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Research

The Impact of Technological Advancement on Economic Development of Nigeria

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Abstract: This study investigates the impact of technological advancement on economic development in Nigeria, with specific focus on Information and Communication Technology (ICT), education technology, and banking technology innovation. Motivated by the paradox of documented technological progress in Nigeria alongside persistently stunted economic development, the study employs ordinary least squares (OLS) regression analysis on data spanning 2016 to 2024, sourced from the National Bureau of Statistics (NBS) and UNESCO reports. Three econometric models were specified to test the effect of each technology innovation variable on Nigeria's Gross Domestic Product (GDP) growth rate. Findings reveal that ICT innovation accounts for approximately 58% of the variability in GDP growth, while banking technology innovation and education technology innovation explain 7.47% and 4.88%, respectively. Hypothesis testing confirmed that all three forms of technological innovation ICT, banking, and education have statistically significant effects on economic growth in Nigeria. The study concludes that technology innovation positively and significantly drives economic development in Nigeria, and recommends increased government budgetary allocation toward ICT, education, and the banking sector, as well as broader replication of this research across other economic sectors to deepen understanding of technology's role in Nigeria's development trajectory.

Keywords: Technological Advancement, Economic Development, ICT Innovation, Banking Technology, Education Technology, Nigeria, GDP Growth, OLS Regression

Introduction

Economic development covers almost every discussion today because economic development creates a society with the ability to solve nearly all the problems of mankind such as poverty, unemployment, hunger, disease, dependency, debt burden etc. Hence, it

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enhances employment, income, output, standard of living, health care, education and self-reliant etc. (Andreea , Olivera and Florina 2015).

According to Eke, Agala and Offum, (2019) for economic development to take place in any society, the available inputs resources must be utilized through a technological process to provides the quantity of outputs resources that is sufficient for consumption, saving and investment. But most societies do not have sufficient inputs resources to produce the quantity of outputs resources needed to stabilize the space for economic growth. Hence the only viable approach for societies to become wealthier and maintain the space for economic growth is how to keep getting more output from the same number of inputs resources available and technological innovation is the only device that guaranteed such economic growth event (Eke, Agala and Offum, (2019).

According to Eke, Agala and Offum, (2019).Joseph Schumpeter had earlier proposed technology innovation as the sure criteria for economic development across nations and in recent century, full attention are turn to technology innovation in order to achieve economic development. As a result, for decades, economists have sought to improve their understanding of the effect of technological innovation on economic development, the debate among researchers and policy makers revolves around how technological innovation accounts for the differences in economic development across countries and over time. Schumpeter (1912) had argued that technology innovation prompts a new business to replace old ones. Subsequently, technology innovation was considered in the Solow growth model as a driver of long-run growth of output per worker. Certainly, it is a plausible argument that technological innovation is the reason more output can be produced today from a given quantity of capital and labor than could be produced a century ago (Romer, 1996 cited by Eke, Agala and Offum, 2019).

In recent times, these efforts have reached a point where they are generating robust, substantive and intellectually interesting findings, to the benefit of those interested in promoting economic development by adopting and enhancing new methods of doing things. This has proven technological innovation as an important driver of a positive economic development performance and the ability to undertake innovation has become a major concern and a source of competitive advantage in space of economic development (Nwosu, Ubi and Fred 2022).

According to Mousume (2022) the growing role of technological innovation in economic development has been lauded among the Europeans nations as a survey for 12

European countries suggest that over 30% of manufacturing turn over based improved products and output continues to rise across the continent while patent data show a surge of technological advancement. A similar report is given in the United States of America. A recent analysis of US economy found that more than 70% yield in GDP is the in US is the outcome of technological advancement. The US technology innovation is more global, arising from many sources and is spread more widely across sectors of the economy thus, broadening the basis for the US economic development and growth (Mousume 2022).

Mousume (2022) posited that in the last decade, Asia has accounted for 52% of global growth in tech-company revenues, 43% of startup funding, and 51% of spending on research and growth (The region is experiencing a new wave of growth led by younger societies from India to the Philippines. Today's infrastructure investments are the platform for the next generation of digital innovation and in the last decade, Asia has expanded its infrastructure and technological capabilities making both economic progress and rapid strides in human growth, Human Capital and innovation. Asia has embraced the digital revolution across industries including retail, banks, education, information and communication, finance, transportation, e-commerce and healthcare etc. (Mousume Roy , 2022).

There is a noticeable technological innovation effort over the years in the Nigeria across industries. The main features of technological innovations in Nigeria are the growing impact of information and communications technologies (ICT), Banking,education among others (Nwosu, Ubi and Fred 2022). According to Nwosu, Ubi and Fred (2022) the financial sector has over time developed successfully with technological innovation products and services available in financial market. Some of these technological innovations is the used of debit cards, credit cards, ATM cards and mobile banking technologies such as point of sales (POS), Opay, internet banking and others products that facilitate the use of electronic means of payment. The overall goal of all these efforts is to bring about economic growth through technology innovation (Nwosu, Ubi and Fred 2022).

The quest for technology innovation has become contentious across industries in Africa and Nigeria in particular. According to Nwosu, Ubi and Fred (2022) Today, more than ever before, innovation, enterprise and intellectual assets drive economic growth a of a country. Technology innovation is instrumental in creating new jobs, providing higher incomes, offering investment opportunities, solving social problems, curing diseases, safeguarding the environment, protecting our security and transparency in organizations

and governments (Štreimikien, 2014 cited by Nwosu, Ubi and Fred (2022)). Speaking in agreement; Festus (2023) posited that in Africa and Nigeria in particular, technology innovation has taken place in several sectors; including banking, ICT and education sector According to world bank (2023) the average value of technology innovation index for Nigeria is 23.28 points. This shows a very high performance of Nigeria in technology innovation when compared with the world average of 32.09 points based on 128 countries (Festus, 2023).

Yet several stake holders in Nigeria has argued that the significance of technological advancement on economic development is yet to be realized across various sectors and states in Nigeria, According to Darius (2015) opined that economic development efforts has been deployed over the years in Nigeria yet; the level of economic development has remained stunted. He posited that after several efforts of technology advancement inputs; there is still a troubling economic development situation in the country. According to Ozozoyin (2023) the government of Nigeria has seeks diaspora involvement in the rescue of Nigeria economic development and growth, statistical report on Nigeria economic growth variables has uncovered a poor growth performance. This report has become very glaring for the researcher to peruse the effects of technological advancement on economic development in Nigeria so as to uncover if the various reported technology advancement efforts in Nigeria has affected the state of economic development in Nigeria

Statement of Problem

Economic development is a serious concern today in every society as economic development success provides a society with the ability to solve the problems of mankind such as poverty, unemployment, hunger, disease, dependency, debt burden among others. And from history, economist has been trying to provide alternative solutions to the problem of economic development. As a matter of concern Schumpeter (1912) cited by Agala and Offum, (2019) proposed technology advancement as a viable tool for solving economic development problems by affirming that technology advancement is the basis for economic development. Agala and Offum, (2019) posited that technology advancement is the reason for the development record in Europe, America and Asia. In fact, it has become a plausible argument that technology advancement is the only reason for economic development among nations and states today. Festus, (2023) opined that there have are several technological advancement through innovation efforts in Nigeria across various industries and state. According to Festus (2023) in Nigeria, technology advancement has taken place

in banking, education, ICT and other sectors. In the financial sector, some of these technology advancement through innovations effort is made through the use of modern financial technologies such as debit cards, credit cards, ATM machines, point of sale POS and mobile banking with other products that facilitate the use of electronic means of payment. To crown it all, world bank (2023) reported that the average value of technology innovation index for Nigeria is 23.28 points, this shows a very high performance of Nigeria in technology advancement when compared with the world average of 32.09 points based on 128 countries. However, with all the technology advancement effort innovation efforts, unanimous reports on economic development outcomes in Nigeria has held that the level of economic development has remained stunted in Nigeria and even with internal technology advancement efforts to control the situation through the various forms of technology innovation. Ozozoyin, (2023) has argued that there is still an alarming poor economic development situation in Nigeria which has compel the government to seek for external intervention. This has created the puzzling question of whether the various technology advancement through innovation efforts in Nigeria has in any way affected economic development in Nigeria? Attempt to give answer to this puzzling question is the main gab that the investigator is attempting to cover via investigating the effects of technology innovations on economic growth in Nigeria with emphasis on the effect of ICT, Education and Banking technology advancement on economic development in Nigeria.

