bureaucratic quality impede economic progress, but human capital, knowledge workers, and democratic accountability all contribute to a thriving digital economy. In addition, corruption in the digital economy stimulates development. This might be because these nations have a low degree of economic digitalisation and a decline in institutional quality, both of which interact with the digital economy to slow down economic development. Researchers concluded that improving institutional quality and the digital economy may help nations become emerging markets.

Bridget (2023) assessed the state of preparedness, obstacles, and opportunities for applying digital technology to improve DE development in Nigeria. To get the right information from the right people, the research employed primary and secondary sources. The 127 IT and related sector experts from Nigerian businesses and universities who participated in a Google poll were the main sources of information gathered. To validate the survey upshots, we conducted both formal and informal interviews with key stakeholders. Websites of various governments, academic journals, books, and newspapers were all considered secondary sources. In congruent with the research, between 45 and 50 percent of Nigerians are prepared to develop DEs. The National Digital Economy Policy and Strategy (NDEPS), Internet Penetration, and the adoption of emerging technologies are the most developed readiness indicators.

Joseph, Simeon, Benison, and Jamilu (2023) scrutinized the consequence of FDI on the production of Nigeria's service industry. Government expenditure (GEX) and exchange rate (EXR) served as control factors, while service sector output (SSO) served as the regresand and FDI was the key regressor. The CBN Statistical Bulletin 2020 served as the data source. The study utilises ECM because of the factors. FDI has a beneficial effect on service sector production, in congruent with the short-term ECM dynamic model. The research found a positive and arithmetically significant lag value for service sector production, which means that in Nigeria, service sector output positively reacts to previous service sector output.

Ogbonna, Chukwuma-Ogbonna, Nwachukwu, and Uzoma (2023) scrutinized how FDI affected Nigeria's GDP growth. The first step of the study is to use the ADF unit root test to check whether the data set is stationary. In the long run, the Bounds test showed that FDI has a unfavourable association with the economy. However, in the short run, FDI has a favourable relationship with the economy, while PI and the trade balance both have unfavourable relationships.

Opeyemi and Olamileke (2022) investigated how digital investments affected the growth of Nigeria's stock market. The dependent factors comprised market capitalisation, stock trading volume, and all share index, while digital investment served as the independent variable. This study tested three hypotheses applying the ARDL estimation approach. The research showed that all share indices were positively and non-significantly affected by digital investment. Additionally, market capitalisation is positively and significantly affected by digital investment. Digital investment substantially and positively affects stock trading volume, it also showed. The research also proved that digital investing and stock market indexes go hand in hand over the long term.

Ariadna, Yuri, and Marina (2022) scrutinized how digitisation affected GDP growth in Russia. This research employed the following factors to measure the effect of digitalisation on economic growth: GDP per capita, Global Competitiveness Index, Index of Digital Life, Digital Adoption Index, and Resilience Index. The researchers found that digital technologies cannot significantly impact the economic growth rate due to the current status of the macroenvironment and the populace's preparedness for digital transformation, as per their thorough assessment applying a three-pronged methodology.

Silva and Ijeoma (2022) employed temporal data from 1981 to 2018 to look at how FDI affected real sector performance in Nigeria. Exchange rate, remittance, trade openness, and GDP recorded FDI, whereas manufacturing and agriculture sector output reflected actual sector performance. This research employed secondary data. For this investigation, we employed the ARDL regression method. Within the time frame of the investigation, the co-integration results of the two models show that FDI and the real sector do in fact have a long-run connection.

METHODOLOGY

Research Design

Research design is the "blueprint" that helps the researcher solve issues and follows different steps in the research process (Stangor, 2007). The research design provides a framework for organising data gathering, processing, and interpretation. To demonstrate a connection between the independent factors and the dependent variable, this study employed an ex-post research methodology, which is essential since it reveals the cause-and-effect nexus between the two. It details the processes and procedures employed for gathering data, creating the test instrument, and validating it. This style lays bare the researcher's utilisation of scientific methodologies in their methodical problem-solving process. Because this study makes utilisation of historical data, the event under consideration has already occurred, and the researcher has no sway over the factors, which is why this research design is so crucial.

