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IMPACT OF INFORMATION COMMUNICATION TECHNOLOGY PENETRATION ON TAX REVENUE IN SUB-SAHARAN AFRICA

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Abstract

The research investigated the effect of Information Communication Technology penetration on tax revenue in Sub-Saharan Africa. The specific objectives of the study were to examine the effect of mobile phone on tax revenue and to determine the effect of personal computer on tax revenue in Sub-Saharan Africa. The research was anchored on digital diffusion which based on the notion that adoption of an innovation involves the spontaneous or planned spread of new ideas. The method of analysis employed for this study was the panel ordinary least square techniques with the aid of e-view version 09. The result showed that mobile phone and personal computer have positive and significant effect on tax revenue in Sub-Saharan Africa. The study recommended amongst others that technological tools should be leverage upon by government in the Sub-Saharan African countries in other to improve their method of tax collection to increase tax revenue.

Keywords: ICT penetration, mobile phone, personal computer, digital diffusion, tax revenue.

1.0 Background to the Study

Taxation has remained one of the major sources of revenue for governments at all levels over the years (Gaspar, et al., 2016). Through the revenue generated, they provide adequate and desirable infrastructures, and meet other expenses of government. The development of any nation largely depends on the amount of revenue generated by the governments for the provision of social and economic infrastructure (Gaspar, et al., 2016). Thus,

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effective and efficient collection of tax is essential, if countries are to meet the tipping point for development and growth of 12.75 percent of GDP (Gaspar, et al., 2016). Taxation is undeniably a powerful tool for national growth. Tax policies can and do stimulate economic growth and job creation through their impact on investment and capital formation in the economy, in addition to being a major source of revenue for the government (Ihenyen, et al., 2022).

Generally, taxes are levied by the government on income, consumption, and production of goods and services (Ganyam, et al., 2019). To effectively achieve the goal of taxation, these taxes ought to be properly administered. Tax administration is defined as the processes that include the management, conduct, direction, and regulation of the execution and application of necessary tax revenue statutes, laws, and conventions (Ganyam, et al., 2019). Tax administration plays an important role in tax revenue of any country. The goal of tax administration is to ensure that the government generates more revenue from taxes. As a result, tax administration encompasses all principles, strategies, and methods used by government to plan, collect, account for, control, and coordinate the collection of taxes (Azende & Ganyam, 2020).

Adequate tax income and proper utilization of tax revenue gives room for the government to finance and fulfill infrastructural expectation of the populace in terms of the amount invested on infrastructural development (Emmanuel & Ibrahim, 2020). Thus, ensuring proper and adequate utilization of tax revenue in achieving infrastructural development is very important to developed, developing and under-developed countries as stakeholders have high expectations of the government hence demands accountability on how the budgeted amount on infrastructures for a particular period translates to the actual investment at the end of that period (Yahayah & Yusuf, 2019).

The future of the world is significantly influenced by globalization, with digitalization emerging as a key driver of this process (Ogidan, 2021). Digital trade plays a crucial role in fostering globalization and facilitating international development by establishing seamless economic connections across borders. However, alongside these benefits, challenges related to foreign taxation have also emerged (Ogidan, 2021). These challenges stem from the diminishing importance of consumers' physical presence in the market or jurisdiction where they operate, thereby posing a threat to the stability of traditional tax systems that rely on location-based principles (Ogidan, 2021). Furthermore, the increasing significance and mobility of intangible assets contribute to these difficulties. The rapid pace of digitalization and its widespread adoption have sparked substantial debates about the need to reform the international taxation framework. These discussions seek to address the implications of digitalization and ensure an updated regime that can effectively navigate the complexities of the digital age (Ogidan, 2021).

Tax collection in Africa is low, but similar to other regions at a similar income level. In 2018, the most recent year with wide data coverage, Sub-Saharan African countries collected 14% in taxes as a share of GDP (UNU-WIDER Government Revenue Dataset, 2021). This continent-wide average masks significant variation across countries. High, upper and middle income countries like Seychelles, Namibia and South Africa have rates as high as 28–33% whereas low-income countries like Chad, Democratic Republic of Congo and Ethiopia have rates as low as 7%. These numbers have remained stagnant over the past three decades, with African countries

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collecting an average of 12–15% of GDP as taxes from 1990 to 2020. Both the South Asia region and the Middle East and North Africa region have similarly low rates as Sub-Saharan Africa of about 14%. In contrast, the Europe and Central Asia region has the highest rate of 32% (UNU-WIDER Government Revenue Dataset, 2021). Across all countries, on average, higher income countries collect a higher share of GDP as taxes.

The composition of taxes in Africa is also roughly similar to that of countries at similar income levels. Evidence on the reliance of countries on different tax instruments include taxes on consumption, personal income, corporations, payroll, trade and property. In almost all regions, the greatest component of taxes in Sub-Saharan Africa is consumption taxes (49%), which consist of sales tax, value added taxes (VAT) and excise taxes (World Bank Enterprise Surveys, 2010–2020). Some striking differences of African countries, even compared to countries at a similar income level, are that African countries collect a minimal amount in payroll taxes, possibly a reflection of the low share of the economy employed in the formal sector. Tax administration patterns in African countries feature lower reliance on technology and greater reliance on manual systems and in-person interactions between taxpayers and tax collectors. In African countries, 72% of firms report being required to meet with tax officials, and for those affected, 3.2 meetings are held on average each year (World Bank Enterprise Surveys, 2010–2020).

ICT penetration may contribute to increase in tax revenue. Penetration of internet, fixed broadband, personal computers, and mobile phones across nations have significantly accelerated in the world since the beginning of 1990s (Koyuncu, et al., 2016). The penetration of internet, on average, increased from 0.55 (percentage of individual using the internet) in the period of 1990-1994 to 39.02 in the period of 2010-2013. On the other hand the penetration of personal computers reached 19.16 (per 100 people) in the period of 2005-2009 from 4.64 in the period of 1990-1994 (Koyuncu, et al., 2016).