Research Objectives

The general objective of this study is to examine the effect of technology advancement on economic development in Nigeria.

The specific objectives are:

1. To examine the effect of Information and Communication Technology (ICT) advancement on economic development in Nigeria
2. To examine the effect of banking technology advancement on economic development in Nigeria.
3. To examine the effect of education technology advancement on economic development in Nigeria.

Research question

The following Questions will guide this research work

1. What is the effect of Information and Communication Technology (ICT) advancement on economic development in Nigeria?

2. What is the effect of banking technology advancement on economic development in Nigeria?
3. What is the effect of education technology advancement on economic development in Nigeria?

Research hypothesis

HO1: Information and Communication Technology (ICT) advancement has no significance effect on economic development in Nigeria!

HO2: Banking technology advancement has no significance effect on economic development in Nigeria!

HO3: Education technology advancement has no significance effect on economic development in Nigeria!

Literature review

Economic development

Anne August, (2023) posited that economic development is the process whereby simple, low-income national economies are transformed into modern industrial economies and that, the term is sometimes used as a synonym for economic growth, generally it is employed to describe a change in a country's economy involving quantitative and qualitative improvements. Economic development is taken to be structural transformation of an economy by introducing more mechanized and updated technologies to increase labour productivity,employment, incomes and stand of living of the population, an increase in the production of economic goods and services in one period of time compared with a previous period (Anne August, (2023).

According to Munichiello and Charles (2023) Economic development is an increase in the production of goods and services in an economy. Increases in capital goods, labor force, technology, and human capital can all contribute to economic development. Economic development is commonly measured in terms of the improvement in the standard of living of the population, aggregated market value of additional goods and services produced, using estimates such as GDP. The four phases of economic growth are expansion, peak, contraction, and trough. In simplest terms, economic growth refers to an increase in aggregate production in an economy, which is generally manifested in a rise in national income. Often, but not necessarily, aggregate gains in production correlate with increased average marginal productivity. That leads to an increase in incomes, inspiring

consumers to open up their wallets and buy more, which means a higher material quality of life and standard of living (Munichiello and Charles 2023).

Broadly, economic growth and development is taken to be the structural transformation of an economy by introducing more mechanized and updated technologies to increase labor productivity, employment, incomes, and standard of living of the population. Economic growth should be accompanied by improvements in infrastructure, as well as social, political, and institutional factors to facilitate transformation of the economy (Myint and Krueger 2016 cited by Prabha 2021). Economic growth and development is regarded as important for a country to reduce its poverty by providing more employment, higher incomes, improved goods and services, and latest technologies of production. But the crux of the problem however, is that the framework for economic growth modern technology, industrial sector, and infrastructural facilities has not yet been established in many countries of the world due to various historical and political reasons (Prabha 2021).

Technology Innovations in Nigeria

The various forms of technology innovation sofar experience in the world Nigeria and Nigeria inclussively however, ICT, Education and Banking technology innovation are considered in this study based on the objectives.

Information and Communication Technology ICT Innovation in Nigeria

According to Upgrad (2022) ICT innovation has made the system of our regular duties easy and comfortable with the invention and innovations of new technologies. ICT innovation has played a vital role in economic by impacting on all sectors growth sectors. 17 Best List of Latest ICT y innovations has been affecting our income, education export, exchange rate, employment, standard of living etc. involved in many sectors of our life. (Tech Republic 2022). Upgrad (2022) has upheld the following as the effects of ICT innovations on economic growth

1. 5G Network: The 5G network brings revolutionary changes in the whole world. It is most helpful for the fastest service in the modern sector. 5G Wireless Technology.

The rise of 5G networks is expanding our capacity to move, control, and analyze information over wireless stages, agreeing to Comp TIA. As 5G rolls out more completely within the coming a long time, it will drive the improvement of more complex apps to solve issues and increase growth and profitability of across industries.

2. Artificial Intelligence and Machine Learning (AI & ML): AI is affecting the way clients are associated with businesses by means of shrewd websites and bots, and these instruments are getting to be progressively commoditized and coordinated into everyday work. Artificial Intelligence (AI) impacts on industry and economic growth from retail to healthcare, neighborliness to finance, education etc. Machine learning (ML) is a process of analyzing data which build an automatic model. It is the inner part of artificial intelligence from which the system can understand patterns, data, human intention, making decisions and predictions to make decisions without taking any help from other programmers. ML and AI will offer organizations phenomenal knowledge into their competitive scene, current execution, and allocation of resources and, in impact, marketers can utilize these experiences to significantly improve performance, at the side of numerous others.

3. Automation: Considering that various developing advances such as cloud computing, enormous information, fake insights, and mechanical technology are heading for high-scale growth , it isn't astounding to see that robotization is at its tallness.Numerous program counseling firms oversee computerization arrangement right from managing an account to fabricating and computer program companies.

4. Block Chain: Blockchain is the best developing innovation of tomorrow. It could be a decentralized computerized record that stores exchanges on thousands of computers around the globe. They are enrolled in a way that hinders their consequent alteration. Blockchain innovation increments security and speeds up the exchange of data in a way that's cost-effective and more straightforward. It also apportions with third parties whose primary part was to supply a component of belief and certification in exchanges. Huge enterprises are primarily looking at three Blockchain stages to develop top-level trade solutions. The request for engineers of blockchain is on the rise. You'll be working with the Bitcoin and Ethereal conventions in this course, making ventures for real-world applications, and learning the fundamental abilities in this energetic space for a career.

5. Cyber Security: Cyber Security Think about Programs instruct you how to ensure computer working frameworks, systems, and information from cyber-attacks. Learn how to track gadgets as they emerge and diminish dangers. The general objective of learning cybersecurity is to assist you to create the specialized abilities vital to anticipate assaults and secure the information and privacy of individuals. Living within the computerized age implies there are unending openings for programmers and cyber terrorists to target individuals, government teaching, and indeed huge trade. Best organizations are willing to

pay a parcel for cyber investigators who can ensure their information and evacuate vulnerabilities to guard against cyber assaults and security breaches. As businesses and governments alike are going advanced, cyber security may be a fast-growing and navoidable requirement. The number of cybersecurity labourers is rising three times quicker than other tech employments as proof of the solid requirement for cybersecurity experts.

6. Voice Technology: Within the past, we've seen progress over voice innovation like Sire, Alexa, and others, but they've continuously fallen short of human measures or even become useful in way of life. Voice could be a. characteristic and free-flowing medium, something that's not effortlessly translated into computerized innovation. Voice commands and voice associates will be indeed more valuable in our day by day lives within the close future, muddling the line between the interfacing between human advances.As the fundamental innovation of these segments propels (AI, discourse acknowledgment, machine learning), it'll as it was pushed into more prominent specialized significance. NLP innovations will be the innovation that brings voice innovation to its full mechanical value through the mysterious value.