Data Collection and Sources

The study employed quarterly data. This study's data came from a variety of places, comprising publications from the Nigerian Communications Commission (NCC), the World Bank's World Development Indicator (WDI), and the National Information Technology Development Agency (NITDA). Credible and trustworthy sources of information were these. The research employed data collected over a twelve-year period (2012 2023).

Model Specification

The study expressed the model in its functional, mathematical and econometric forms respectively:
The functional function of the model can be expressed as follows:

$$HDI = f(TBBS, TIP, TDRD, SIF, TNTC) \quad (3.1)$$

The model is expressed as follows to demonstrate the mathematical link in a linear form:

$$HDI = \beta_0 + \beta_1 TBBS + \beta_2 TIP + \beta_3 TDRD + \beta_4 SIF + \beta_5 TNTC \quad (3.2)$$

Incorporating the error or stochastic factor (ꝏt) into our econometric model, our model will transform into.

$$HDI = \beta_0 + \beta_1 TBBS + \beta_2 TIP + \beta_3 TDRD + \beta_4 SIF + \beta_5 TNTC + \text{ꝏ}_t \quad (3.3)$$

Long-Run ARDL Model

The model's long-run ARDL standard is as follows:

$$\Delta\ln(HDI_t) = \beta_0 + \beta_{1i}\Delta\ln(HDI_{t-1}) + \beta_{2i}\Delta\ln(TBBS_{t-1}) + \beta_{3i}\Delta\ln(TIP_{t-1}) + \beta_{4i}\Delta\ln(TDRD_{t-1}) + \beta_{5i}\Delta\ln(SIF_{t-1}) + \beta_{6i}\Delta\ln(TNTC_{t-1}) + \sum_{t=1}^{p}\delta_{1i}\Delta 1n(HDI_{t-1}) + \sum_{t=1}^{q}\delta_{2i}\Delta 1n(TBBS_{t-1}) + \sum_{t=1}^{p}\delta_{3i}\Delta 1n(TIP_{t-1}) + \sum_{t=1}^{q}\delta_{4i}\Delta 1n(TDRD_{t-1}) \sum_{t=1}^{q}\delta_{5i}\Delta 1n(SIF_{t-1}) + \sum_{t=1}^{p}\delta_{6i}\Delta 1n(TNTC_{t-1}) + \delta ECMT_{t-1} + \varepsilon_{1i} \quad (3.4)$$

Where: HDI = human development index, TBBS = total broad band subscription, TIP = total internet penetration, TDRD = total digital research and development expenditure, SIF = share of information and technology to GDP, TNTC = total number of telephone lines, *f* = Functional relationship, β_0, α_0 = Regression intercept, β_1- β_5 = Co-efficients or parameters linked to the independent factors in HDI model, $\mathbb{O}_t$ = Stochastic or error term which captures the consequence of factors that are not comprised in the model.

Data Analysis Techniques

Using descriptive statistics for all of the model factors was the first step in analysing the data for this research. Descriptive statistics revealed details about the mean and median for each set of observations across the study period, likewise dispersion measures (standard deviation, maximum and minimum values), and skewness and kurtosis characteristics of the dependent and independent factors. Following this, the research estimated a co-integrating regression and as mentioned before, performed pre-estimation tests to make sure the model was not spurious. The unit root test result informed the choice to use the ARDL approach, which accounts for factors applying a combination of I(0) and I(1) series.