Intuitively, ICT penetration affects tax revenue through affecting the factors which lead to raise the level of output and economic growth (Pradhan et al. 2014). ICT penetration reduces production costs, promote demand and investment, improve efficiency of resource allocation whereby raise the level of output and economic growth which may lead to increase in tax revenue (Pradhan et al. 2014). Moreover, tax collection, administration, and monitoring become easier with ICT penetration which may eventually cause to increase in tax revenue. For example, the government in England have recently started using digital tax accounts as a part of modernize the tax system. Under this system, tax payers can check their tax information online, know how much they owe, and have the option to pay as they go. This system ensures tax payers to manage their cash flow better since they have more certainty regarding what they need to pay and when (HM Revenue & Customs, 2015).

The use of ICT continues to rise substantially across the continent. In 2008, less than 5% of Africans were using the internet. That fraction had increased fivefold to 25% by 2018 and continues to grow (World Development Indicators, 2018). Mobile cellular access, in particular, has large penetration across the continent with about 90 subscriptions per 100 people across the continent, more than double the prevalence rate a decade earlier. Africa has achieved striking successes in some aspects of technology innovation, particularly in the adoption of mobile money with services like M-Pesa being able to leapfrog the technology frontier, with users bypassing

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traditional financial service providers (World Development Indicators, 2018).

Kenya has been a leader with more than half of the adult population having a mobile money account. Other countries like Uganda, Zimbabwe, Gabon, Namibia and Ghana also have high levels of mobile transactions. While the most common use of mobile money is for sending remittances, commercial uses such as paying utility bills and receiving wages are starting to emerge. This holds promise for Africans using technology services for tax purposes as well. The use of ICT is also growing across different sectors of government in Africa. In many countries, tax administrations often lead technology adoption and digitalization, compared to other government bodies (World Bank, 2016).

Robust adoption of technology is designed to move tax administration from manual systems characterized by tax official discretion across taxpayers, tedious and error-prone data entry and case-by-case detection of evasion to a reliance on electronic systems, where there is a more consistent and predictable experience across taxpayers, timely data for decision making and automated detection of suspicious activity (World Bank, 2016). This study tends to examine how ICT penetration with the aid of mobile phones, internet, computer and so on may help to improve core tax revenue in Sub-Saharan Africa.

1.1 Statement of the Research Problem

High inequality, informality, debt, and dependence on aid were already afflicting African states before the coronavirus pandemic broke out (Yahaya, 2023). Africa is at a point in its history where its resources are more crucial than ever, to begin, the United Nations Agenda 2030 to end poverty, reduce inequality, strengthen institutions, and battle climate change requires adequate funding (Brooksworth, et al, 2023). This plan has the long-term goal of increasing prosperity for all Africans while decreasing reliance on foreign aid and bolstering governmental, economic, and social structures that are weak. All of the aforementioned factors come down to one thing, the ability of African tax systems to produce revenues to pay the projects necessary for durable growth trajectories (Brooksworth, et al, 2023).

It is essential that Africa's tax systems bring in enough revenue. But the organization for Economic Cooperation and Development 2020 Income Statistics report shows that African countries efforts to raise tax revenue are weak when compared to those of countries on other continents (Ofori & Asongu, 2022; Mpofu, 2022). In comparison to Europe (41.1%), Asia and the Pacific (21%), and Latin America and the Caribbean (22.9%), Africa's average tax to GDP ratio was 16.6% (Cheng, Kannaiah, & Shabbir, 2022).

Abdullahi (2012) documented that with ICT desperately needed to drive information technology adequate skilled personnel who will drive the technology is imperative, high need of enabling laws to synchronize and consolidate with other nations trade relations as it affects taxation. Also, Ayodeji (2016) posited that high level of tax illiteracy, low level of educational qualification of some tax officials, are some of the problems of effective tax assessment, that there has been an endemic high level of corruption and lack of patriotic attitudinal disposition by the tax administrators.

Beyond this, there are gaps existing between the knowledge of ICT penetration required to make the expected impact on the tax revenue in Sub-Saharan Africa. Though some literatures do exist in ICT and

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effective tax revenue in Sub-Saharan Africa (Asongu & Paul (2020); Alamirew, et al., (2020); Audu & Ishola (2021), Bari, et al., (2022), however, there are few of them that had focused the effect of ICT penetration on effective tax revenue in Sub-Saharan Africa (Alex, et al., (2022); Akintoye, et al., (2022); Nassibou & Houngbédji (2022). In addressing this gap and extending the frontiers, in the emerging literature in Sub-Saharan African, this study sought to investigate the effect of ICT on effective tax revenue in Sub-Saharan Africa covering data up to 2022. This study will also be using time series data, preliminary tests such as unit root test, correlation, regression and descriptive statistics test to bridge methodological gap.

1.2 Objectives of the study

i. To examine the effect of mobile phone on tax revenue in Sub-Saharan Africa.

ii. To determine the effect of personal computer on tax revenue in Sub-Saharan Africa.

2.1 Conceptual Review

1.1 Information and Communication Technology (ICT)

Digital disruptions have significant implications on the organization and functioning of any economy and one of the consequences is their impact on taxation. Information communication technology is an integration of digital technologies into every life, including tax administration (Warren, 2018). Santiego-Diaz-De (2018) defined information communication technology as the adoption of digital technologies to modify a business model as it relates to tax administration in all ramification in line with the global trend, with the aim of creating value from the use of advanced technologies, by exploiting digital networks dynamics for the benefit of the improved tax generation and ease of tax payments by taxpayers. Furthermore, Isiadinso and Omoju (2019) submitted that information communication technology is the process by which companies re-organize their administrative tax work methods and strategies to obtain greater benefits including the implementation of new technologies.

