ADOPTION OF INFORMATION COMMUNICATION TECHNOLOGY TOOLS AND FEDERAL TAX REVENUE GENERATION IN NIGERIA

MABAMIDJE, Nyoreme
PG/ACC/230008

BENSON IDAHOSA UNIVERSITY

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A DISSERTATION WRITTEN IN THE DEPARTMENT OF ACCOUNTING, FACULTY OF SOCIAL AND MANAGEMENT SCIENCES AND SUBMITTED TO THE SCHOOL OF POSTGRADUATE STUDIES IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE AWARD OF MASTER OF SCIENCE (M.Sc.) DEGREE IN ACCOUNTING OF BENSON IDAHOSA UNIVERSITY, BENIN CITY, EDO STATE, NIGERIA

DECEMBER, 2025

DECLARATION

I, MABAMIDJE, Nyoreme do hereby declare that this dissertation **"ADOPTION OF INFORMATION COMMUNICATION TECHNOLOGY TOOLS AND FEDERAL TAX REVENUE GENERATION IN NIGERIA."** is entirely my own work and composition. The work embodied in the dissertation has not been submitted for any degree and is not currently being submitted for any other degree. All references made to the works of other persons have been duly acknowledged

_____ _____

MABAMIDJE, Nyoreme **Date**
PG/ACC/230008

CERTIFICATION

We certify that this dissertation was carried out by **MABAMIDJE, Nyoreme** with Matriculation Number PG/ACC/230008 in the Department of Accounting, Faculty of Social and Management Science, Benson Idahosa University, Benin City.

Dr. (Mrs.) Beauty E. Jackson-Akhigbe

(Supervisor)

….……

Date

Dr. (Mrs.) Rachael E. Abusomwan

(Ag. Head of Department)

….……

Date

(External Examiner)

….……

Date

DEDICATION

This dissertation is dedicated to God Almighty.

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ABSTRACT

This study examined the effect of Information and Communication Technology (ICT) tools adoption on federal tax revenue generation in Nigeria, with specific focus on Company Income

Tax (CIT), Personal Income Tax (PIT), and Value Added Tax (VAT). The ICT tools considered include TaxPro Max (TPM), Taxpayer Identification Number (TIN), electronic tax payment (EPAY), and electronic Tax Clearance Certificate (e-TCC), while population growth rate was introduced as a control variable. Annual time-series data covering a 30-year period (1995–2024) were obtained from the Federal Inland Revenue Service (FIRS), the Central Bank of Nigeria (CBN) statistical bulletins, and other credible sources. This study adopted the ex-post facto research design and employed the Augmented Dickey–Fuller (ADF) test, Spearman rank correlation, Portmanteau white-noise test, and other diagnostic procedures to validate model adequacy, while the hypotheses were tested using the Vector Autoregressive (VAR) model and ARIMA Intervention Analysis. The findings revealed that ICT adoption significantly influences CIT, PIT, and VAT revenues, and exerts a strong joint effect on overall federal tax revenue generation. However, the ARIMA intervention results showed that tax revenue growth does not exhibit statistical persistence before and after ICT adoption, indicating that ICT reforms alone do not fully account for long-run revenue growth patterns. The study concludes that ICT tools have transformed federal tax administration by enhancing accountability, widening taxpayer coverage, improving remittance efficiency, and strengthening compliance, yet broader macroeconomic and structural factors continue to shape Nigeria's revenue outcomes. It therefore recommends deeper ICT integration, stronger enforcement, improved digital taxpayer management, expanded inter-agency data harmonization, and complementary institutional and macroeconomic reforms to sustain long-term revenue generation. The study contributes to knowledge by providing empirical evidence on aggregate impacts of ICT tools on tax revenue, advancing understanding of digital tax reforms in developing economies, and introducing methodological insights on the limitations of ICT-induced revenue growth using ARIMA intervention analysis.

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

The global shift toward digital governance has repositioned information and communication technology (ICT) as a strategic driver of institutional performance, particularly in public finance administration. ICT tools facilitate automation, transparency, and real-time data processing, all of which are essential for improving tax compliance, expanding the tax base, and curbing revenue leakages (Desi & Bingilar, 2023). In developing countries such as Nigeria, the tax system has long been characterized by inefficiencies stemming from manual processes, poor taxpayer engagement, and institutional capacity deficits. As such, the integration of ICT tools in tax administration is not only a reform imperative but also a response to the need for enhanced public revenue mobilization to support sustainable development.

Federal government tax revenue generation in Nigeria is largely driven by the effectiveness of tax administration, which serves as the operational arm of the tax system through core functions such as taxpayer registration, assessment, filing, collection, enforcement, and service delivery (Adeagbo, Salami & Ogunleye, 2025). Recent reforms in Nigeria have led to the deployment of various ICT-driven solutions, including the Taxpayer Identification Number (TIN), electronic tax payment systems, electronic tax clearance certificates, and the recent TaxPro Max, an integrated software introduced by the Federal Inland Revenue Service (FIRS) in 2021 to streamline tax operations. These initiatives align with global best practices that emphasize digital transformation as a pathway to improved fiscal outcomes.

The National Tax Policy of Nigeria (2017) provides a strategic blueprint for the development and modernization of the country's tax system, with a strong emphasis on administrative efficiency, equity, and transparency. In line with this framework, tax administration serves as a pivotal mechanism for translating tax policies and legal provisions into actionable outcomes

through structured processes such as taxpayer registration, filing, assessment, enforcement, and compliance monitoring. These operational functions are central to achieving the fiscal objectives of the Federal Government. As such, the adoption of ICT tools within this framework is not merely an innovation but a necessary transformation to enhance efficiency, accountability, and ultimately, federal tax revenue generation (Peter, 2023).

ICT tools such as the Taxpayer Identification Number (TIN), electronic tax payments and receipts, and electronic tax clearance certificates have significantly enhanced the capacity of tax authorities to process data in real time, monitor taxpayer activities more effectively, and deliver services in a more transparent and efficient manner, thus, have become integral to the implementation of these tax functions. As highlighted by Nwankwo (2024), through automation, tax authorities are able to reduce administrative bottlenecks, enhance voluntary compliance, and broaden the tax base. Also, Ibrahim and Bala (2021) opine that the integration of ICT tools collectively strengthen compliance enforcement, reduce administrative delays, and support a more data-driven approach to federal tax revenue generation. One of the most notable innovations in recent years is the deployment of the TaxPro Max platform by the Federal Inland Revenue Service (FIRS), designed to serve as a unified digital solution for managing the life cycle of tax obligations. This platform supports functionalities such as e-registration, e-filing, e-payment, and automated reporting, thereby aligning with global trends in digital tax administration.