DATA PRESENTATION AND DISCUSSION OF RESULTS

Descriptive Statistical Analysis

Presented below are the outcomes from the descriptive statistical analysis:

Table 4.2: Descriptive Statistics

	HDI	GDP	TBBS	TIP	TDRD	SIF	TNTC
Mean	0.536438	32859.26	62.78958	27.98125	63.10833	8986.728	87.11388
Median	0.531500	30038.62	68.75000	26.65000	57.75000	7964.845	83.09400
Maximum	0.599000	65908.26	117.9000	62.80000	94.90000	13297.18	137.4450
Minimum	0.507000	16450.36	11.30000	14.70000	34.67000	6211.110	61.32000
Std. Dev.	0.020779	12486.86	29.69349	8.666164	18.94360	2187.268	16.22705
Skewness	1.231031	0.780187	-0.174545	1.305486	0.186015	0.652058	0.889473
Kurtosis	4.096067	2.778923	2.202419	6.524120	1.512904	2.096340	3.791830
Jarque-Bera	14.52622	4.967287	1.516000	38.47319	4.699721	5.034641	7.583285
Probability	0.000701	0.083439	0.468603	0.000000	0.095382	0.080676	0.022559
Sum	25.74900	1577244.	3013.900	1343.100	3029.200	431362.9	4181.466
Sum Sq. Dev.	0.020294	7.33E+09	41440.06	3529.813	16866.43	2.25E+08	12375.90
Observations	**48**	**48**	**48**	**48**	**48**	**48**	**48**

Source: Computation from author (2025).

From 2012Q1 to 2023Q4, the descriptive data indicated that the HDI ranged from 0.507 to 0.599, with an average value of 0.536. A Jarque-Bera value of 14.526 and a probability value of 0.0007 indicate that the human development index (HDI) does not follow a normal distribution.

Unit Root Test

ADF Test summarising the results:

Table 4.3: Augmented Dickey-Fuller (ADF) Test Upshots

Factors	ADF	Mackinnon Critical Value @ 5%	P-value (Prob.*)	Decision	Order of Integration
ADF At Levels					
LOG(HDI)	2.674566	-2.926622	1.0000	Non-stationary	
LOG(GDP)	1.385291	-2.931404	0.9987	Non-stationary	
LOG(TBBS)	-3.164332	-2.931404	0.0292	Stationary	
LOG(TIP)	-1.894481	-2.926622	0.3320	Non-stationary	
LOG(TDRD)	-0.093219	-2.925169	0.9441	Non-stationary	
LOG(SIF)	0.616569	-2.925169	0.9888	Non-stationary	
LOG(TNTC)	0.951643	-2.925169	0.9954	Non-stationary	
ADF At First Difference					
LOG(HDI)	-5.279002	-2.926622	0.0001	Stationary	I(1)
LOG(GDP)	-3.042307	-2.931404	0.0000	Stationary	I(1)
LOG(TBBS)	-	-	-	-	I(0)
LOG(TIP)	-7.727249	-2.928142	0.0000	Stationary	I(1)
LOG(TDRD)	-4.573034	-2.929734	0.0006	Stationary	I(1)
LOG(SIF)	-7.422079	-2.926622	0.0000	Stationary	I(1)
LOG(TNTC)	-5.678423	-2.926622	0.0000	Stationary	I(1)

Source: *Computation from author (2025).*

Table 4.3, the Mackinnon critical value for rejecting unit root hypotheses shows that total wide band subscription (TBBS) is level and integrated of order zero, I(0), meaning it is stable. Further, after first differencing, the following factors—human development index (HDI), gross domestic product (GDP), total internet penetration (TIP), total digital research and development expenditure (TDRD), share of information and technology to GDP (SIF), and total number of telephone lines (TNTC)—are stationary and, thus, integrated of order one, I (1). With factors integrated at Order 1(0) and Order 1(1), the best approach is to use the ARDL estimate methodology.