Information technologies are tools, devices, and resources used to communicate, create, manage, and share information (Adewoye & Olaoye, 2014). They include hardware (computers, modems, and mobile phones), software (computer programs, mobile phone applications), networks (wireless communications, Internet) and basically concerned with the purpose of collecting, processing, storing and transmitting relevant information to support the management operations in any organizations (Adewoye & Olaoye, 2014). It is a system that provides historical information on current status and projected information, all appropriately summarized for those having an institutions or forms (Adigbole & Olaoye, 2013).

2.1.2 ICT Infrastructure

ICT infrastructure to consist of all components that somehow play a role in overall ICT and ICT-enabled operations or developing customer IT or business solutions as follows (Umaru, Nasiru & Yusuf, 2019);

i. Hardware: Servers, computers, data centers, switches, hubs and routers etc

ii. Software: Enterprise resource planning (ERP), customer relationship management (CRM), productivity applications and more. ii. Network: Network enablement, internet connectivity, firewall and security.

iii. Meat-ware: Human users such as network administrators (NA), developers, designers and generic users with access to any IT appliance or service are also part of

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an IT infrastructure, specifically with the advent of user-centric IT service development.

iv. Sensing technologies: These equipments gather data and translate them into form that can be understood by the computer. These include sensors, scanners, keyboard, mouse, electronic pen, touch or digital boards, barcode sensors or readers, voice recognition system, etc.

v. Communication technologies: These equipments enable information to be transferred from the source to user. It also tries to overcome natural barriers to information transfer like speed and distance some of these include: facsimile machines (fax), telecommunication system, telephone, electronic mail, teleconferencing, electronic bulletin boards, etc.

vi. Display Technologies: These are output devices that form the interface between sensing, communication and analyzing technologies and human user. They include: computer screen, printers, television, etc.

vii. Analysis technologies: These are the technologies that help in the investigation or query of data, analysis and in-depth query for answers for simple to complex phenomena in research procedures. A complete set of a computer system could be a micro, mini, mainframe or super scamper.

viii. Storage Technologies: These technologies facilitate the efficient and effective storage of information in a form that can be easily accessed. They include magnetic tapes, disks, optical disks cassettes, etc.

2.1.3 ICT Penetration

ICT penetration means the portion of the population that has access to the Internet. It defines a portion of the digital divide. Indicates the percentage of internet users in any country. The portion of the population that has access to the Internet which is measured by the percentage of internet users in any country (IGI Global, 2020). According to the International Telecommunication Union (ITU) 2015 ICTs figures, Internet penetration has grown from just over 6 per cent of the world's population in 2000 to 43 per cent in 2015. Today, there are more than 7 billion mobile subscriptions worldwide, up from 738 million in 2000. Globally, 3.2 billion people are using the Internet, of which two billion live in developing countries. Mobile broadband has overcome infrastructure challenges, enabling more areas to connect to the Internet. Its penetration rate increased fourfold between 2010 and 2015, reaching 47 per cent. ICTs have completely transformed the way people live, work and communicate. Their role is crucial for achieving the Sustainable Development Goals (SDGs).

ICTs access and use are still unequally distributed within and between countries. The digital divide with respect to internet use, innovative capacity and quality access is particularly pronounced (according the 2015 MDG report). For instance, just over one third of the population in developing countries uses the Internet, compared to 82 per cent in developed countries and an estimated 450 million people living in rural areas still live out of reach of a mobile signal. There is still more work to be done for the development and use of ICTs infrastructure, as well as capacity-building, particularly in least developed countries, landlocked developing countries and small island developing States, including rapid universal and affordable access to the Internet.

The Outcome Document adopted at the Third International Conference on Financing for Development (Addis Ababa, Ethiopia, 13–16 July 2015) called for the establishment of a Technology Facilitation Mechanism to be launched at the UN

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summit for the adoption of the post-2015 development agenda. The Technology Facilitation Mechanism will be based on a multi-stakeholder collaboration between Member States, civil society, the private sector, the scientific community, United Nations entities and other stakeholders and will be composed of a United Nations inter-agency task team on science, technology and innovation for the sustainable development goals, a collaborative multi-stakeholder forum on science, technology and innovation for the sustainable development goals and an online platform.

2.1.4 Role of ICT in Increasing Tax Revenue in Africa

Robust adoption of technology is designed to move tax administration from manual systems characterized by tax official discretion across taxpayers, tedious and error-prone data entry and case-by-case detection of evasion to a reliance on electronic systems, where there is a more consistent and predictable experience across taxpayers, timely data for decision making and automated detection of suspicious activity (Okunogbe & Santoro, 2022).

i. Define Compliance: In order to tax, the government must be able to identify the tax base. Tax authorities can use technology-based tools to collect information to identify taxable entities (such as individuals or property during registration drives) as well as to collect information on the tax liability that may otherwise be concealed by the taxpayer. For example, tax authorities may require firms to use electronic billing machines (EBMs) that record sales transactions, or they may collect information from third-party sources like employers, vendors, customers, or financial institutions.

ii. Monitor Compliance: Technology can also help the tax authority detect evasion when it occurs. Technology provides tools for collecting and analyzing large amounts of data to automatically detect inconsistencies, such as mismatches between self-reported and third party–reported tax liability. Analyzing different indicators of evasion allows a tax authority to have a data-centric approach to targeting audits by building a risk profile for each taxpayer and prioritizing those with higher risk of evasion.

i. **Facilitate Compliance:** Technology can be used to simplify procedures and improve service delivery to taxpayers. Services like electronic filing and payment can make the taxpaying experience less time consuming and more consistent across taxpayers. EBMs reduce the costs of compiling and submitting information. Electronic modes of communication such as email and SMS provide a timely and cost-effective way of providing information to taxpayers. These technologies also reduce the level of in-person interactions between taxpayers and tax officials, thus reducing opportunities for extortion and collusion.