7. Virtual Reality Virtual Reality (VR) progresses the user's experience while Increase Reality (AR) improves the environment. There are major players in the VR market, such as Google, Samsung, and Oculus, but there is a bounty of start-ups rising and enlisting, and the request for VR and AR abilities experts will as it develops. It does not require a part of specialized information to urge begin in VR. Essential programming abilities and a forward-thinking attitude can make work, although other bosses will moreover explore optics as an ability set and equipment engineers.

8. IOT: IOT is driving trade changes by giving the information required to move forward marketing, increment deals, and diminish costs, the report found. "Everybody within the innovation world, as well as numerous buyers, is hearing the term Internet of Things," Straight to the point Raimondi, a part of the Comp TIA Developing Innovation Community administration bunch who works in the key channel and commerce improvement for Chargaff, said in a press release.

9. Serverless Computing: Serverless computing permits organizations to form a Snoops IT environment that's mechanized and disconnected from the fundamental foundation, lessening operational costs and permitting businesses to contribute creating modern capabilities that include more esteem, the report found. Serverless computing was

modern on the list this year, together with mechanical autonomy, supplanted quantum computing, and computerization, Comitia famous.

11. Biometrics: Biometrics including confront, fingerprint, and retina scans-are getting to be standard strategies for confirming character. These strategies will shape the security establishment for solutions conveyed by IT companies moving forward, comitia said.

12. Robotics: Robotics is a mentionable invention of modern science that affect employment rate. It makes the process of business faster, less expensive, and more efficient.

13. Virtual reality (VR or Augmented reality (AR): Utilizing VR, AR mixed reality, AI, and sensor advances can offer assistance organizations progress operational effectiveness and person efficiency, according to the report.

14. Drones: Drones empower robotic computerization with less geological restrictions, the report noted. Opening for advancement and integration are tall for this advertise, it include:

Intelligent Apps: Another era of mobile applications will coordinate numerous advances and will be a strong blend when application growth meets artificial intelligence, the internet of things, and enormous information analytics. Put basically, these are apps that continually learn from user interactions and other information sources to end up indeed more important and valuable. Based on Wi-Fi and smartphone information, a smart app can determine when to turn off the lights in an office building and when to put the machines off in a production line.

15. NFT: Right now NFT is a trading topic around the world. So, what does it mean by the NFT- A Non-Fungible Token). This is a sort of crypto which records the main owner of the digital wallet or items. It has become the most valuable asset in the respected creative world. Through the NFT any form of artwork, music, internet memes, and tweets selling in million dollars. To buy the artwork anyone can see who is the real owner of that particular digital work. Recently, someone bought Elon Musk’s first tweet. It is said that NFT will be the big invention of the digital world.

16. Big Data Analytics: Big data is a complex process of examining big data to find out the needed information such as – market trends, correlations, various patterns which success in the field, and customer behavior as well. By analyzing those data come out the informed business decisions.

17. Computer Network: A computer network is two or multiple computers interconnected with the common communication protocol in the digital medium. Those computers share their information with one another. To build this type of equipment requires a lot of equipment. To set up those computers need a physical area to see if there is any need to use for business purposes. A good example can be hosting a services.

Computer Technology has spurred economic growth and growth by creating employments income improve health care and industrial processes. It computer science made the system of work easy and short. Above, List of latest technologies in computer science is a blessing of modern science. We can do anything within a short time by the use of this technology (Tech Republic 2022).

In its drive to diversify the economy from oil and gas, the government is encouraging partnerships between local ICT companies and foreign investors. To promote these partnerships and grow an entrepreneurial ecosystem in the technology sector, the Nigerian government has supported government or private sector led incubator hubs, youth innovation programs, and science technology parks (Tech Republic 2022).

Much like the federal government, several states have begun to implement policies and ICT projects that may help to attract ICT investments and create an enabling business climate for their regions. The Lagos state government announced the construction of a free tech zone that would allow for growth and financing of innovative ideas and may become one of the major technology clusters in West Africa. Similarly, the Edo state government is promoting a live-work-play project that is expected to support a dynamic environment for innovation, growth, and development in technology.

Prominent among the partnerships with the private sector are collaborations with local accelerators like iDEA and the Co-Creation Hub (CC-Hub) in Lagos. These initiatives have attracted foreign investors like the Silicon Valley's Y Combinator, who recently participated in pitches by Nigerian startups, and New York 's Andela, which established an incubation center in Lagos to recruit and train talented Nigerians to code and subsequently outsource them to foreign firms. In 2022, Microsoft launched its first African Development Center (ADC) in Lagos. The facility is expected to recruit world-class African engineering talent to develop innovative solutions that span the intelligent cloud and edge.

The Federal Ministry of Communications and Digital Economy has overall responsibility for the ICT sector. The ministry also has purview over three different agencies including the NCC as the regulator for the telecoms industry; the National

Broadcasting Commission (NBC) regulates the broadcast industry; and the National Information Technology Development Agency (NITDA) is responsible for digital policy implementation.

The Nigerian government in November 2019 launched the National Digital Economy Policy and Strategy (2020-2030) aimed at repositioning the Nigerian economy toward opportunities that digital technologies provide and to diversify the economy away from dependence on the oil and gas sector. The program is based on 8-pillars for the acceleration of the Nigerian economy:

1. Developmental regulation
2. Digital literacy & skills
3. Solid infrastructure
4. Service infrastructure
5. Digital services development & promotion
6. Soft infrastructure
7. Digital society & emerging technologies
8. Indigenous content development & adoption

As part of measures to achieve this objective, the NCC rolled out the National Broadband Plan for 2020-2025.

The Broadband Plan is designed to deliver data download speeds across Nigeria of a minimum 25 Mbps in urban areas, and 10 Mbps in rural areas, with effective coverage available to at least 90% of the population by 2025. As part of the initial broadband expansion plan, Nigerian government is seeking private sector infrastructure partners in expanding last-mile access. To deepen broadband penetration across the country, the NCC granted licenses to telecommunications infrastructure companies (infracos) to provide telecommunication broadband infrastructure across the various geo-political regions of the country, especially the rural populace. The infracos include:

1. Main One Cable Company (Lagos zone)
2. IHS Holding Limited (north central and Abuja zone)
3. Zinox Technology Ltd (southeast zone) BCN (northwest zone)
4. Brinks Integrated Solutions Ltd (northeast zone)

Nigeria aspires to become one of the top economies in the world and the country recognizes ICT development and broadband access as critical requirements to achieve this vision. This ambition, however, remains far from being accomplished as several hurdles

have encumbered broadband expansion and investment opportunities for the sector. Some of the major challenges that have affected the sector include long delays in the processing of permits; multiple taxation at federal, state, and local government levels; multiple regulatory bodies; damage to existing fiber infrastructure as a result of cable theft, road works and other operations; and right of way (ROW) charges implemented incongruously by several state governments. This typically leads to the high cost of leasing transmission infrastructure. Following criticisms and outcry by several stakeholders, the federal government has been pushing for the states to review ROW charges as part of promoting ease of doing business and attracting more investment. Currently, many states have started reviewing the charges above the federal-approved rate of $0.37 (145 naira) per linear meter. Some states are providing zero cost for laying broadband or any other telecommunications infrastructures to boost digital infrastructure rollout outside of urban **Educational Technology Innovation in Nigeria:**

Education technology is designed innovation process to improve the learning experience for all educators and students who are engaging in remote, hybrid, and even in-person learning. It is an industry that will surely continue to evolve as tech continues to play a role in Human Growth through the class room. The ends of educational technology are to achieved and sustain a higher level of economic growth capacity that is sufficient to meet the growth needs of mankind through the class room. Teachers and students use technology in the classroom in a variety of ways to boost the learning experience and make education smarter than ever, and education technology, is now an industry of its own, generating revenue for economic growth . During the pandemic, education technology helps to transformed from a perk to a necessity for school districts continuing to use remote and hybrid learning practices.