ARDL Bounds Co-integration Test

The table shows the results of the ARDL Co-integration test conducted in this study:

Table 4.4: ARDL Bound Co-integration Test Result

Test Statistic	Value	K
F-statistic	5.836673	5
Significance	Lower Bound [I(0)]	Upper Bound [I(1)]
10%	2.08	3
5%	2.39	3.38
2.5%	2.7	3.73
1%	3.06	4.15

Source: *Computation from author (2025).*

In line with Table 4.4, which displays the results of the ARDL bound co-integration test, the model factors HDI, TBBS, TIP, TDRD, SIF, and TNTC are all cointegrated, meaning that their respective values are above the upper bound critical value and lower bound critical value at 5%. In other words, the following factors are good long-term predictors of HDI: total broadband subscription (TBBS), total internet penetration (TIP), total digital research and development expenditure (TDRD), amount of telephone lines (TNTC), and share of information and technology to GDP (SIF).

Short Run ARDL Estimation of Human Development Index (HDI) Model

This part estimates the short run ARDL HDI model, as described in chapter three, applying the statistical program Econometric Views (E-Views) 12. The results in Table 4.5 below:

Table 4.5: Results of Short Run ARDL Estimation of Human Development Index (HDI) Model

Variable	Co-efficient	Std. Error	t-Statistic	Prob.*
Dependent Variable = LOG(HDI)				
DLOG(HDI(-1))	0.318125	0.129643	2.453850	0.0200
DLOG(TBBS)	0.014578	0.005957	2.447219	0.0203
DLOG(TBBS(-1))	-0.007108	0.005861	-1.212617	0.2344
DLOG(TBBS(-2))	0.001078	0.002254	0.477977	0.6360
DLOG(TIP)	0.016495	0.006002	2.748420	0.0099
DLOG(TIP(-1))	-0.005341	0.002528	-2.112670	0.0428
DLOG(TDRD)	0.034161	0.016411	2.081515	0.0457
DLOG(SIF)	0.383299	0.198847	1.927604	0.0625
DLOG(TNTC)	1.753166	0.951422	1.842679	0.0744
CointEq(-1)*	-0.058154	0.008328	-6.983156	0.0000
R^2 = 0.779865; Adjusted R^2 = 0.738217; Durbin-Watson stat = 1.754453				

Source: *Computation from author (2025).*

Interpretation of the Parameters: Total wide band subscription has a positive nexus with HDI (r=0.014578), suggesting a link between the two. What this implies is that, for every one-unit increase in total wide band subscription, the HDI will rise by 0.014578, and for every one-unit reduction, the index will fall by 0.014578.

When looking at the short-term association between total internet penetration and HDI, the co-efficient of total internet penetration is 0.016495, suggesting a positive correlation. What this implies is that for every one-unit increase in total internet penetration, the HDI will rise by 0.016495, and for every one-unit decline in total internet penetration, the index will fall by 0.016495, at least in the near term.

It is worth noting that the total digital research and development spending co-efficient (0.034161) suggests a positive association between this variable and the HDI. Because of this, a unit increase in total digital R&D spending will result in a 0.034161 rise in the HDI, while a unit decrease will cause a 0.034161 fall.

Furthermore, the proportion of information and technology to GDP co-efficient of 0.383299 suggests a positive nexus between this metric and the HDI. This indicates that, the HDI will increase by 0.383299 for every one unit rise in the percentage of technology and information to GDP, and that it will decrease by the same amount for every one unit fall in the share of technology and information to GDP.

Finally, the total number of telephone lines has a positive nexus with the HDI, as is shown by the co-efficient of total number of telephone lines (1.753166). If the total number of telephone lines were to increase by one unit, the HDI would rise by 1.753166; conversely, if the total number of telephone lines were to decline by one unit, the HDI would fall by 1.753166.

Significance of Individual Parameters [T-statistics (Prob. values)]:

At the 5% level of significance, this checks if the model parameter is arithmetically significant. As per the ARDL result, we can infer that complete wide band subscription is arithmetically significant in the short term since the p-value of 0.0203 is smaller than the alpha value of 0.05 and the t-statistic value of 2.447219 is more than 1.96.