2.1.5 Taxation

Tax is a mandatory, non-repayable remittance made to the government for products and services intermittently. It is normally paid by private businesses and consumers to the government (Agunbiade & Idebi, 2020). The government is empowered to control, administer and make provisions for law, rules, regulations and policies that will regulate and guide tax system so as to ensure all taxes are properly administered and all revenue generated is reimbursed to the government (Abomaye-Nimenibo et al., 2018). Nigeria's government being one of those countries that has the legal authority to impose any

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type of tax on its population at any rate it deems fit (Amadi & Alolote, 2019).

Taxation is a financial charge on income levied by the government on citizen, corporate entities, businesses or possessions that yield revenue. Similarly it is mean by the compulsory proportional donations from individuals and property possession, imposed by the Government by the virtue of its power for the funding of Government administration and general public necessities (FIRS, 2012). Being an ancient practice, taxation is a source of generating revenue by community or society that form a state to shoulder the public expenditure and improve economic, social and standard of living of the taxpayer's. Taxes are imposed on individuals and corporate income directly or indirectly. Tax that are levied on personal or corporate income of taxpayers are known as direct tax while tax that are impose on sales of good (tangible) and services (intangible) or trade which involve profit/loss is term as indirect tax. Therefore, tax is a monetary liability placed upon persons or belongings maintains to support the government, thus, tax is not a deliberate payment or contribution but rather an enforced role, obtained pursuant by legislative authority and in any contribution imposed by government (Babatunde, et al, 2017).

Taxation can be defined as the system of imposing a compulsory levy on all income, goods, services and properties of individuals, partnership, trustees, executorships and companies by the government (Khobai, Abel & Le Roux, 2016). Khumbuzile and Hlalefang (2018) defined taxation as a compulsory payment made by individuals and organization to relevant Inland Revenue authorities at the federal, state or local government level. Khumbuzile and Hlalefang (2018) sees taxation as a levy imposed by the government against the income, profit or wealth of the individual, partnership, corporate organization. A precise definition of taxation by Ojong, Anthony and Arikpo (2016) is that taxation is one of the sources of income for government, such income as used to finance or run public utilities and perform other social responsibilities.

Taxes are classified into direct and indirect. Okwara, and Amori, (2017) defined direct taxes as taxes levied on the income of individual, group of individuals, and business firms and are paid directly by the person or persons on which it is legally imposed by the tax authority. Direct taxes can be classified into Personal Income tax, Company Income tax, Capital Gain tax, Petroleum Profit tax, and Capital Transfer tax. Indirect taxes are taxes levied on expenditure that is, goods and services. These taxes are paid as part of payment for goods and services purchased by the ultimate users or consumers. The incidences of this type of taxes are usually borne by the third party. Indirect taxes can be classified into the following: Import duties, Export duties and Value Added tax (Okwara, & Amori, 2017).

Taxation is perceived as a critical instrument for National Development and growth in most societies of the world. One of the significant records by which development and growth can be measured in any general public is the degree of wealth, which is made by economic workouts struggled in that society. Furthermore, one of the methods for formation of wealth for nationals is through significant employment, so that citizens have the capacity to earn income to cater for their needs and additionally support taxes to the Government as a portion of their commitment to National Development (Gurama & Muzainah, 2015).

2.1.6 Tax Revenue

Tax revenue has been seen as a major source of government revenue all

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over the world (Oladipupo, &Ibadin, 2015). It is the revenue collected from taxes on income and profits, social security contributions, levies on goods and services, payroll taxes, taxes on the ownership and transfer of property, and other taxes (Okwara&Amori, 2017). It can also be regarded as one measure of the degree to which the government controls the economy's resources (Yahaya&Bakare, 2018; Zayol, et al, (2017).

Tax revenue is defined as the revenues collected from taxes on income and profits, social security contributions; taxes levied on goods and services, payroll taxes, taxes on the ownership and transfer of property, and other taxes. Total tax revenue as a percentage of GDP indicates the share of a country's output that is collected by the government through taxes. It can be regarded as one measure of the degree to which the government controls the economy's resources. The tax burden is measured by taking the total tax revenues received as a percentage of GDP. This indicator relates to the government as a whole (all government levels) and is measured in million USD and percentage of GDP (Harelimana, 2018).

2.1.7 Foreign Direct Investment (FDI)

According to Orji, Orji and Ogbuabor (2018) foreign direct investments are the net inflows of investment to acquire a lasting management interest (10 percent or more of voting stock) in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. Foreign direct investment is an investment made by a company or entity based in one country, into a company or entity based in another country. It differs substantially from indirect investments such as portfolio flows, wherein overseas institutions invest in equities listed on a nation's stock exchange.

According to International Monetary Fund (2016), foreign direct investment simply means the direct investment equity flows in an economy which encompasses equity capital, reinvestment of earnings, and other capital. Direct investment is a category of cross-border investment associated with a resident in one economy having or gaining control or a significant amount of influence on the management of an enterprise that is resident in another economy. Foreign direct investment (FDI) is a direct investment into production or business in a country by an individual or company of another country, either by buying a company in the target country or by expanding operations of an existing business in that country. Foreign direct investment is in contrast to portfolio investment which is a passive investment in the securities of another country such as stocks and bonds (Adeleke, Olowe, & Fasesin, 2014).

According to the International Monetary Fund's balance of payments and international investment position manual, FDI is the term used to represent the process of making a long-term investment in an enterprise which operates in any other economy than that of the enterprise which is making this investment. In this action, intention of the investing firm is not just to get higher returns but also to gain some extent of managerial authority and control or an effective voice in the management of enterprise in which this investment will be made (Cevis & Camurdan 2017). Mfinanga (2018) foreign direct investment reduces the level of poverty, sustain the economic growth and stimulate the smooth and favorable integration of country's economy

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into the global international economy which promote long run development. Due to insufficiency of domestic investment to promote the growth aspiration of an economy, the need for international investment to stimulate growth becomes necessary. However, the capacity of an economy to attract the inflow of foreign investment depends on some factors.