However, despite these reforms, significant challenges persist. Voluntary tax compliance remains low due to limited taxpayer awareness and digital literacy (Akanbi & Adejare, 2019). Fragmentation among ICT platforms and weak system integration hinder efficient data sharing and enforcement (Nwankwo, 2024). Infrastructure gaps such as; poor internet access and erratic power supply, further limit access to digital tax services, especially in underserved regions. In addition, (Akadakpo & Imonitie, 2024) reported that institutional constraints,

including inadequate staff capacity and resistance to digital systems, continues to affect the effective use of these technologies. Critically, there is insufficient empirical evidence assessing the actual impact of these digital reforms on revenue generation. These challenges highlight the need for a focused investigation into the revenue implications of ICT-based tax administration in Nigeria. This therefore forms the basis of this current study.

1.2 Statement of the Research Problem

The integration of Information and Communication Technology (ICT) tools into public tax system, particularly through electronic platforms adoption, has been globally recognized as a strategic enabler of administrative efficiency, compliance monitoring, and revenue generation enhancement (Okunogbe & Santoro, 2021; World Bank, 2022). In Nigeria, several ICT-driven reforms have been implemented by the Federal Inland Revenue Service (FIRS), including the introduction of the Taxpayer Identification Number (TIN), electronic filing and payment platforms, electronic tax clearance certification and more. These reforms aim to reduce manual processes, limit physical contact between taxpayers and tax officers, and ultimately increase non-oil revenue mobilisation (FIRS, 2021; IMF, 2022). However, the performance outcomes of these initiatives remain contested, as inconsistencies in tax revenue growth suggest that the effectiveness of these digital innovations is yet to be fully realized. For instance, despite nationwide deployment of the TaxPro Max platform in 2021, issues such as poor taxpayer responsiveness, system downtime, and low digital literacy continue to affect the system's operational impact, thus raising questions as to the effect on revenue generation (NBS, 2023; Tyokoso & Eze, 2021).

Empirical research on the effect of ICT adoption on federal tax revenue generation in Nigeria has largely been dominated by studies that rely on perception-based primary data gathered through questionnaires or interviews, often conducted in single states or regions (Okafor & Ude, 2023; Oladele, Omodero & Ekundayo, 2020). For example, Okafor and Ude (2023)

assessed the effect of ICT adoption on tax revenue using data from Oyo State and adopted a cross-sectional survey approach. While their findings suggested a positive relationship between ICT and tax revenue, the study's reliance on subjective responses and its geographically limited focus significantly undermines its generalizability to the federal tax system. Similarly, Oladele, Omodero and Ekundayo (2020) investigated the influence of ICT on tax revenue generation in Lagos State, relying exclusively on primary data obtained through surveys of tax officers. Such approaches do not adequately capture real-time data or allow for robust longitudinal analysis across the federation.

Furthermore, several studies employed outdated scopes that fail to reflect the recent digital transformations in the Nigerian tax landscape (Fabian & David, 2021; Nwabachili, Lawal & Musake, 2024). Fabian and David (2021) examined ICT and tax revenue using data from 2005 to 2014, a period that predates the implementation of TaxPro Max and other post-2020 digital reforms. Likewise, Nwabachili, Lawal and Musake (2024) evaluated ICT effectiveness in public finance generation with data ending in 2016. These studies, while useful in their contexts, do not provide insights into the impacts of the most current ICT innovations that have shaped the Nigerian tax system, particularly since the 2020 nationwide roll-out of ICT tools.

A significant methodological concern in the extant literature is the under-utilization of secondary macroeconomic data and the absence of econometric modeling that could link specific ICT tools to revenue performance (Okonkwo, 2023; Muita, 2011). For example, Okonkwo (2023) conducted a study on e-taxation in Nigeria but relied solely on descriptive statistical techniques without modeling causal or time-based relationships. This limits the empirical rigor of their conclusions and constrains their relevance for policy application. Similarly, Muita (2011) analyzed ICT and revenue performance using correlation analysis without isolating the effect of individual ICT tools, such as TIN or electronic payments, Taxpromax, e-TCC on tax revenue.

Furthermore, much of the existing literature failed to delineate between Nigeria's federal and sub-national tax structures, thereby overlooking the unique operational mandate of the Federal Inland Revenue Service (FIRS), which holds exclusive responsibility for administering key revenue sources such as Value Added Tax (VAT) and Company Income Tax (CIT); (Ibrahim & Bala, 2021; Okafor & Ude, 2023; Oladele, Omodero & Ekundayo, 2020). Consequently, findings drawn from state-level investigations offer limited applicability to the federal fiscal context.

These empirical shortcomings are particularly critical given the ongoing fiscal pressures facing Nigeria, including declining oil revenue, mounting debt obligations, and an urgent need to expand the non-oil tax base, making it difficult to identify which of the digital reforms are most effective in revenue generation or where policy gaps remain. Reports by the National Bureau of Statistics (2023) reveal significant volatility in VAT revenue generation despite the implementation of digital tax tools, raising concerns about the efficacy of ICT-driven reforms. Additionally, the International Monetary Fund (IMF, 2022) has emphasized the need for Nigeria to enhance domestic revenue mobilization through administrative efficiency rather than tax rate increases, underscoring the importance of rigorous empirical evaluation of the effects of ICT tools on tax revenue generation.

In light of the foregoing, this study sought to address the gaps in the extant literature by using 30years secondary time-series data from 1995 to 2024 to evaluate the effects of the adoption of ICT tools on federal tax revenue generation in Nigeria.

1.3 Research Questions

The following research questions guided the empirical investigation:

i. what is the influence of the adoption of ICT tools in Nigeria's tax administration on company income tax revenue generation in Nigeria?

ii. how has the adoption of ICT tools in Nigeria's tax administration affected federal personal income tax revenue generation in Nigeria?

iii. what is the effect of the adoption of ICT tools in Nigeria's tax administration on value added tax revenue generation in Nigeria?

iv. to what extent has the adoption of ICT tools in Nigeria's tax administration affected federal tax revenue generation in Nigeria?

v. to what extent does tax revenue growth exhibit persistence before and after the adoption of ICT tools in Nigeria's tax administration?