Additionally, overall internet penetration is arithmetically significant in the short run because the t-statistic value of 2.748420 in absolute terms is larger than 1.96 and the p-value of 0.0099 is below the alpha value of 0.05.

In addition, there is a statistical significance in the short run for total digital research and development expenditure (p = 0.0457, which is below the alpha = 0.05) and a t-statistic value of 2.081515 (in absolute terms, above 1.96).

Furthermore, we infer that the information and technology to GDP share is not arithmetically significant in the short run since the t-statistic value of 1.927604 is below 1.96 and the p-value of 0.0625 is higher than the alpha value of 0.05.

After reviewing the ARDL results, we can conclude that the total number of telephone lines is not arithmetically significant in the short term since the p-value of 0.0744 is more than the alpha value of 0.05 and the t-statistic value of 1.842679 is below 1.96.

Interpretation of Adjusted R-Squared:

The Adjusted R-squared value is 0.738217, as obtained from the estimated ARDL short-run results. Thus, after adjusting for the co-efficient of determination, we find that the following factors account for about 74% of the variance in the HDI: total broadband subscription, total internet penetration, total digital research and development expenditure, share of information and technology to GDP, and total number of telephone lines. The error term, which captures the remaining 26% of the variation, represents unknown factors outside the model.

Interpretation of CointEq(-1) Values: Finally, the cointEq(-1) result in Table 4.5 indicates a large negative co-efficient for the error correction term. Put differently, the negative sign demonstrates its importance. Because of this, we may assume that CointEq(-1)* will successfully fix any long-run equilibrium problems. With a CointEq(-1)* co-efficient of -0.058154, we can see that, excluding a correction of any deviations in the past, the rate of adjustment to long-run equilibrium is 6%. This indicates that changes in total broadband subscription, total internet penetration, total digital research and development spending, total number of telephone lines, contribution of information and technology to GDP, and total number of broadband subscribers have a relatively gradual effect on the current value of the HDI.

Long Run ARDL Estimation of Human Development Index (HDI) Model

Here we estimate the long run ARDL HDI model, as described in chapter three, applying the statistical program Econometric Views (E-Views) 12. The results in Table 4.6 below:

Table 4.6: Results of Long Run ARDL Estimation of Human Development Index (HDI) Model

Dependent Variable: LOG(HDI)				
Variable	**Co-efficient**	**Std. Error**	**t-Statistic**	**Prob.***
LOG(TBBS)	0.334585	0.112436	2.975793	0.0054
LOG(TIP)	0.401342	0.107980	3.716820	0.0007
LOG(TDRD)	0.473316	0.213130	2.220782	0.0333
LOG(SIF)	0.094489	0.171715	0.550270	0.5861
LOG(TNTC)	0.784545	0.581915	1.348214	0.1874
C	-4.034742	2.120384	-1.902836	0.0664

Source: *Computation from author (2025).*

Interpretation of the Parameters: The positive nexus between total wide band subscription and HDI (r=0.334585) suggests a link between the two factors. Thus, in the short term, a unit increase in total wide band subscription will result in a 0.334585 rise in the HDI, while in the long run, the same unit increase will cause a 0.334585 decline in the index.

Total internet penetration has a negative nexus with HDI over the long term (0.401342), in congruent with the co-efficient. In other words, for every one unit increase in total internet penetration, the HDI will rise by 0.401342, and for every one unit drop in total internet penetration, the index will fall by 0.401342.

Additionally, the total digital R&D expenditure co-efficient (0.473316) suggests a positive nexus between the two factors, total digital R&D expenditure and HDI. If we were to raise spending on digital R&D by one unit, the HDI would rise by 0.473316; conversely, if we were to reduce spending on digital R&D by one unit, the HDI would fall by 0.473316 over time.