Foreign direct investment refers to an investment in the form of either establishing a business or acquiring business assets by an individual or a company in a country other than the country of origin of the investor (John, 2016). Increased interest in foreign direct investments in recent times could be attributed to the benefits associated with getting foreign investments. Pulatova (2016) attributed the increase in foreign direct investment to an increase in the volume of export, while other studies have also attributed the inflow of foreign direct investment to a transfer in information technology, as it gives the country a competitive edge as a result of new experience, knowledge, management style and production process (Melnyk, Kubatko, & Pysarenko, 2014). Countries are in constant competition to attract FDIs and the extent of investment depends on the tax policies such as corporate income tax reductions, tax holidays, accelerated depreciation, investment tax credits, and preferential treatment of income such as low taxes on earnings from exports (Kersan-Skabic & Mirkovic, 2015).

2.2 Theoretical Review

2.2.1 Digital Diffusion

Innovation theory was developed by a sociologist Everett Rogers in 1962 in the first edition of a publication "Diffusion of Innovations" in 1962. The theory of digital diffusion is based on the notion that adoption of an innovation involves the spontaneous or planned spread of new ideas. It involves the application of new idea, practice or object that is perceived as new in (Rogers, 1995). The theory was reviewed and fact checked by Robert Kelly and Yarilet Perez in June 2023. The theory stressed that it is the perception of change that is important, if the idea seems new to the potential adopter then it should be considered to be an innovation. The theory approached innovation diffusion by considering a variety of case studies on some topics including controlling scurvy in the British Navy, diffusion of hybrid corn in Iowa, diffusion of new news, bottle feeding a babies in the third world, how the refrigerator got its hum, Xerox Parc and Apple computers, digital economy, black music in white America and the possible information technology of administrations and products (Thomas, 2014). The philosophy of this theory is associated with the independent variable of this study, hence considered appropriate and relevant to the study as the theory contented that a technological innovation embodies information and its adoption acts to reduce complexities as applicable tax related issues in Sub-Saharan Africa.

2.3 Empirical Review

This aspect of the research work reviews the various literature on effect of information communication technology penetration and tax revenue in Sub-Saharan Africa. A good number of these researches has been carried out in Nigeria and other countries and thus be summarized in the below:

Ridwan, et al., (2023) used time-series data and the Autoregressive Distributed Lag (ARDL) estimation approach to demonstrate that ICT infrastructure has no substantial positive

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impact on overall tax revenue collection. Nevertheless, it is possible to uncover tax loopholes and administer a country's taxation system effectively in the context of good governance and efficient systems. Bari, et al., (2022) studied the impact of ICT readiness and ICT usage on tax revenue mobilization in low- and middle-income countries. The authors use the fixed effect estimator to demonstrate that, although ICT readiness reports a positive association with tax revenue, it is not statistically significant, and ICT usage is a major tax revenue mobilization enhancer. In addition, the authors state that ICT use increases direct tax revenues through personal income tax and indirect tax revenues through VAT, and that the pass-through effect is evident through three channels: corruption control, government effectiveness, and tax compliance.

Alex, et al., (2022) examined the study on driving information communication technology for tax revenue mobilization in Sub-Saharan Africa. This study explores whether increasing Information and Technology Communication (ICT) boosts government revenue mobilization for sustainable development in 48 Sub-Saharan African countries from 2004 to 2020. The study adopted the Generalized Method of Moments (GMM). The empirical findings are as follows. First, while the calculated net impacts are substantially positive, the corresponding marginal ICT effects utilized for calculating net effects are extremely negative. Second, an extensive study is carried out to determine complementing policy thresholds. This study has policy relevance, and implications as the penetration of the ICT rate can be influenced by policies to mobilize government revenue effectively.

Akintoye, et al., (2022) examined tax revenue and infrastructure expectation gap in selected Sub-Saharan African countries. The study found that tax revenue jointly had significant effect on the total infrastructural expectation gap in Sub-Sahara Africa. The study concluded that tax revenue influenced infrastructural expectation gap in Sub-Saharan African countries. It was recommended that government of sub-Saharan African countries should prioritize stakeholders' interest when making strategic decisions to reduce the infrastructural expectation gap in these countries.

Mohammed and Ajibola (2022) carried out a research on corruption, governance and tax revenue performance in Sub-Saharan Africa. The study examines the impact of corruption and five other indicators of governance on tax revenue performance in Sub-Saharan African countries. A dynamic panel data modelling approach is used as against the static approach used by most of the earlier studies. The findings show that out of the governance indicators considered, only corruption has a significant impact on tax revenue performance, while the effects of the other indicators (political stability and absence of violence, rule of law, government effectiveness, regulatory quality and voice accountability) are not statistically significant.

Nassibou and Houngbédji (2022) examined a research on does tax digitalization improve tax revenues collection in Sub-Saharan Africa? This study investigate whether the tax digitalization reforms operated by Sub-Saharan African countries generated more revenues for their economies. The mixed results from the impacts of tax digitalization on tax revenues, indicating that positive, negative, as well as no significant impact of tax digitalization. However, the positive impacts of tax digitalization on tax revenues are the most result shared among the experiences investigated. Some policy implications are

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suggested for improving the effectiveness of tax digitalization reforms in the sub-Saharan Africa region.

Aslam, et al., (2022), revenue mobilization in Sub-Saharan Africa during the Pandemic. High frequency data available up until December 2020 reveals how the pandemic caused a median 15 percent drop in monthly tax revenues in mid-2020 relative to the year before. Many of the revenue mobilization challenges facing countries before the pandemic remain unresolved and, if anything, have only been exacerbated by lockdowns and the stop-start aftermath. Going forward, as the pandemic comes under control, governments face an even more urgent need to renew domestic revenue mobilization efforts, including diversifying and broadening tax bases and strengthening revenue collection infrastructures. Digital solutions also present important opportunities to open up new or underutilized sources of taxation.