1.4 Objectives of the Study

The main objective of this study is to examine the effect of Information Communication Technology (ICT) tools adoption on federal tax revenue generation in Nigeria. In pursuit of this objective, this study specifically sought to:

i. assess the influence of the adoption of ICT tools in Nigeria's tax administration on company income tax revenue generation in Nigeria.

ii. examine how the adoption of ICT tools in Nigeria's tax administration affected federal personal income tax revenue generation in Nigeria.

iii. evaluate the effect of the adoption of ICT tools in Nigeria's tax administration on value added tax revenue generation in Nigeria.

iv. investigate the extent to which the adoption of ICT tools in Nigeria's tax administration affected federal tax revenue generation in Nigeria.

v. examine whether tax revenue growth exhibited persistence before and after the adoption of ICT tools in Nigeria's tax administration.

1.5 Research Hypotheses

To guide the empirical analysis, the following null hypotheses were formulated:

H_{O1} The adoption of ICT tools in Nigeria's tax administration does not have significant influence on company income tax revenue generation in Nigeria.

H_{O2} The adoption of ICT tools in Nigeria's tax administration has no significant effect on federal personal income tax revenue generation in Nigeria.

H_{O3} The use of ICT tools in Nigeria's tax administration does not have significant effect on value added tax revenue generation in Nigeria.

H_{O4} The adoption of ICT tools in Nigeria's tax administration does not exert significant influence on federal tax revenue generation in Nigeria.

H_{O5} There is no significant persistence (AR effect) in Nigeria's tax revenue growth before and after the adoption of ICT tools in Nigeria's tax administration.

1.6 Scope of the Study

This study focused on examining the effect of Information and Communication Technology (ICT) adoption on federal tax revenue generation in Nigeria, with particular emphasis on four major ICT interventions; TaxPro Max, Taxpayer Identification Number (TIN), electronic tax payments, and electronic tax clearance certification. The study thus, adopted a federal-level perspective, rather than a regional or state-based analysis, to ensure broader generalizability of findings.

The temporal scope of this study spanned from 1995 to 2024. The starting year, 1995, is justified by the fact that it marks the beginning of significant tax reforms in Nigeria. This reform laid the groundwork for future automation and ICT integration in tax processes, including the early stages of TIN development and other digitization efforts.

The endpoint, 2024, was selected to capture the most recent available data at the time of this research. This includes the full effect of TaxPro Max and other electronic systems that have been implemented in the last decade.

Geographically, the study focused on data published by the Federal Inland Revenue Service (FIRS), being the primary agency responsible for tax collection at the federal level in Nigeria and the Central Bank of Nigeria's periodic Statistical Bulletins. The choice of federal-level data is further justified by the availability and reliability of national tax statistics over the period under review and the need for a national level policy-relevant outcome.

Furthermore, the study concentrated on quantifiable aspects of federal tax revenue generation, such as company income tax, personal income tax and value added tax. These indicators were used to evaluate the effectiveness of ICT tools in enhancing revenue generation. The study did not include qualitative dimensions such as taxpayer satisfaction or staff competence in ICT usage, as these fall outside the scope of its empirical orientation.

1.7 Significance of the Study

This study is poised to benefit a broad spectrum of stakeholders, each of whom plays a critical role in Nigeria's tax ecosystem. By examining the impact of ICT tools on federal tax revenue generation, the research offers targeted value to the following groups:

Federal Inland Revenue Service (FIRS):

As the primary institution responsible for tax administration in Nigeria, FIRS will benefit from empirical evidence on how digital initiatives, such as the TaxPro Max platform, electronic tax clearance systems, and online payment solutions, have influenced revenue generation. The findings will help FIRS assess the efficacy of its digital reforms, enhance strategic planning, and refine the design and deployment of future ICT tools for improved revenue generation.

Ministry of Finance and Fiscal Policy Makers:

The study provides actionable insights into how tax-related ICT policies affect national revenue generation . This is especially important for evidence-based decision-making on digital investment and resource allocation within the Ministry. By assessing the long-term effects of ICT adoption on federal tax revenue generation, policymakers will be better positioned to advocate for fiscal modernization and drive sustainable revenue reform programs.

National Assembly (Finance and ICT Committees):

Legislators responsible for fiscal oversight and ICT development will gain deeper understanding of the legislative and institutional frameworks required to support digital tax systems. This could inform the enactment or amendment of laws needed to strengthen electronic taxation and enhance revenue generation.

Taxpayers (Individuals and Corporate Entities):

Taxpayers stand to benefit indirectly from more transparent, efficient, and user-friendly tax processes resulting from well-implemented ICT solutions. A tax system enhanced through digital innovation can lead to reduced compliance costs, shorter processing times, and clearer communication from authorities, all of which improve revenue generation and trust in the system.

ICT Developers and System Vendors:

The study highlights both the strengths and limitations of current tax administration technologies. These insights will inform ICT vendors and developers in customizing future solutions tailored to the Nigerian context. Software providers can use the findings to improve system architecture, user interface, and integration capacity with other government platforms.

Academic and Research Community:

Scholars in accounting, economics, public administration, and information systems will find

the study valuable for its empirical contribution to the discourse on digital governance and public sector reform. It provides a foundation for future studies by bridging existing gaps, particularly in the longitudinal analysis of ICT tools' impact on federal tax revenue.

International Donor Agencies and Development Partners (e.g., World Bank, IMF, DFID):

These institutions support public sector reform and digital infrastructure projects in developing countries. The study offers an evaluative lens on Nigeria's tax digitization journey, providing a model that can be replicated or adapted in similar contexts. It will also help in justifying ongoing and future funding for ICT-based public finance projects.

Civil Society and Tax Advocacy Groups:

By promoting accountability and transparency, civil society organizations involved in fiscal governance will use the study to advocate for more citizen-centric tax systems. The findings will empower these groups to engage constructively with tax authorities, pushing for reforms that enhance inclusiveness and improve revenue generation.

In summary, this study offers multidimensional benefits across governance, technology, fiscal policy, and research landscapes, which makes it a crucial one to Nigeria's pursuit of improved tax revenue generation.

1.8 Limitations to the Study

While this study is expected to make significant contributions to the field of ICT adoption and its effect on federal tax revenue generation in Nigeria, it is subject to the following limitations:

Data Availability and Reliability:

The study relied largely on secondary data from the Federal Inland Revenue Service (FIRS), Central Bank of Nigeria (CBN) statistical bulletins, and National Bureau of Statistics (NBS). The availability, completeness, and consistency of these data sets across the long study period (1995–2024) posed challenges, particularly for earlier years. To address this, the study

corroborated different sources wherever possible. However, the figure for PIT in the last quarter of 2024 has not been released at the time of this study. As a way out, the researchers calculated and applied the incremental rate of the previous year to arrive at the data used for 2024.