These examples of education technology innovations are in the form of learning management systems, hardware products like video conferencing cameras for the classroom, and educational gaming platforms help and also show the range of how technology can be infused in both teaching and learning.

1. The Meeting Owl: The Meeting Owl is a video conferencing camera for classrooms that enables hybrid collaboration for students and teachers. The Meeting Owl turns any classroom environment into a hybrid classroom with its unique 360-degree camera that can capture audio and video from everyone in the room.

2. Cengage: Cengage is an online textbook and course distributor that also focuses on testing. Students can buy their textbooks for their specific course and take notes and quizzes all within the Cengage portal. This makes it a one-stop-shop for learning tools for students.

3. Civitas Learning: Civitas Learning is a company dedicated to improving student outcomes in colleges and universities. Their tools are used to track student data to see which subjects or areas they might need help in, as well as what fields they might work well in.

4. Google Classroom: Teachers can use Google Classroom to organize assignments and create a collaborative online learning environment for students. It's an all-in-one online tool where educators can create classes, distribute and grade assignments, provide feedback, and connect with students.

5. Kahoot: Kahoot is a quiz game that can be created by teachers and answered by students about any topic they want. Students answer questions together and win points for the more answers they get correct. It's a fun way to get students learning in a format they're interested in.

6. Apex Learning: Apex Learning has online courses that accompany middle and high school classes. They can be assigned by teachers to supplement what students are currently learning and keep students on top of their subjects if they need more help.

7. Chegg: Chegg is a marketplace for textbooks, allowing students to buy or rent physical or digital copies to save money. The site also has tutorials, online tutoring, and practice problems for students to work on.

8. Smart Technologies: SMART Technologies makes a host of technology solutions for schools and students. Their most popular item is the SMART Board, a digital screen that functions as a whiteboard for students and teachers to write and demonstrate on. Drawings can be recorded and copied for further use and study. It does everything else a whiteboard does, plus it has the functionality of a projector screen and a computer.

9. Asynchronous Learning: Asynchronous learning includes lectures, classes, projects, or seminars that don’t happen in real-time. Instead, with asynchronous classes or coursework, lessons are pre-recorded and students can consume educational materials on a self-paced schedule. Some courses are completely asynchronous, but asynchronous classes can also be used in a remote or hybrid learning model to supplement live discussions and activities.

10. Blended Learning: Blended learning refers to a course of study that combines online and live and/or in-person learning. The distinguisher between online learning and blended learning is that blended learning must involve live discussions or lectures, whereas online learning can be completely asynchronous.

11. Content Management System (CMS): A content management system (CMS) is software that lets users create, publish, and share online content. Colleges and universities that publish online course content might post assignments or reading material using a CMS as the backbone of their website.

12. Distance Learning: Distance learning refers to students who take courses without physically sitting in a classroom on campus where courses are being taught. Distance learning can take the form of hybrid learning, fully-online learning, or taking courses at a satellite campus.

13. Education ICT: Education ICT is the use of information and communication technologies (ICT) for educational purposes. Examples of education ICT include using cloud-based learning software, apps, blogs or discussion boards, digital whiteboards, and other interactive online tools for students and teachers.

14. Flipped Classroom: A flipped classroom is an educational model that changes the traditional learning method by having students completes what would be considered "homework", in class with a teacher present. Instead of doing homework after school hours are over, students watch instructional videos or other pieces of content and activities and come to school to do actual work with their teachers. Students can learn at their own paces, and use their class time to have questions answered and get help with their work. A flipped classroom model is ideal for hybrid learning, where in-person class time is valuable for teacher-student connection and in-person collaboration.

14. Hybrid Learning: Hybrid learning is an educational model where some students join class in-person while others join remotely. Hybrid learning can combine synchronous learning with asynchronous learning elements like online forums, discussion boards, and other pieces of digital content.

15. Instructional Technology: Instructional technology is a field that creates classroom technology tools to assist in instruction and learning. It covers the software and hardware needed to make instruction as easy and dynamic as possible for teachers and students.

Banking Technologies Innovations in Nigeria

According to Nwani, Nwaimo, Kanu , and Eke (2020) cash transaction and payments are part of an individual daily life. Banking technology innovation provides the opportunity to make payments using different payment technologies. For the most part of the 1900s, cash and cheques were the most common means of transacting business among individuals and between organizations (Evans and Schmalensee, 2005 cited by Nwani, Nwaimo, Kanu , and Eke 2020). Payment cards like credit and debit cards were introduced in the second half of the 1900s for store purchases and eventually to make cash withdrawals from Automatic Teller Machines (ATMs) and towards the end of the 1990s, electronic commerce was viewed as an alternative way of conducting financial transactions over the internet which subsequently led to internet payments and the merger between the internet and banks (Nwani, Nwaimo, Kanu , and Eke 2020). The recent introduction of mobile payment applications adds to the variety of digital payment technologies (Chae and Hedman, 2015 cited by Nwani, Nwaimo, Kanu , and Eke 2020). According to Nwani, Nwaimo, Kanu , and Eke (2020) In Nigeria (and Nigeria state) today, customers are not only charged with the responsibility of choosing between goods and services but also between payment technology options. An example is, even with online payment, the customer will choose between internet bank transfer, the use of POS terminals or even PayPal. This various payment methods brought in by the Banking technology innovation of different regime has a great influence on households income and on the volume and value of interbank transaction with an associated growth and growth implications in the economy. The volume and value of payment on different cashless channels (comprising ATMs, POS, Mobile, and Internet) rose by 34.7 percent and 18.3 percent in 2017 to 1,023.6 million and N9, 134.0 billion, respectively, compared with 355.2 million and 1671.4 billion naira recorded in 2011(Nwani, Nwaimo, Kanu , and Eke 2020). The volume and value of various categories of financial transaction payments technology for interbank transfer show the influence Banking technology innovation regime on the volume and value of interbank transaction's in Nigeria and Africa at large of which are discuss From the breakdown of e-payment transactions for 2017, the use of ATM machines has remained the most patronized, it accounts for 78.2 percent of the transactions, followed by POS terminals transactions and mobile payments with 14.3 and 4.7 percent, respectively. Most Nigerians stayed away from the web (internet) e-payment option and it was the least patronized,

accounting for 2.8 percent of the total e-payment transactions. In terms of the value of the transactions, the ATM usage accounted for 70.5 percent, POS, 15.4 percent, mobile channels 12.1 percent, and web (internet), 2.0 percent. And according to CBN (2023) in 2022 the total volume and value of e-payment transaction in Nigeria was 22.07 million and 1. 550 trillion naira respectively (Nwani, Nwaimo, Kanu , and Eke 2020).