A further piece of evidence linking the information and technology share to GDP and the HDI is the co-efficient of this connection, which is 0.094489. This indicates that for every one unit increase in the proportion of IT to GDP, the HDI will rise by 0.094489, and for every one-unit decline in that proportion, the HDI will fall by 0.094489 over the long term.

Finally, the total number of telephone lines has a positive nexus with the HDI: the co-efficient is 0.784545. In other words, if the total number of telephone lines were to increase by one unit, the HDI would rise by 0.784545, and if the total number of telephone lines were to decline by one unit, the index would fall by 0.784545.

Significance of Individual Parameters [T-statistics (Prob. values)]: At the 5% level of significance, this checks if the model parameter is arithmetically significant. As per the ARDL result, we can infer that total wide band subscription is arithmetically significant in the long run since the t-statistic value of 2.975793 is more than 1.96 and the p-value for total broad band subscription is below the alpha value of 0.05.

We also find that total internet penetration is arithmetically significant in the long run since the t-statistic value of 3.716820 in absolute terms is more than 1.96 and the p-value for total internet penetration is below the alpha value of 0.05.

Our long-term analysis also shows that total digital R&D spending is arithmetically significant, with a p-value of 0.0333 being lower than the alpha value of 0.05 and a t-statistic value of 2.220782 in absolute terms being higher than 1.96.

In addition, the t-statistic value of 0.550270 is below 1.96 and the p-value for the information and technology to GDP share of 0.5861 is above the alpha value of 0.05, so we conclude that this share is not arithmetically significant in the long run.

The ARDL result concludes that total number of telephone lines is not arithmetically significant in the long run because the p-value of 0.1874, which is more than the alpha value of 0.05, and the t-statistic value of 1.348214, which is below 1.96.

Post-Estimation Tests of Human Development Index (HDI) Model

The results of Post Estimation Tests are presented below:

Table 4.7: Post-Estimation Tests Upshots HDI Model

Test	F-Statistic	Probability	Null Hypothesis	Decision
Normality Test	2.860436	0.2392	**H_0:** Normally distributed	Retain H_0
Serial nexus LM Test	0.068799	0.9337	**H_0:** No serial correlation	Retain H_0
Heteroskedasticity Test	1.752112	0.0987	**H_0:** Homoscedasticity	Retain H_0
Ramsey RESET test	3.713093	0.0842	**H_0:** Correctly specified	Retain H_0

Source: *Computation from author (2025).*

As per the results of the Jarque Bera (Normality) test in Table 4.7, it is not possible to reject the null hypothesis of normal distribution since the probability value (0.2392) is larger than the 0.05 levels of significance. Because of this, we may infer that the model follows a normal distribution and accept the null hypothesis.

In Table 4.7, we can see the results of the Breusch-Godfrey Serial nexus LM test. The probability values (0.9337) are higher than the 0.05 threshold of significance, which means that we cannot reject the null hypothesis of no serial correlation. Because of this, we may infer that the model does not have a serial nexus issue and accept the null hypothesis.

Table 4.7 displays the upshots of the Breusch-Pagan-Godfrey heteroskedasticity test; there exist no way to reject the null hypothesis of homoscedasticity since the probability values (0.0987) are higher than the 0.05 levels of significance. This leads us to believe that the model is homoscedastic, because we must accept the null hypothesis. It follows that they did not leave out any essential factors.

Finally: in line with Table 4.7's Ramsey RESET test results, the probability values (0.0842) are higher than the 0.05 significance thresholds, thus we cannot rule out the possibility that the null hypothesis is valid. This proves the model is well-specified as it calls for accepting the null hypothesis. This proves that the model's functional form is accurate.

DISCUSSION OF FINDINGS

The research found that digital investment contributed to Nigeria's economic growth. Total wide band subscription positively and significantly affects Nigeria's HDI in the short and long term, in in line with the study's results. This suggests that total wide band subscription, which is a measure of digital investment, has had a positive and significant outcome on the short- and long-term economic growth of Nigeria. This is in lines with what Marshal (2024) found, which is that digital payment channels, of which complete wide band subscription is a key component, greatly aid economic progress in Nigeria.