Measurement Limitations:

The use of proxy variables such as dummy indicators or aggregated revenue figures did not fully capture the nuanced effect of ICT tools on various dimensions of tax revenue. Similarly, separating the effect of ICT adoption from other macroeconomic and policy influences over the 30-year period was statistically complex. To mitigate this, the study employed relevant diagnostic tests (including Augmented Dickey Fuller unit root test, Bartlett Periodogram-based white noise test and Portmanteau white noise test) to determine the stationarity and presence, or otherwise of autocorrelation in the time series dataset and residuals and ensure that measurement challenges do not compromise the study's conclusions.

Attribution of Causality:

Although the study applied econometric techniques, it was still somewhat difficult to make definitive causal inferences due to the non-experimental nature of the data. The presence of confounding variables such as; population growth, economic shocks, or political reforms may affect the reliability of cause-and-effect relationships (Chukwu & Ferdinand, 2023). To manage this challenge, the study controlled for major confounding variables, population growth, within its models, ensuring that the integrity of the results is not undermined.

Generalization of Findings:

Although the study adopts a national perspective, some state-level tax activities (especially in revenue mobilization and ICT adoption) may not be fully reflected in federal data. Therefore, findings may be more representative of ICT tools and federal tax revenue generation. To

address this, the study clearly delineated its scope and acknowledge contextual limitations, ensuring that conclusions are not inappropriately generalized beyond the intended coverage. Despite these limitations, the study maintained methodological rigour by adopting robust analytical technique, validating data sources, and offering clear justifications for its choices, thereby ensuring its findings remain relevant and credible.

1.9 Operational Definition of Terms

Information and Communication Technology (ICT): In this study, ICT refers to the integration of computing systems, internet technologies, and software applications used by tax authorities to automate and enhance tax-related processes. It includes digital platforms such as TaxPro Max, electronic payment systems, and online taxpayer registration and electronic tax clearance tools.

TaxPro Max: TaxPro Max is an end-to-end electronic tax administration platform developed and deployed by the Federal Inland Revenue Service (FIRS) to facilitate digital tax filing, payments, taxpayer engagement, and real-time compliance monitoring in Nigeria.

Taxpayer Identification Number (TIN): TIN is a unique numeric code assigned to individuals and corporate entities by tax authorities for the purpose of identifying, tracking, and administering their tax obligations. It is a prerequisite for conducting tax-related transactions and business registrations in Nigeria. It is generated electronically by the Federal Inland Revenue Service (FIRS) for federal taxpayers.

Electronic Tax Payment: This refers to the use of digital channels such as; internet banking, mobile payments, and online portals for remitting taxes to government authorities. It is a key component of ICT-enabled tax systems intended to enhance transparency and reduce manual errors.

Electronic Tax Clearance Certificate (e-TCC): An e-TCC is a digitally issued document that confirms a taxpayer has settled all outstanding tax liabilities. It is generated through automated platforms and is often required for public procurement, business contracts, and government services.

Tax Revenue Generation: For the purpose of this study, tax revenue generation refers to the effectiveness and efficiency of the Federal Inland Revenue Service (FIRS) in mobilizing tax income. This is empirically assessed using disaggregated indicators including revenue from Company Income Tax (CIT), Personal Income Tax (PIT), and Value Added Tax (VAT), which serve as measurable proxies for evaluating the fiscal impact of ICT adoption in federal tax revenue generation.

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

The literature review aims to identify key themes, trends, theories and gaps in prior research, thereby situating the current study within the broader academic discourse. By synthesizing past findings, this chapter establishes the contextual basis for the research, highlighting areas that require further empirical exploration and methodological refinement. It also serves to justify the study's focus on specific ICT components such as TaxPro Max, Taxpayer Identification Number (TIN) registration, electronic tax payments, and electronic tax clearance certificates in the Nigerian tax environment.

2.2 Conceptual Review

2.2.1 Federal Tax Revenue Generation

Federal tax revenue generation reflects the effectiveness with which the central government mobilizes income through major tax instruments such as Company Income Tax (CIT), Personal Income Tax (PIT), and Value-Added Tax (VAT). As a core indicator of fiscal sustainability, it demonstrates the capacity of domestic resources to support national development ambitions without undue dependence on oil earnings or external borrowing (Adewale & Mohammed, 2022). Strong performance in this area signals a government's ability to stabilize its finances, fund public services, and pursue long-term economic planning. Company Income Tax (CIT) represents the federal government's efficiency in capturing revenue from corporate profits and activities of formal business entities. Personal Income Tax (PIT), on the other hand, measures the extent to which taxation reaches individuals, particularly wage earners and self-employed persons who operate within the formal sector (Amegashie & Oteng, 2021). VAT, being a broad-based consumption tax, reflects the vibrancy of economic transactions and the effectiveness of indirect tax administration (Oyedele, 2020). Together, these three components provide a comprehensive view of how well the federal revenue system performs.

The assessment of tax generation often involves analyzing absolute revenue figures, growth patterns across fiscal periods, and comparative ratios such as tax-to-GDP, which provide context for evaluating how revenue mobilization measures up against overall economic activity (Okonkwo, 2023; Bello & Usma, 2018). In Nigeria, historical challenges including a narrow tax base, significant informal sector activity, administrative weaknesses, and a general culture of taxpayer apathy have consistently constrained the effectiveness of tax collection. In recent years, however, the federal government has undertaken digital transformation initiatives aimed at improving transparency, minimizing leakages, and simplifying taxpayer interactions. These reforms recognize the need for a modernized, technologically empowered tax administration capable of meeting current fiscal demands (Okeke & Nwankwo, 2022; FIRS, 2022). Technology-driven solutions, therefore, constitute a crucial pillar in the effort to enhance compliance and strengthen revenue outcomes.