Mpofu (2022) empirically investigated taxing the digital economy through consumption taxes (VAT) in African countries: possibilities, constraints and implications. Owing to the Fourth Industrial revolution and digital transformation, the digital economy has grown substantially globally and in Africa. Despite the positive outcomes such as advancements in technology, improvements in business models and expansion in digital financial inclusion, negative implications include the erosion of tax bases due to the invisible nature of digital transactions. Through a conceptual analysis based on a critical review of the literature, this article contributes to the ongoing debate by assessing the possibilities and constraints of taxing the digital economy in Africa using value added tax (VAT). The paper reviewed 55 articles, most of them current, published between 2014 and 2022, reflecting embryonic nature of the subject area. The findings on the opportunities include the existence of VAT regulation, increased revenue mobilization and efficiency gains, while challenges include ambiguities in legislation, capacity constraints and tax knowledge gaps.

Using unbalanced panel data Wandaogo, et al., (2022) present compelling evidence that ICT penetration drives tax revenue mobilization. Specifically, the results indicate that, among the four ICT penetration indicators mobile subscription, internet access, personal computers, and fixed broadband subscription, fixed broadband subscription contributes the most to three distinct tax revenue indicators, namely overall tax revenue, VAT, and corporate tax.

Conversely, Audu and Ishola (2021) reported that ICT has no major impact on tax revenue generation in Nigeria. Also, Nwauzor (2021) examined the impact of e-taxation on Nigeria's revenue and economic growth from 2010 to 2019; and found that e-taxation has no substantial impact on federally collected revenue or tax-to-GDP in Nigeria. The study recommended that more knowledge of the existence of e-taxation as a method of dealing with tax concerns should be promoted. Roger (2021) observed that digital tax administration has reduced tax evasion and avoidance in Rwanda in the last three years.

Benno, et al., (2021) examined fiscal regimes and digital transformation in Sub-Saharan Africa. The study investigated how the fiscal authorities, through tax policies or fiscal incentives, can play an important role in supporting digitalization of the economy (digital transformation) to exploit its opportunities. Findings emphasize the importance of trade-offs between short-term revenue objectives and the longer-term opportunity costs of higher revenue, enabled by the large positive

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externality effects of the sector, generating higher social returns than those accruing privately.

Asongu and Paul (2020) examined a study on enhancing ICT for productivity in Sub-Saharan Africa: Thresholds for Complementary Policies Simplicity. The purpose of this research is to investigate the relevance of enhancing information and communication technology (ICT) on dynamics of total factor productivity (TFP) in 25 Sub-Saharan African countries using data covering the period 1980-2014. The empirical evidence is based on the Generalized Method of Moments. The following main findings are established. First, while enhancing ICT overwhelmingly has net positive effects on productivity, the corresponding marginal effects are negative. Second, an extended analysis is performed to establish thresholds for complementary policies.

Alamirew, et al., (2020) investigated determinant of tax revenue effort in Sub-Saharan African countries: a stochastic frontier analysis. The main objective of this paper was empirically examined the trend and its drivers of tax revenue effort in Sub- Saharan African countries using panel data and stochastic frontier analysis techniques inter alia:- random effect, fixed effect, half-normal, exponential-normal, and truncated-normal analysis for a period of 2000 to 2018. The estimation result shows that tax effort is positively and significantly related to openness, Share of agriculture sector, external debt, share of the construction sector, population growth, age dependency, corruption and GDP per capita and negatively and significantly related with a share of the service sector, official development assistance, foreign direct investment, population density, literacy and official exchange rates.

In the Nigerian context, Oladele et al. (2020) discovered a substantial link between electronic taxation and tax compliance; but opined that security measures should be implemented regularly to prevent hackers, malicious assaults, and other calamities that are common in ICT-based environments. Ajala and Adegbie (2020) in their study found that ICT had a strong positive impact on tax assessment. The study advised that government at various levels should create enabling tax legislation and eliminate the ambiguities and complexities existing tax rules.

Maina (2018) reports that online tax administration systems have increased revenue generation and resulted in notable success in filing returns, remitting payments, applying for tax refunds, lodging tax objections, applying for tax waivers, and requesting tax compliance certificates in Kenya. McCluskey, et al., (2018) confirmed, via a study of four African countries, that ICT increases tax income in African. Chijioke, et al., (2018) found that, despite the deployment of e-taxation, tax revenue, as well as federally collected money and the tax-to-GDP ratio in Nigeria, has not improved; the study instead, showed the implementation of e-taxation resulted in decreased tax to-GDP ratio. The impact of e-tax collection on Nigeria's revenue and monetary development was studied by Ofurum et al. (2018) also reported that e-taxation has had no impact on tax income, federally collected money, or the tax-to-GDP ratio in Nigeria. Similarly, Okafor, et al., (2020) revealed that e-taxation has little impact on production of capital gains charges in Nigeria.

3.0 Methodology

3.1 Population of the study

The population comprises of countries in the Sub-Saharan Africa. The total number

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is 48 countries (WDI 2021) which are Angola**,** Benin**,** Botswana, Burkina Faso**,** Burundi**,** Cape Verde**,** Cameroon, Central African Republic, Chad, Comoros, Congo, Democratic Republic of Congo, Republic of Cote d'Ivoire, Equatorial Guinea, Eritrea, Eswatini (Formerly Known as Swaziland), Ethiopia, Gabon, Ghana, Guinea, Guinea-Bissau, Kenya, Lesotho, Liberia, Madagascar, Malawi, Mali, Mauritania, Mauritius, Mozambique, Namibia, Niger, Nigeria, Rwanda, Sao Tome and Principe, Senegal, Seychelles, Sierra Leone, Somalia, South Africa, South Sudan, Sudan, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

3.2 Sample size and sampling technique

The sampling method used was judgmental sampling techniques due to lack of data. The sample of this study was selected based on their level of economy improvement. The sample of this study included Nigeria, South Africa, Kenya, Angola, Ghana, Ethiopia, Cameroon, Benin, Mali, Togo, Sierra Leone, Gabon, Mozambique, Niger and Burkina Faso. These 15 countries have sufficient data to be used compared to the remaining countries of the Sub-Saharan Africa.