According to Clerk (2022) to satisfy the needs of customers and succeed, each industry must keep growing and developing. In the financial industry, too, the same principle holds true. Technology innovation has impacted on the banking sector. Financial interactions and business practices are being transformed by the widespread adoption of digital technology products in Nigeria such as the used of Automated Trading machine ATM, Point of Sales POS etc. . When it comes to technology innovation in the Nigeria banking industry, both the epidemic and technological advancements have had a role in the process. According to the Reserve Bank of India (2020) India total digital transaction volume was around 4,371 crores in 2020 whereas it was 3,412 crores in 2019. Technology innovation in banking has created a wide range of growth in the baking industry and speedier solutions for clients' banking related challenges. Innovation in the banking techniques include:

a. **Open Banking:** Banks in open banking systems employ third-party software to integrate their financial solutions, giving their clients a single point of entry to all their banking needs and the bank's services. In order for financial institutions to compete and expand, open banking is an essential approach. Fintech businesses and banks work together to make it easier for clients to make quick and easy payments using mobile apps. Online payments for buying meals from Zomato or reserving an Uber with an online payment are just a few examples of this type of transaction.

b. **Blockchain**: When numerous parties need access to the same data at the same time, they can use blockchain technology to ensure the integrity and immutability of the data are preserved. Banks are increasingly relying on blockchain technology to keep their critical information safe from hackers. In order to increase efficiency, boost security, and speed up transactions, banks are continually experimenting with this new technology.

c. **Biometrics:** If you've ever wanted to make a quick payment by scanning your fingerprint or using face recognition technology, biometric payments are for you. It's becoming increasingly popular as more and more people want to avoid carrying around

cash. WhatSapp and Google are among the firms that have already developed these kinds of solutions.

d. **Cloud Banking**: For many banks, cloud banking is transforming their cost-efficiency and allowing them to create new experiences for their clients while maintaining the traditional model in place. In the cloud, banks are able to synchronize the enterprise and break down operational and data silos across customer care, finance, risk, and other areas of the business.

e. **Artificial Intelligence and Machine Learning:** These days, AI and ML don't require an introduction, and banks are quickly adopting them in order to provide consumers with just-in-time, personalized service. They automate banking operations to improve customer care and credit services as well as prevent fraud.

f. **Chatbots:** Speech-based engagements are becoming increasingly popular with clients. Therefore chatbots rely on a voice interface. Financial chatbots have been shown to save banks over four minutes each transaction and allow them to gather client feedback more quickly and cost-effectively.

g. **Zero Trust' Security Model:** The zero-trust security concept is utilized to prevent cyber fraud to the greatest extent feasible. It secures the banks and customers by taking away implicit trust and requiring the users to authenticate their identities and their devices identifications in a stringent manner throughout the whole network.

RESEARCH METHODOLOGY

Estimation Techniques and Procedures.

The simple regression analysis will be used to do the ordinary least square econometric analysis in this study in order to analyzed and uncover the relationship between the topic variable. It allow us to study and summarize the relationships between variables

Mathematical and Econometric Model

The mathematical model stated as GDP = $F(T_E)$. Hence, the econometric model is given as GDP = $A + BT_E + U$

Where GDP is the rate of economic growth

A = is autonomous economic growth which take place without any influence of technology innovation (T_E)

B = Is marginal propensity to innovate the state of technology

T_E =Technology innovation which is the causal variable of economic growth (D)

U = Is the disturbance variable showing the presence of other factors that also affect economic growth

In this study, the researcher measure Technology innovation in terms of innovation in information and communication technology ICT_E, Banking innovation (B_E) and Educational innovation ($Edu_{E)}$

Therefore, the general econometric model is stated thus: $GDP= A+BX_1 +BX_2 +BX_3 + U$. Hence, $GDP = A + BICT_E +B\ B_E +B\ Ed_E + U$

This is the summary of the theoretical framework of this investigation.

Empirical Model Specification

Given that D = Sum(GDP, E and HCD) = $A+BT_E+U$.

For analytical purpose, three (3) different econometric model for ordinary Leeds square (OLS) analysis are specified in this study based on the research objections and these models include:

$GDP = A + BICT_E +U$ (1)

$GDP = A+ B\ B_E +U$ (2)

$GDP =A+ B\ Edu_E +U$ (3)

Definition of Variables and Justification for the econometric models

In the three models economic growth is represented in gross domestic product (GDP) as the dependent variable and it depend on technology innovation which is represent by ICT innovation (ICT_E), banking technology innovation (B_E) and education technology innovation (Edu_E) based on the research objective respectively

A = Is autonomous growth which take place without any influence of technology innovation

B = Is marginal propensity to innovate the state of technology which explain the extent to which technology innovation brings about change in economic growth .

U = Is the disturbance variable showing the presence of other factors that may also affect economic growth

Hence the econometric models for the econometric analysis are:

$GDP = A + BICT_E +U$ (1)

$GDP = A+ B\ B_E +U$ (2)

$GDP =A+ B\ Edu_E +U$ (3)

Test of Research Hypotheses and Decision Rules

The null hypothesis (HO) will be tested at 0.05 level of significance and will be rejected if the value of the t – statistics fall outside the critical region,

Data Sources

The data are sourced from NBS reports, UNESCO reports and Published Journals

Data Presentation and Analysis

Table 1.1 data on the effect of Information and Communication Technology (ICT) Innovation on Economic Growth in Nigeria

Year	ICT INNOVATION RATE	GDP GROWTH RATE
2016	9.7	2.7
2017	11.4	-1.6
1018	10.6	0.8
2019	9.9	1.9
2020	13.0	2.3
2021	13.2	-1.9
2022	6.6	3.4
2023	9.8	3.1
2024	7.9	2.5

Source: UNESCO, (2024)

Table 1.1a: Present data on ICT innovation growth rate and GDP growth rate in Nigeria from 2016- 2024

Table1. 1b

Regression Statistics	
Multiple R	0.7564850958
R Square	0.7

Table 1.1c: ANOVA

Adjusted R Square	0.3496 8282
Standard Error	1.5955 04
Observations	9

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	13.49613	13.49613	5.301683	0.054786
Residual	7	17.81942	2.545632		
Total	8	31.31556			

Table 4.1b: above depicts the values of the R, R2, adjusted R2 and the standard error of the estimate; the above values determine how well a regression model fits the data. More so, the "R" column signifies multiple correlation coefficients. The value of multiple R measures the quality of the prediction of the dependent variable (GDP), in this case a value of 0.756 implies a good level of prediction. The "R Square" column depicts the R2 value (coefficient of determination), which is the proportion of variance in the dependent variable that can be explained by the independent variables. The value of 0.58 implies that our independent (ICT) variables explain 58% of the variability of our dependent variable, GDP.

Table 1.1c the ANOVA table presents values that can be used to ascertain the relationship between the dependent and independent variables. The F-ratio in the ANOVA table tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, F (1, 7) = 5.3016, p > .0.005 (i.e., the regression model is a good fit of the data).

Table 1.1d coefficient table

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	7.658087	2.736341	2.798691	0.026574	1.187741	14.12843	1.187741	14.12843
X Variable 1	-0.60328	0.262008	-2.30254	0.054786	-1.22283	0.016267	-1.22283	0.016267

Estimated model coefficients

The general form of the equation to predict Internet-Users from Population, Inflation, GDP per capita is: **GDP(Y) = -0.6033X + 7.6581**

This is extracted from the Coefficients table, as shown above. Also, the "Sig." column shows that all independent variable coefficients are statistically significantly different from 0 (zero) excluding GDP.from the regression showed that Unstandardized coefficients signify how much the GDP growth rate varies with ICT innovation rate when all other independent variables are held constant.