Beyond institutional and technological factors, broader structural variables exert considerable influence on federal tax revenue generation. Population growth, for instance, can either expand the tax base or intensify dependency pressures, depending on how effectively individuals are integrated into the formal economic system. Macro-economic indicators such as inflation and GDP also shape taxable capacity and revenue outcomes, reinforcing the need to align tax policies with economic realities (Tyokoso & Eze, 2021; Oyedele, 2020). Despite ongoing reforms, Nigeria continues to grapple with issues such as limited compliance culture, gaps in administrative capacity, and persistent overreliance on a small segment of formal taxpayers. These challenges underscore the need for a holistic strategy that integrates technological adoption with improved regulatory frameworks, institutional strengthening, and sustained public engagement. Without these complementary efforts, the full benefits of digital tax innovations may not be realized.

Recent interventions including the deployment of ICT platforms such as TaxPro Max, electronic filing systems, digital tax identification processes, and automated payment channels are designed to strengthen tax collection efficiency and enhance reporting accuracy (FIRS, 2022; Olaoye et al., 2017). Nevertheless, the federal government's revenue generation remains constrained by structural and operational limitations.

2.2.1.1 Company Income Tax (CIT)

Company Income Tax (CIT) represents a major component of Nigeria's federal tax structure, serving as a direct levy on the profits of incorporated entities operating within the country. It is a critical indicator of fiscal capacity, particularly in economies like Nigeria where efforts to diversify revenue sources away from oil dependence continue to intensify (Musa & Ajayi, 2024). CIT generation thus reflects both the strength of the corporate sector and the broader effectiveness of revenue mobilization policies. As the business environment evolves, the federal government increasingly relies on CIT as a stable and predictable means of supporting public expenditure and developmental programmes.

The generation of CIT is often measured by examining the total annual revenue collected from companies, the year-on-year growth rate of these revenues, and the share of CIT within the overall tax portfolio. These metrics provide important insights into the responsiveness of the corporate tax system to economic conditions and administrative changes (Obiora, 2024). A well-designed CIT framework is expected to be broad-based, fairly administered, and capable of curbing tax avoidance through strategic and well-enforced legislation. In Nigeria, these processes are anchored by the Federal Inland Revenue Service (FIRS) under the regulatory authority of the Companies Income Tax Act (CITA), ensuring that tax policy and administration work in tandem.

In Nigeria, the generation of CIT is shaped by several interrelated factors, including the financial health and profitability of registered firms, the degree of taxpayer compliance, and

the operational efficiency of tax authorities (Ojo & Nwachukwu, 2021). Macroeconomic conditions such as inflation, interest rates, and exchange rate volatility further influence corporate profitability and, by extension, tax outcomes. During periods of economic instability, CIT revenue may decline due to shrinking business margins, while economic expansion typically enhances corporate tax contributions.

In response to persistent challenges in tax administration, Nigeria has increasingly leveraged information and communication technology (ICT) tools to modernize the CIT collection process. The introduction of digital platforms such as TaxPro Max, electronic filing systems, automated payment portals, and centralized taxpayer databases reflects a deliberate effort to enhance tax administration through technological innovation (Olatunde, Eze & Bakare, 2024; FIRS, 2021). These ICT tools have been designed to streamline tax processes, reduce human interference, improve record-keeping, and close loopholes that previously enabled tax evasion and administrative leakages.

The adoption of ICT solutions has also strengthened compliance management, enabling FIRS to monitor tax activities more effectively and enforce statutory obligations with greater precision. Automated reminders, real-time transaction tracking, and integrated reporting systems assist both taxpayers and administrators in fulfilling their responsibilities efficiently. These innovations align with global trends promoting digital taxation as a means of improving transparency and reducing administrative burdens on businesses.

Nevertheless, despite these advancements, Nigeria's CIT generation continues to face several structural and operational constraints. Issues such as limited digital literacy among taxpayers, intermittent system downtimes, inconsistent broadband infrastructure, and lingering bureaucratic practices sometimes impede the full effectiveness of ICT adoption. Furthermore, gaps in taxpayer documentation, the prevalence of informality, and corporate resistance to compliance reforms may limit the expected gains from digital transformation initiatives.

Ultimately, while ICT tools hold substantial promise for enhancing CIT administration and revenue generation in Nigeria, their success depends on broader institutional, technological, and economic factors. Creating an enabling environment—characterized by capacity building, infrastructural investment, and policy consistency—remains essential for unlocking the full benefits of digital tax systems. As reforms deepen and more corporate taxpayers transition to digital platforms, Nigeria's ability to strengthen CIT generation and support sustainable revenue growth is likely to improve significantly.

2.2.1.2 Personal Income Tax (PIT)

Personal Income Tax (PIT) represents a core component of Nigeria's direct tax system and is levied on income earned by individuals from salaries, wages, commissions, dividends, interest, and other personal earnings. While PIT is primarily a state-level revenue source, certain categories of taxpayers fall under the direct administration of the Federal Inland Revenue Service (FIRS) as outlined in the Personal Income Tax Act (PITA), Cap P8, LFN 2004 (as amended). These include residents of the Federal Capital Territory (FCT), personnel of the armed forces and police, staff of the Ministry of Foreign Affairs, and non-resident individuals earning income within Nigeria's jurisdiction (FIRS, 2023). This federal mandate makes PIT an essential component of domestic revenue mobilization within the national fiscal framework.

Despite its importance, federal PIT generation has historically remained modest. This outcome is partly attributed to the relatively narrow taxpayer segment assigned to FIRS, which is limited compared to the broader PIT base managed by state governments. Structural barriers such as incomplete taxpayer data, limited documentation of income flows, and gaps in real-time monitoring further weaken federal PIT collection. Fabian and David (2021) highlight that the federal share of PIT revenue is affected by Nigeria's large informal economy, where many income earners operate outside the formal tax structure. Consequently, the restricted visibility

of income activities and the difficulty of tracking non-resident taxpayers reduce the effectiveness of PIT administration at the federal level.

The challenges associated with non-resident taxpayers also pose significant constraints to PIT collection. Cross-border enforcement difficulties, weak international information-sharing mechanisms, and complex residency rules often contribute to low compliance. These issues are compounded by the mobility of expatriate workers and multinational professionals whose tax obligations may not always be adequately captured in domestic systems. As a result, substantial revenue remains uncollected, limiting the federal government's ability to optimize PIT as a reliable revenue source.

To address these weaknesses, the FIRS has increasingly adopted digital solutions aimed at improving efficiency, accountability, and taxpayer compliance. Key innovations include electronic filing (e-filing), electronic tax clearance certificates (e-TCC), automated taxpayer registration, and online self-service portals designed to simplify the entire compliance process (Chukwu & Anyanwu, 2020). These ICT tools reduce the time and cost of compliance for taxpayers, eliminate manual bottlenecks, and improve the integrity of PIT administration. Such digital reforms are aligned with global best practices, where tax authorities rely on automation to enhance transparency and expand tax coverage.