The research also found that overall internet penetration positively and significantly affects Nigeria's HDI in the short and long term. This suggests that overall internet penetration, which is a measure of digital investment, has significantly aided Nigeria's economic growth in the short and long term. These results are in line with those of Olubukola, Ikpefan, Akinrinola, and Itai (2023), who found that total internet penetration—an indicator of the digital economy—was significantly related to economic growth. This suggests that total internet penetration played a significant role in determining economic growth in Nigeria.

Furthermore, this study's results demonstrated that overall digital R&D spending positively and significantly affects Nigeria's HDI in the short and long term. Taken together, these results suggest that Nigeria's economy has benefited greatly from overall digital R&D spending, which is a good indicator of digital investment. Consistent with this result, László (2024) discovered that overall spending on digital R&D is significantly associated to long-term economic growth in Nigeria.

In addition, the research found that the HDI in Nigeria are positively and non- significantly affected by the proportion of information and technology to GDP in the medium and long term. It follows that the percentage of GDP attributable to IT, as a measure of digital investment, has contributed positively and insignificantly to Nigeria's economic growth, both in the short and long term. Olabode (2023) came to a similar conclusion, stating that IT is a crucial component of the digital economy that contributes to Nigeria's GDP development.

Finally, the research found that total telephone lines had a positively but non- significant sway on HDI in Nigeria over the short and long terms. This suggests that the total number of telephone lines, which is a measure of digital investment, has had a positive but little outcome on Nigeria's economic progress, both in the short and long term. The results of Bridget (2023), who found that the total number of telephone lines had a negligible beneficial effect on economic development, corroborate these results.

CONCLUSION AND RECOMMENDATIONS

Conclusion

A game-changer in Nigeria's economy, digital investment has opened doors to long-term prosperity, new employment opportunities, and the alleviation of poverty. The widespread utilization of digital technology can boost productivity, innovation, and inclusiveness in many different areas; these are all areas in which Nigeria, the biggest economy in Africa, stands to gain greatly. Considering the above, this research set out to objectively ascertain the consequence of digital investment on Nigeria's economic growth. Research shows that key indicators of digital investment and economic growth in Nigeria comprise total broadband subscription, total internet penetration, total digital research and development expenditure, total number of telephone lines, and the contribution of information and technology to GDP. Researchers in this research concluded that digital investment is critical to the acceleration, improvement, and maintenance of Nigeria's economic growth.

Recommendations

The following recommendations are provided in this study:

i. Investing in fiber-optic networks and 5G technology throughout the nation, especially in rural regions that are underserved, should be a top priority for the Nigerian government as it aims to increase overall broadband connections. From digital extension services in agriculture to mobile banking in the financial sector, augmented broadband penetration may boost productivity in all kinds of industries. In addition to subsidies for low-income subscribers, public-private partnerships (PPPs) with telecom companies help speed up rollout.

ii. Nigeria must launch digital literacy initiatives aimed at women, young people, and small and medium-sized enterprises (SMEs) if it wants to use overall internet penetration to fuel economic growth. Tech hubs, NGOs, and the government should work together to educate the public about digital fiscal services, remote jobs, and online shopping.

iii. To keep up with competitors like South Africa, Nigeria must increase its overall spending on digital R&D. University and tech incubator research on artificial intelligence, blockchain, and the internet of things should get specific funding from the government. As the information technology (IT) boom in India attests, tax breaks for private sector R&D expenditures may encourage innovation.

iv. Nigeria may encourage tech companies with incentives, lower corporate taxes, and simplified regulations to increase the contribution of ICT to GDP. Reforms to STEM education and visa processes for international tech specialists should be the policy focusses of local governments to increase their tech talent pools.

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