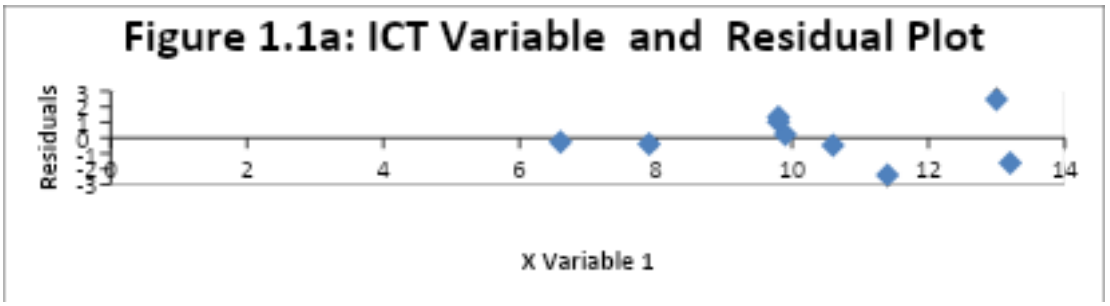
Table 1.1e: Residual and probability Output *PROBABILITY OUTPUT*

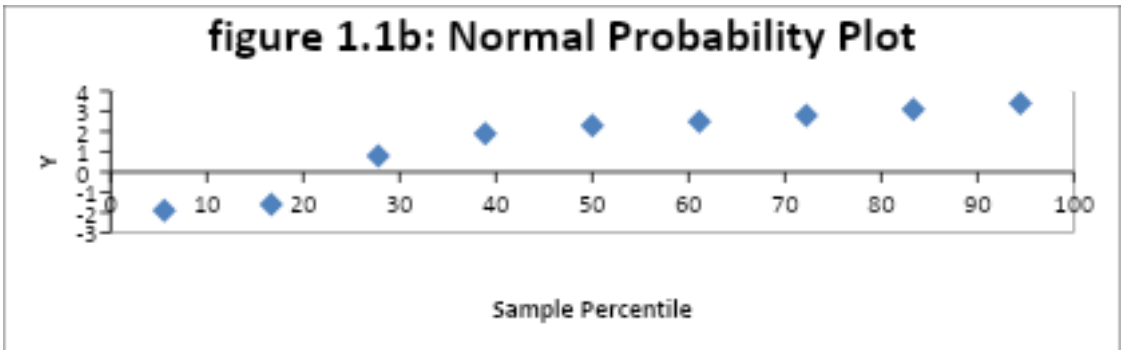
Percentile	*Y*
5.555556	-1.9
16.66667	-1.6
27.77778	0.8
38.88889	1.9
50	2.3
61.11111	2.5
72.22222	2.8
83.33333	3.1
94.44444	3.4

Observation	*Predicted Y*	*Residuals*	*Standard Residuals*
1	1.745904	1.054096	0.706282
2	0.78065	-2.38065	-1.59512

3	1.263277	-0.46328	-0.31041
4	1.685576	0.214424	0.143672
5	-0.1846	2.484605	1.664775
6	-0.30526	-1.59474	-1.06853
7	3.676413	-0.27641	-0.18521
8	1.745904	1.354096	0.907293
9	2.892144	-0.39214	-0.26275

Table 1.:1b-1.1e Present the summary of regression output on the effect of Information and Communication Technology (ICT) Innovation on Economic Growth in Nigeria.





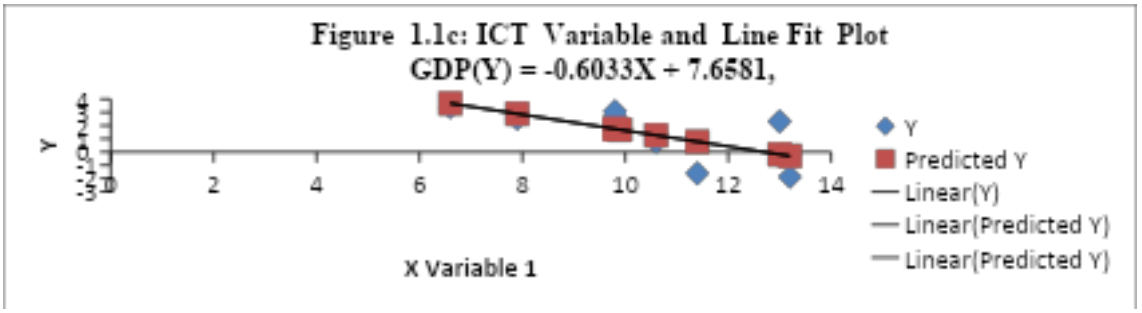


Figure 1.1d: Summary Output of Regression Statistics Figure of the effect of ICT Technology Innovation on GDP

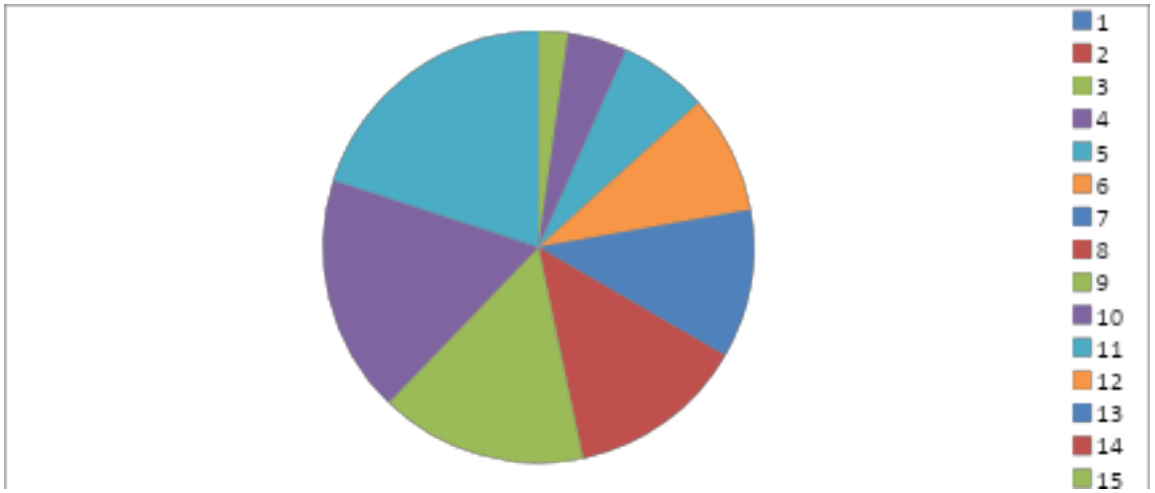


Figure 1.1d shows the Summary Output of Regression Statistics, Multiple R, R Square, Adjusted R Square, Standard Error, Observations, ANOVA, Regression Residual and Total.

Table 1.2a: Data on Education Technology Innovation and Economic Growth in Nigeria.

Year	EDUCATION INNOVATION RATE	GDP GROWTH RATE
2016	15.1	2.8
2017	7.9	-1.6
1018	6.1	0.8
2019	7.1	1.9
2020	8.4	2.3
2021	6.5	-1.9
2022	5.4	3.4
2023	5.4	3.1
2024	8.2	2.5

Source: UNESCO, (2024)

Table 1.2: present data on education technology innovation and economic growth in Nigeria from 2016-2024.

Table 1.2b Summary Regression Statistics for Banking Technology Innovation and GDP

Regression Statistics	
Multiple R	0.220962
R Square	0.048824
Adjusted R Square	-0.08706

Standard Error	2.06282
Observations	9

Table 1.2c: ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	1	1.528958	1.528958	0.359313	0.567775
Residual	7	29.78663	4.255233		
Total	8	31.31559			

Table 1.2b: above depicts the values of the R, R2, adjusted R2 and the standard error of the estimate; the above values determine how well a regression model fits the data. More so, the "R" column signifies multiple correlation coefficients. The value of multiple R measures the quality of the prediction of the dependent variable (GDP), in this case a value of 0.2209 implies a lower level of prediction. The "R Square" column depicts the R2 value (coefficient of determination), which is the proportion of variance in the dependent variable that can be explained by the independent variables. The value of 0.0488 implies that our independent (Education technology Innovation) variables explain 4.88% of the variability of our dependent variable, GDP.