Furthermore, the deployment of ICT tools strengthens the capacity of FIRS to maintain comprehensive taxpayer records and monitor income streams more effectively. Digital platforms enable faster data validation, improved taxpayer profiling, and enhanced audit capabilities through data analytics. These functions are critical for addressing revenue leakages and minimizing tax evasion. Over time, such systems are expected to broaden the federal PIT base and contribute to a more stable and predictable revenue environment.

Nonetheless, despite the promising role of ICT, several obstacles continue to impede the full optimization of PIT at the federal level. Challenges such as limited inter-agency data sharing, weak integration between FIRS and private-sector payroll systems, and persistent gaps in taxpayer awareness hinder the effectiveness of digital reforms. Taxpayer apathy and low tax morale remain significant problems, often driven by concerns over government accountability and perceptions of inadequate public service delivery.

Ultimately, as Maphosa and Ncube (2022) note, digital transformation must be accompanied by broader institutional reforms for it to achieve meaningful outcomes. Enhancing tax education, fostering trust through fiscal transparency, and strengthening enforcement mechanisms are essential to complement the gains achieved through ICT adoption. When effectively integrated, these measures can transform PIT administration, expand the federal government's revenue capacity, and contribute to improved tax generation in Nigeria.

2.2.1.3 Value Added Tax (VAT)

Value Added Tax (VAT) is a broad-based consumption tax imposed at each stage of the supply chain on the incremental value added to goods and services. As a multi-stage tax, it is considered one of the most efficient means of generating public revenue because it captures a wide range of economic transactions while minimizing significant market distortions (Ojo & Nwachukwu, 2021). In Nigeria, VAT is administered by the Federal Inland Revenue Service (FIRS) in accordance with the VAT Act, and the proceeds are distributed among federal, state, and local governments. This structure makes VAT a crucial fiscal instrument in the country's revenue framework.

VAT has emerged as a major contributor to Nigeria's non-oil revenue, especially against the backdrop of fluctuating global oil prices and the federal government's increasing efforts to diversify revenue sources. As Okonkwo (2023) notes, VAT has played a significant role in stabilizing government income since its introduction in 1994, particularly during periods of

economic downturn driven by oil price shocks. The tax's consumption-based nature ensures broad coverage, allowing individuals and entities including those operating in the informal sector to contribute indirectly to public revenue through their spending patterns.

Despite its broad potential, VAT generation in Nigeria faces persistent challenges that limit the full realization of its revenue-generating capacity. One of the key constraints is low compliance among businesses, especially small and medium-sized enterprises. Weak enforcement mechanisms, coupled with inconsistent record-keeping practices, hinder effective monitoring and assessment of VAT obligations. Todaro and Smith (2015) highlight that inadequate administrative efficiency and poor tracking systems significantly constrain revenue collection from consumption taxes in developing economies, a trend that is equally reflected in Nigeria.

Another hindrance to effective VAT administration is the limited ability of tax authorities to capture digital transactions and cross-border economic activities, particularly as e-commerce continues to expand. The rapid shift toward digital marketplaces has outpaced traditional tax monitoring mechanisms, creating significant gaps in VAT collection. Additionally, the prevalence of multiple informal levies and taxes imposed by subnational governments discourages firms from making full disclosures, further shrinking the taxable base.

To address these challenges, Nigeria has increasingly turned to the adoption of ICT tools aimed at modernizing VAT administration. These digital reforms include the introduction of electronic invoicing systems, VAT automation platforms, integration of sales data into centralized databases, and real-time monitoring tools designed to ensure accuracy in reporting and remittances. According to Chukwuma (2022), such innovations have improved tax transparency, reduced leakages, and enhanced administrative efficiency in jurisdictions that effectively deploy them.

Automation of VAT processes also strengthens compliance by reducing human interference, simplifying filing procedures, and enabling tax authorities to conduct data-driven audits. With

digital tools, FIRS can better track sales transactions, reconcile taxpayer declarations, and identify discrepancies that may signal evasion or underreporting. These capabilities are critical in improving the reliability of VAT revenue and expanding the tax base through better enforcement and taxpayer segmentation.

However, realizing the full benefits of ICT adoption in VAT administration requires continuous investment in tax technology infrastructure, capacity building, and robust policy support. Technical challenges, such as system downtimes, limited interoperability across agencies, and low digital literacy among taxpayers, can undermine the effectiveness of digital reforms. Strengthening enforcement frameworks, promoting taxpayer education, and fostering inter-agency collaboration remain essential for maximizing ICT-driven improvements in VAT generation. When these elements are aligned, VAT has the potential to expand significantly as a sustainable and stable source of federal revenue in Nigeria.

2.2.2 Information and Communication Technology (ICT) Tools in Taxation

Information Communication Technology (ICT) has become a critical driver of efficiency and innovation in public sector management, especially in the area of tax administration (Abubakar & Danjuma, 2022). ICT refers broadly to the technologies that facilitate the electronic processing, storage, and transmission of information. Laudon and Laudon (2020) describe ICT tools as comprising computer hardware, software, databases, networks, and other digital infrastructures that support data generation and decision-making. Within the tax system, ICT tools include a wide array of digital solutions used to manage processes such as taxpayer registration, assessment, filing, payments, audits, and enforcement (OECD, 2021). Akanbi and Adejare (2019) emphasize ICT as the deployment of electronic platforms that support both strategic planning and operational execution in tax collection, while Muita (2011) highlights its role in tools such as e-filing, online tax payments, digital identification systems, and real-time analytics.

In Nigeria, the evolution of ICT-enabled tax administration began with the introduction of the Integrated Tax Administration System (ITAS), developed to replace the cumbersome manual system with a seamless digital framework. Although conceptualized earlier, ITAS was formally launched in 2013 and fully operationalized by the Federal Inland Revenue Service (FIRS) in 2016 (Musa & Ajayi, 2024). The system was designed to provide a central platform for tax registration, filing, computation, and payment. Complementing ITAS, the FIRS deployed multiple digital payment platforms such as Remita, Interswitch, and the Nigeria Inter-Bank Settlement System (NIBSS) to support real-time remittances and interbank settlements, thereby enabling taxpayers to meet their obligations conveniently and securely from any location (Nwosu & Ekennia, 2022).