3.3 Model specifications

This study adapted the model of Koyuncu, et al., (2016) who examined how ICT penetration enhance tax revenue using panel evidence. The model is;

$TAXREV_{it} = \alpha + \beta_1 ICT_{it} + \beta_2 GDPPCGRO_{it} + \beta_3 FDI_{it} + \beta_4 OPENNESS_{it} + (\tau_t + \mu_{it})$

Where;

TAXREV = Tax revenue (% of GDP)

GDPPCGRO = GDP per capita growth (annual %)

FDI = Foreign Direct Investment, Percentage of Gross Fixed Capital Formation

OPENNESS = [[Export of goods and services (current US$) + Import of goods and services (current US$)]/GDP (current US$)]*100

ICT = *f* (INT, CP, COM, FXB)

INT = Internet

CP = Cell Phone

COM = Computer

FXB = FXBROADBAND

τ_t= Time specific effect

i-th is the country's observation time valuation

μ_{it}= Error term

This model is then modified to:

TAXREV= *f* (ICT, FDI, GDP, POP)
ICT = *f* (MP, PC)

$TAXREV = \beta_0 + \beta_1 MP + \beta_2 PC + \beta_3 FDI + \beta_4 GDP + \beta_5 POP + \mu_i$

Where

TAXREV=Tax revenue (% of GDP)

MP = Mobile Phones

PC = Personal Computers

FDI = Foreign Direct Investment

GDP = Gross Domestic Product

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POP = Population

β_0 = constant term

β_1- β_5 = Coefficient of Independent Variables

μ_{it} = Error term.

3.4 Method of data analysis

The method of analysis employed for this study was the Panel Ordinary Least Square (OLS) techniques with the aid of E-view version 09. The analysis employed were descriptive statistics and regression analysis.

3.5 Sources of data

Secondary data were employed. The panel data covered 15 Sub-Saharan African countries having available data of thirty (30) years (1992 to 2021). The source of data will be taken from IMF, International Financial Statistics (IFS), World Development Indicators (WDI), World Bank Database, World Economic Outlook (WEO), Transparency International (TP), African Economic Outlook (AEO) and International Countries Risk Guide (ICRG).

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4.1 Analysis of Result

4.1.1 Descriptive Analysis

	TAXREV	MP	PC	FDI	GDP	POP
Mean	22.4835	32.6142	1.2148	21.0136	3.5255	2.7027
Median	22.2423	20.3670	1.2553	20.6801	3.8036	2.6900
Maximum	25.0487	84.2021	1.5580	23.0602	6.5585	2.7938
Minimum	18.8800	0.0035	0.5788	19.0997	-2.0689	2.5937
Std. Dev.	1.8514	32.8472	0.2760	0.9205	2.1500	0.0630
Skewness	-0.0936	0.3727	-0.6377	0.4016	-0.7093	-0.0023
Kurtosis	1.8062	1.4429	2.5045	2.6385	3.1178	1.7615
Jarque-Bera	1.8252	3.7252	2.3405	0.9698	2.5331	1.9173
Probability	0.4015	0.1553	0.3103	0.6158	0.2818	0.3834
Sum	674.5057	978.4260	36.4426	630.4090	105.7641	81.0794
Sum Sq.Dev.	99.4066	31289.1900	2.2090	24.5745	134.0490	0.1153
Observations	450	450	450	450	450	450

Source: E-View Output, 2023

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Table 4.1.1 presents descriptive statistics for Sub-Saharan African countries for a period of thirty (5) years from 1992-2021. MP ranges from 0.0035 to 84.2021 with a mean of 32.6142 and standard deviation of 32.8472. Also, PC has a minimum value of 0.5788 and maximum of 1.5579 with corresponding average value of 1.2148. These are the two surrogates for the dependent variable (financial performance) while FDI with minimum and maximum with value of 19.0997 and 23.0602 respectively and mean value of 21.0136. Also, GDP ranges from -2.0689 to 6.5585 with a mean of 3.5255 and standard deviation of 2.1500. POP ranges from 2.5937 to 2.7938 with a mean of 2.7027 and standard deviation of 0.1153. The probability value of 0.4015, 0.1553, 0.3103, 0.6158, 0.2818 and 0.3834 revealed that TAXREV, MP, PC, FDI, GDP and POP are normally distributed

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Sample: 1992 2021

Included observations: 450

4.1.2 Regression Analysis

Dependent Variable: TAXREV.

Method: Least Squares

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	8.419134	10.94855	0.768972	0.4494
MP	0.052460	0.009192	5.707100	0.0000
PC	3.238850	1.168067	2.772828	0.0106
FDI	0.669654	0.188633	3.550030	0.0016
GDP	-0.088186	0.087598	-1.006720	0.3241
POP	-1.976554	4.001037	-0.494010	0.6258

R-squared	0.850224	Durbin-Watson stat	1.223323
Adjusted R-squared	0.819021	S.D. dependent var	1.851435
S.E. of regression	0.787630	Akaike info criterion	2.537281
Sum squared resid	14.88868	Schwarz criterion	2.817520
Log likelihood	-32.05921	Hannan-Quinn criter.	2.626932
F-statistic	27.24794	Mean dependent var	22.48352
Prob(F-statistic)	0.000000		

Source: *Author's Computation from E-View Output*, 2023

From the estimated regression result above, it can be deduced that while all other variables remain constant, TAXREV will increase 8.419134. Also, MP, PC and FDI with value of 0.052460, 3.238850 and 0.669654 respectively maintain positive relationship with TAXREV. Thus, since MP, PC and FDI maintain a positive relationship with TAXREV, it follows that