Table 1.2c the ANOVA table presents values that can be used to ascertain the relationship between the dependent and independent variables. The F-ratio in the ANOVA table tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, F (1, 7) = 0.359 , p > .0.005 (i.e., the regression model is a good fit of the data).

Table 1.2d Coefficient Table

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	2.256093	1.469261	1.535529	0.168531	-1.21816	5.730342

X Variable 1	-0.07006	0.11687	-0.59943	0.56777 5	-0.3464 1	0.20629 9

Estimated model coefficients

The general form of the equation to predict GDP is: **GDP(Y)** = -0.0701x + 2.2561 This is extracted from the Coefficients table, as shown above.

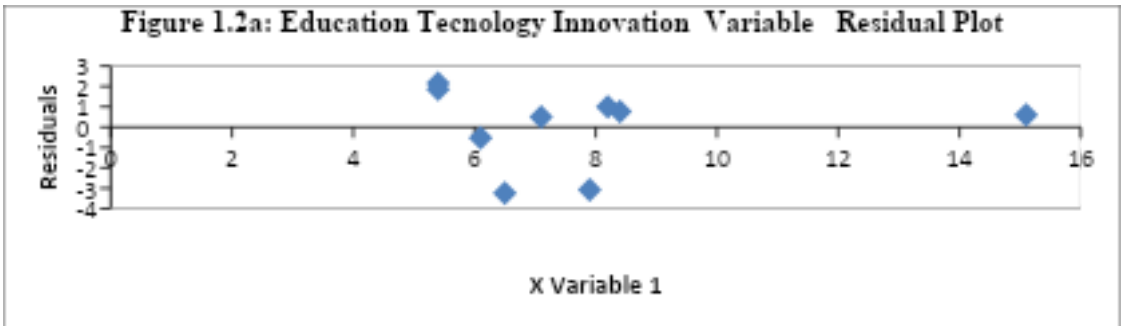


Figure 1.2a: Education Tecnology Innovation Variable Residual Plot

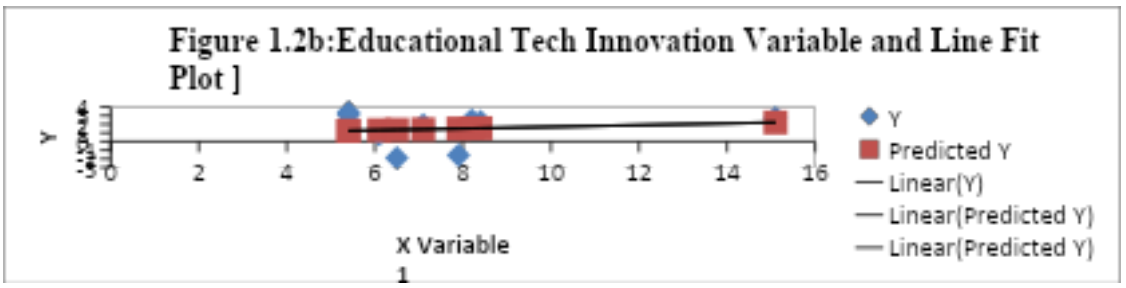


Figure 1.2b:Educational Tech Innovation Variable and Line Fit Plot]

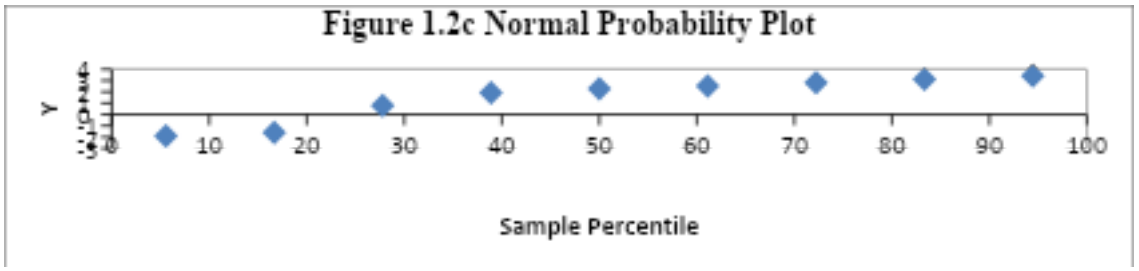


Figure 1.2c Normal Probability Plot

Figure 1.2d: Summary of Output of the Effect of Education Technology Innovation on GDP

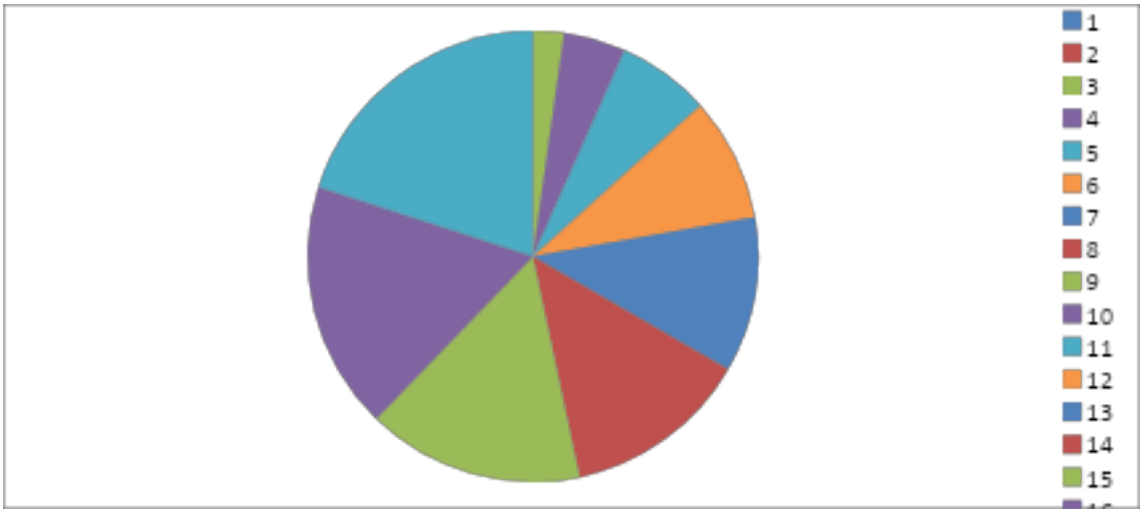


Figure 1.2d: shows the summary of output of Regression Statistics, Multiple RR Square, Adjusted R Square, Standard Error, Observations, ANOVA, Regression Residual and Total

Table 1.3 a: Data on the Effect of Educational Innovation in Economic Growth in Nigeria.

YEAR	BANKING INNOVATION GROWTH RATE	GDP GROWTH RATE
2016	10..04	2.8
2017	10.34	-1.6
1018	26.36	0.8
2019	4.47	1.9
20120	6.24	2.3
2021	11.85	-1.9
2022	12.23	3.4
2023	8.70	3.1
2024	9.76	2.5

Source: NBS, (2024)

Table 1.3b Model Summary

Regression Statistics	
Multiple R	0.273323
R Square	0.074705
Adjusted R Square	-0.05748
Standard Error	2.034563

Observations	9

Table 1.3c: ANOVA

	Df	*SS*	*MS*	*F*	*Significance F*
Regression	1	2.339436	2.339436	0.565157	0.476701
Residual	7	28.97612	4.139446		
Total	8	31.31556			

Table 1.3 b: above depicts the values of the R, R2, adjusted R2 and the standard error of the estimate; the above values determine how well a regression model fits the data. More so, the "R" column signifies multiple correlation coefficients. The value of multiple R measures the quality of the prediction of the dependent variable (GDP), in this case a value of 0.273323 implies a lower level of prediction. The "R Square" column depicts the R2 value (coefficient of determination), which is the proportion of variance in the dependent variable that can be explained by the independent variables. The value of 0.074705 implies that our independent (Banking Technology Innovation) variables explain 7.47% of the variability of our dependent variable, GDP.