The adoption of ICT tools has significantly automated tax functions, reducing the delays and administrative bottlenecks associated with manual processes. According to the International Monetary Fund (IMF, 2022), ICT integration strengthens revenue administration by improving data accuracy, lowering compliance costs, and enhancing the overall ease of doing business. Mugisha and Ayebale (2022) further note that automation facilitates the efficient tracking of taxable activities and provides tax authorities with tools to better identify liabilities, thereby expanding the tax base and limiting evasion.

In developing economies, ICT has proven essential for controlling revenue leakages and correcting structural inefficiencies in tax systems. Efanga, Etim, and Udo (2020) observe that digital solutions have helped governments modernize collection processes and improve accountability. In Nigeria specifically, FIRS has introduced systems such as the TaxPro Max platform, the Electronic Tax Payment System, and digital Tax Clearance Certificate (e-TCC) portals to strengthen accuracy, streamline operations, and enhance service delivery (FIRS, 2021). These tools have also improved taxpayer engagement by reducing filing errors, ensuring transparency in transactions, and providing real-time visibility into payments and remittances.

As noted by Olatunji and Oladayo (2018), ICT-based systems have contributed meaningfully to reducing financial leakages and enhancing compliance in Nigeria's federal tax administration.

Another significant advantage of ICT integration is its support for analytics-driven enforcement. Adebisi and Gbegi (2020) explain that ICT enables tax authorities to analyze patterns of taxpayer behaviour, detect non-compliance, forecast revenue, and make evidence-based policy decisions. Digital footprints created through automated systems strengthen the capacity of tax authorities to identify fraud, reconcile discrepancies, and pursue enforcement actions more effectively. However, these authors also caution that Nigeria faces obstacles such as weak digital infrastructure, limited technical skills among tax officials, and resistance to change from both taxpayers and administrators.

Despite these challenges, the literature consistently underscores ICT as more than a set of technical tools. The World Bank (2022) argues that ICT represents a transformational reform instrument capable of shifting the tax administration model from a manual, reactive system to one that is proactive, transparent, and data-driven. Countries that successfully implement ICT solutions often experience strengthened tax morale, improved compliance culture, and a more efficient allocation of administrative resources.

In summary, this study conceptualizes ICT tools as independent variables representing the digital infrastructure, platforms, and automated processes that underpin modern electronic tax administration in Nigeria. These tools ranging from e-filing systems to real-time analytics platforms play a central role in shaping federal tax revenue generation and serve as the foundation for understanding the relationship between technology adoption and improved revenue outcomes.

2.2.3 TaxPro Max Adoption

The adoption of the TaxPro Max platform by the Federal Inland Revenue Service (FIRS) in June 2021 marked a major turning point in Nigeria's federal tax administration. Introduced as part of the country's broader digital transformation strategy, the platform sought to address long-standing challenges in tax registration, filing, remittance, and compliance monitoring. By integrating these processes on a single automated platform, TaxPro Max aimed to improve the transparency, efficiency, and accuracy of federal non-oil revenue administration, particularly across Company Income Tax (CIT), Value Added Tax (VAT), Personal Income Tax (PIT), and Education Tax regimes.

Existing empirical studies provide evidence that the deployment of TaxPro Max has yielded notable improvements in tax administration outcomes. Adewale and Ilesanmi (2023) reported that the platform simplified taxpayer onboarding, reduced bureaucratic delays, and improved real-time compliance verification, thereby strengthening the administrative capacity of FIRS. Their findings suggest that automating these processes not only shortened the tax filing lifecycle but also reduced human contact, which historically enabled rent-seeking behavior.

Further reinforcing this perspective, Uchenna and Obasi (2022) highlighted that the automation embedded within TaxPro Max helped streamline the processing and reconciliation of tax payments. They argued that features such as real-time data capture, automatic acknowledgment notifications, and digital audit trails enhanced the accuracy and timeliness of tax remittances. This, in turn, contributed to improved trust and confidence in the tax administration system, especially among compliant corporate taxpayers.

In the same line of analysis, Nwankwo (2024) observed that TaxPro Max played a critical role in addressing revenue leakages that previously hindered federal non-oil tax generation. Through its automated reconciliation mechanisms, the platform could quickly detect inconsistencies in returns, mismatches in declarations, and suspicious patterns indicative of evasion. According to Nwankwo, such capabilities strengthened accountability and reduced

opportunities for manipulation, thereby supporting a more robust and transparent revenue collection regime.

Despite these notable achievements, some scholars caution that the impact of TaxPro Max has been uneven and limited in certain contexts. Okonkwo (2023) noted that infrastructural deficits, digital illiteracy, and poor taxpayer awareness continue to impede the platform's efficient use, especially among micro and small enterprises. These challenges are more pronounced in rural areas and informal sectors where internet access and technological exposure remain low. Consequently, the potential of TaxPro Max to significantly improve federal tax revenue is constrained by disparities in digital readiness.

Moreover, Yusuf and Hassan (2021) argued that the increase in federal tax revenue observed after the platform's introduction may not be solely attributable to TaxPro Max. They contended that macroeconomic variables such as inflationary pressures, the post-pandemic economic rebound, and relative stability in global oil markets may have contributed to rising revenue figures. Their critique underscores the need to avoid attributing all revenue improvements to the platform without considering broader economic dynamics.

Finally, Ogunleye and Nwachukwu (2022) raised concerns about the unequal adoption of the platform across industries, regions, and demographic groups. While digitally advanced sectors adapted quickly and benefited significantly from TaxPro Max, less digitized taxpayers faced persistent challenges such as poor network connectivity, frequent system downtimes, and inadequate support services. These issues continue to limit the full realization of the platform's objectives and raise questions about the extent to which its adoption could independently drive improvements in federal tax revenue generation.

2.2.4 Taxpayer Identification Number (TIN) Issuance

The introduction of the Taxpayer Identification Number (TIN) system in Nigeria marked a significant institutional reform aimed at modernizing tax administration and strengthening federal revenue mobilization. Implemented by the Joint Tax Board (JTB) in collaboration with the Federal Inland Revenue Service (FIRS), the TIN initiative was designed to centralize taxpayer data, improve traceability, and enhance compliance monitoring. By creating a unified database for both individuals and corporate entities, the reform sought to broaden the tax net and support more efficient non-oil revenue mobilization. According to Obiora (2024), this system aligns with global best practices by providing a reliable mechanism for tax authorities to identify, track, and regulate taxpayers' fiscal activities.