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for every 1% variation or changes in TAXREV, it will result to 0.052460, 3.238850 and 0.669654 increase in the mean value of TAXREV. While GDP and POP with values of -0.088186 and -1.976554 respectively maintain negative relationship with TAXREV. Thus, since GDP maintains a negative relationship with TAXREV, it follows that for every 1% variation or changes in TAXREV, it will result to -0.088186 and -1.976554 decrease in the mean value of TAXREV. The result also showed that MP, PC and FDI with value of 0.0000, 0.0106 and 0.0016 respectively have significant effect on the TAXREV under the period of consideration, while GDP and POP with value of 0.3241 and 0.6258 have insignificant effect on TAXREV under the period of consideration. Also, the R-squared value of 0.850224 (or 85%) of variations in TAXREV is explained by ICT penetration variables employed in this study, which means the variables employed are 85% significant o this study while the remaining 15% was covered by error term. The F-statistics result showed that the result is significant at value of 0.0000, which means ICT penetration has significant effect on tax revenue in Sub-Saharan Africa.

4.1.3 UNIT ROOT TEST

VARIABLE	Phillips-Perron		Order of Integration
	Level	**1st Difference**	
TAXREV	-1.506537(0.5162)	-5.144680*(0.0003)	I(1)
MP	0.515522(0.9843)	-3.596117**(0.0125)	I(1)
PC	-0.075676(0.9432)	-2.850264**(0.0442)	I(1)
FDI	-2.827599(0.0668)	-12.16617*(0.0000)	I(1)
GDP	-3.257081(0.0267)	-6.851432*(0.0000)	I(1)
POP	-0.805670(0.8025)	-3.476845**(0.0164)	I(1)

Source: *Author's Computation from E-View Output* (2023); ** & ** represent significance at 1% and 5%*

The table 4.1.3 above present the group unit root test, using Phillips-Perron test statistic as the criteria for decision. It was found that all variables in the model were non-stationary at levels which is not statistically qualified for further estimation because it might bring spurious estimates. However, the Phillips-Perron test statistic was carried out to test the stationary of the variables and found all the variables stationary at first difference, showing the existence of no unit root. This indication is made through the p-value against that of 1% and 5% level of significance as shown above. Differencing is essential in order to reduce or eliminate trend in unit root test result which would in turn stabilize the mean of the time series. The unit root result in table 4.1.3 above shows that the independent and dependent variables under the study are stationary at first difference at 0.05 (5%) significance

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level since the probabilities are less than 0.5.

Table 4.1.4 Correlation

	TAXREV	MP	PC	FDI	GDP	POP
TAXREV	1.0000	0.8220	-0.2449	0.6810	-0.0302	0.3923
INT	0.7072	0.9097	-0.7689	0.5537	-0.2915	-0.0841
MP	0.8220	1.0000	-0.5796	0.5204	-0.1627	0.2797
PC	-0.2449	-0.5796	1.0000	-0.2921	0.5890	0.4560
FDI	0.6810	0.5204	-0.2921	1.0000	-0.0936	0.0723
GDP	-0.0302	-0.1627	0.5890	-0.0936	1.0000	0.4394
POP	0.3923	0.2797	0.4560	0.0723	0.4394	1.0000

Source: E-View Output, 2023

Table 4.1.4 reported correlation between variables used in the study. Estimates in the table indicated that there is positive correlation between pairs of TAXREV and MP, TAXREV and FDI while negative correlation exists between pairs of TAXREV and PC, TAXREV and GDP. MP has positive correlation with TAXREV and POP while negative correlation with PC and GDP. PC has negative correlation with TAXREV, MP and FDI while positive correlation with GDP and POP Observably, this result demonstrates that the correlations between pairs of variables are relatively strong.

4.2 Hypotheses Testing

Ho_1: Mobile phone has no significant effect on tax revenue in Sub-Saharan Africa.

Decision rule: Since the p-value of mobile phone is less than 5% level of significance,

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we reject null hypothesis and conclude that mobile phone has significant effect on tax revenue in Sub-Saharan Africa.

Ho_2: Personal computer has no significant effect on tax revenue in Sub-Saharan Africa.

Decision rule: Since the p-value of personal computer is less than 5% level of significance, we reject null hypothesis and conclude that personal computer has significant effect on tax revenue in Sub-Saharan Africa.

4.3 Discussion of Result

The first objective of this study is to examine the effect of mobile phone on tax revenue in Sub-Saharan Africa. The result showed that mobile phone has positive and significant effect on tax revenue in Sub-Saharan African under the period of study. The second objective of this study is to examine the effect of personal computer on tax revenue in Sub-Saharan Africa. The result showed that personal computer has positive and significant effect on tax revenue in Sub-Saharan African under the period of study. This shows that ICT penetration significantly influence tax revenue. Generally, the analysis shows that ICT penetration has substantial positive influence on tax revenue in Sub-Saharan Africa.

5.1 Summary of Findings

The result showed that mobile phone and personal computer have positive and significant effect on tax revenue in Sub-Saharan African under the period of study. This means that for every one unit increase in mobile phone and personal computer users, tax revenue in the Sub-Saharan Africa will increase. Mobile phone and personal computer significantly affect tax revenue in Sub-Saharan Africa.

5.2 Recommendations

The study recommended that;

i. Technological tools should be leverage upon by government in the Sub-Saharan African countries in other to improve their method of tax collection to increase tax revenue.
ii. Citizens should be encouraged on the use of ICT tools especially mobile phone and personal computer for easy payment of tax and to curb tax evasion.
iii. Educational programs should be conducted to enhance digital literacy in order to increase mobile phone and personal computer usage.
iv. Digital infrastructures should be invested in so as to support increased mobile phone and personal computer usage as it positively affect tax revenue.
v. Tax authorities need to provide ongoing training on tax officials to be able to effectively use IT systems, as well as specialized training to use the electronic tax data generated for sophisticated analyses to help monitor compliance.

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