Table 1.3c the ANOVA table presents values that can be used to ascertain the relationship between the dependent and independent variables. The F-ratio in the ANOVA table tests whether the overall regression model is a good fit for the data. The table shows that the independent variables statistically significantly predict the dependent variable, F (1, 7) = 0.565157 , p > .0.005 (i.e., the regression model is a good fit of the data).

Table 1.3d Coefficient Table

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0.704764	2.062851	0.341646	0.742644	-4.1731	5.582633

X Variable 1	0.099246	0.24926	0.39816	0.70237	-0.4901	0.68865

Estimated model coefficients

The general form of the equation to predict GDP is : **GDP(Y) = 0.0992x + 0.7048.** This is extracted from the Coefficients table, as shown in table 4.3d.

Table 1.3e Residual and Probability Table for banking technology innovation and GDP

RESIDUAL OUTPUT				PROBABILITY OUTPUT	
Observation	*Predicted Y*	*Residuals*	*Standard Residuals*	*Percentile*	*Y*
1	1.552737	1.247263	0.646387	5.555556	-1.9
2	1.531722	-3.13172	-1.623	16.66667	-1.6
3	0.409434	0.390566	0.202409	27.77778	0.8
4	1.942945	-0.04295	-0.02226	38.88889	1.9
5	1.818947	0.481053	0.249303	50	2.3
6	1.425937	-3.32594	-1.72365	61.11111	2.5
7	1.399316	2.000684	1.036843	72.22222	2.8
8	1.646611	1.453389	0.75321	83.33333	3.1
9	1.572352	0.927648	0.480748	94.44444	3.4

Figure 1.3a Banking Technology Innovation Line Plot

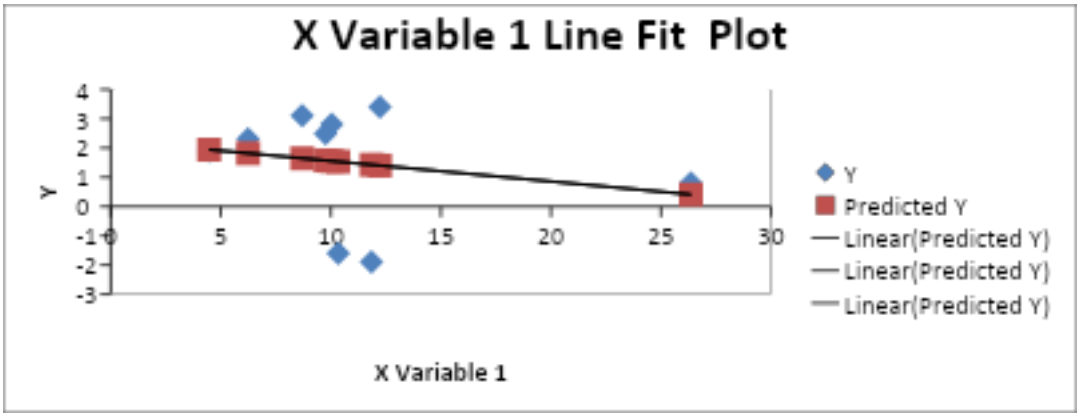


Figure 1.3d: Summary of Output of the Effect of Banking Technology Innovation on GDP

Test of Hypothesis

Test of Hypothesis HO1: Calculated t = -0.60328-1/0.262008 = 6.1192 Df = 9-2 = 7, Level of significance @ = 0.5%, Critical t-value: 2.365

The Null Hypothesis which state that information and communication technology innovation has no significant effect on economic growth in Nigeria is rejected at 0.05% level of significant as t-test value calculated (6.1192) is greater than the critical value (2.365) at 7 degree of freedom. Hence, information and communication technology innovation has a significant effect on economic growth in Nigeria

Test of Hypothesis HO2: Calculated t = -0.07006-1/0.116871= 9.15598 Df = 9-2 = 7, Level of significance @ = 0.05%, Critical t-value: 2.365

The null hypothesis which state that educational technology innovation has no significant effect on economic growth in Nigeria, is rejected at 0.05% level of significant as t-test value calculated (9.15598) is greater than the critical value (2.365) at 7 degree of freedom. Hence, educational technology innovation has a significant effect on economic growth in Nigeria

Test of hypothesis HO3: Calculated t = 0.099246 – 1/0.249261 = 3.61369 Df = 9-2 = 7, Level of significance @ = 0.5% Critical t-value: 2.365

The null hypothesis which state that banking technology innovation has no significant effect on economic growth in Nigeria is rejected at 0.05% level of significant as t-test value calculated (3.61369) is greater than the critical value (2.365) at 7 degree of freedom. Hence, banking technology innovation has a significant effect on economic growth in Nigeria

Discussion of Findings

From table 1.1 the result of the econometrics test shows that information and communication technology innovation has a significant effect on economic growth in Nigeria. From the result the independent (ICT) variables explain 58% of the variability of our dependent variable GDP.. Result of the ANOVA test shows that the independent variables (ICT) statistically significantly predict the dependent variable GDP and the regression model is a good fit of the data).

From table 1.2 the result of the econometrics test shows that Educational Technology Innovation has a significant effect on economic growth in Nigeria. From the result the independent (Educational Technology Innovation) variables explain 4.88% of the variability of our dependent variable GDP. Result of the ANOVA test shows that the independent variables (Educational Technology Innovation) statistically significantly predict the dependent variable GDP and the regression model is a good fit of the data.

From table 1.3; the result of the econometrics test shows that Banking Technology Innovation has a significant effect on economic growth in Nigeria. From the result the independent (Banking Technology Innovation) variables explain 7.47% of the variability of our dependent variable GDP. Result of the ANOVA test shows that the independent variables (Banking Technology Innovation) statistically significantly predict the dependent variable GDP and the regression model is a good fit of the data.

Summaries of Findings

1. From table 1.1 the result of the econometrics test shows that information and communication technology innovation has a significant effect on economic growth in Nigeria.

2. It is revealed that ICT innovation explain 58% of the variability of GDP in Nigeria.

3. It is revealed that ICT innovation statistically significantly predict GDP and the regression model is a good fit of the data

4. From table 1.2 the result of the econometrics test shows that Educational Technology Innovation has a significant effect on economic growth in Nigeria.

5. It is revealed the Educational Technology Innovation explain 4.88% of the variability of GDP in Nigeria

6. It is revealed that Educational Technology Innovation statistically significantly predicts the dependent variable GDP and the regression model is a good fit of the data.

7. From table 1.3; the result of the econometrics test revealed that Banking Technology Innovation has a significant effect on economic growth in Nigeria.

8. It is revealed that Banking Technology Innovation explains 7.47% of the variability of GDP in Nigeria.

9. It is also revealed that Banking Technology Innovation statistically significantly predict the dependent variable GDP and the regression model is a good fit of the data.

Conclusion

Information and communication technology innovation has a significant and positive effect on economic growth in Nigeria. Educational Technology Innovation has a significant effect on economic growth in Nigeria and Banking Technology Innovation has a significant effect on economic growth in Nigeria. Hence; technology innovation has a significant and positive effect on economic in Nigeria.

Recommendation

1. Technology innovation in Nigeria should be given more attentions in all sector of the economy.
2. Government budgetary allocation in education, ICT and the banking sector should be review to reflect technology innovation progressed in such areas.
3. There should be a replicate of this study with reference to other sectors than ICT, Education and the banking sector in order to ascertain the specific effect of its technology innovation on economic growth in Nigeria.

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