Empirical studies consistently suggest that the adoption of TIN has contributed positively to federal non-oil tax revenue generation. Oloyede, Adegbite, and Oladipo (2025) documented a significant rise in post-adoption revenue, attributing this improvement to better taxpayer identification and strengthened enforcement procedures. Their findings indicate that the standardized numbering system reduces ambiguity in taxpayer records and enhances administrative coordination. Similarly, Tyokoso and Eze (2021) observed that nationwide deployment of TIN coincided with increased revenue generation, reinforcing its relevance in strengthening Nigeria's tax collection capacity.

State-level analyses also provide compelling evidence of the system's effectiveness. In Akwa Ibom State, Efanga, Etim, and Udo (2020) reported that TIN implementation helped curb tax evasion and promote greater compliance, pointing to measurable improvements in revenue administration. Comparable outcomes were noted by Chukwu and Onwubuya (2021) in Enugu State, where TIN enhanced internally generated revenue (IGR) by enabling more accurate monitoring of taxpayer activities. These findings demonstrate that TIN adoption has strengthened both enforcement and compliance structures at sub-national levels.

Additional insights emerge from studies conducted in other regions. In Adamawa and Ekiti States, Hanga, Ahmed, and Yusuf (2020) and Olatunji and Oludayo (2018), respectively, found that the TIN system contributed significantly to improved taxpayer record accuracy and enhanced revenue generation. Their results underscore the importance of accurate and comprehensive taxpayer databases in mitigating leakages and facilitating effective tax administration. The cumulative evidence across these states highlights the pivotal role of TIN in promoting more structured and efficient revenue processes.

Reinforcing these observations, studies from the South-West region affirm the administrative benefits of the TIN system. Akinleye, Ojo, and Bello (2019) reported substantial improvements in revenue collection across several South-Western states, emphasizing that the TIN greatly streamlined taxpayer registration and documentation. In Lagos State, Asaolu, Fagbemi, and Oladele (2015) similarly found a positive relationship between TIN adoption and increased tax revenue, although they noted that the effects may have been amplified by simultaneous fiscal reforms. Okeke and Nwankwo (2022) also reported positive revenue outcomes in the South-East, while Ibrahim and Musa (2023) documented improved collection efficiency in five Northern states though with limited coverage of the informal sector.

Despite the largely positive findings, several scholars highlight important limitations that temper the overall conclusions. Efanga et al. (2020) and Chukwu and Onwubuya (2021) cautioned that the effects documented in specific states may not be fully generalizable due to institutional and demographic variations across regions. These differences in administrative capacity, digital infrastructure, and taxpayer characteristics may shape the extent to which TIN adoption translates into revenue improvements at the national level.

Furthermore, Agbaje, Eze, and Olajide (2024) emphasized that the informal sector which represents a significant share of Nigeria's economy remains poorly captured within the TIN database. This limited coverage suggests that the system's benefits are unevenly distributed

and may restrict its full impact on federal tax revenue. The exclusion of many informal sector actors highlights persistent structural challenges and underscores the need for complementary reforms to broaden the tax base and enhance the inclusiveness of digital identification systems.

2.2.5 Electronic Tax Payment Systems

Electronic tax payment systems refer to digital platforms that enable taxpayers to remit their tax obligations remotely, securely, and efficiently. In this study, the concept is understood as technology-driven channels that automate the payment of taxes and reduce the need for physical interaction with tax officials. Mugisha and Ayebale (2022) define electronic tax payments as automated processes through which individuals and corporate entities settle tax liabilities via online banking interfaces, government portals, or mobile applications. Similarly, Okeke and Nwankwo (2022) describe these systems as digital infrastructures designed to simplify tax remittance, enhance traceability, and reduce human interference an especially critical advancement in developing economies. In Nigeria, the integration of platforms such as Remita and various e-Tax payment gateways reflects ongoing efforts by the Federal Inland Revenue Service (FIRS) to strengthen federal revenue streams, particularly Company Income Tax (CIT), Value Added Tax (VAT), and Personal Income Tax (PIT).

Theoretically, electronic tax payment systems are expected to improve federal tax revenue generation by minimizing leakages, lowering administrative and transaction costs, and enhancing voluntary compliance. Digital platforms provide real-time monitoring, automated reconciliation, and secure payment trails that reduce the opportunities for fraud, evasion, and manual manipulation. These features create a more transparent tax environment and support efficient payment processing. As a result, electronic tax systems are increasingly being viewed as fundamental components of modern tax administration across emerging economies.

Empirical studies on CIT generation offer substantial evidence of the positive impact of digital remittance systems. Agbaje, Eze, and Olajide (2024) found that electronic payment platforms

enhanced CIT revenue by improving traceability and reducing under-reporting among corporate entities. Their findings indicate that digital channels encourage timely remittances and improve audit capabilities through automated records. Likewise, Oloyede, Adegbite, and Oladipo (2025) reported that the adoption of e-payment tools facilitated quicker reconciliation and strengthened the accuracy of remittances, particularly for large taxpayers, thereby improving the overall efficiency of CIT collection.

The role of electronic platforms in supporting VAT generation is equally important due to the transactional nature of the tax. Since VAT is collected at multiple stages of production and distribution, real-time reporting and automated remittance significantly reduce leakages. Ibrahim and Musa (2023) observed that e-payment systems improved VAT collection by streamlining reporting and enabling timely remittances. However, Mwenda and Ouma (2022) cautioned that these benefits remain unevenly distributed across Nigeria, especially in rural areas where digital infrastructure is limited. Such disparities highlight the challenges of achieving uniform nationwide gains from VAT digital reforms.

The generation of PIT under electronic payment systems presents a more mixed picture. PIT administration in Nigeria, particularly through the Pay-As-You-Earn (PAYE) framework, benefits from integrated payroll and electronic remittance tools. Oloyede et al. (2025) reported improvements in remittance cycles, reconciliation, and compliance among salaried workers whose employers use automated systems. However, Hanga, Ahmed, and Yusuf (2020) noted that informal sector earners who constitute a substantial proportion of PIT potential remain largely excluded due to digital illiteracy, limited internet access, and weak integration into formal payment systems. As a result, the effectiveness of electronic platforms for PIT collection is constrained by structural barriers.

The overall impact of electronic tax payment systems is also moderated by broader environmental and institutional factors. Agbaje, Eze, and Olajide (2024) highlighted the

influence of digital literacy, internet penetration, and institutional capacity on the success of electronic payment reforms. Without adequate infrastructure, training, and taxpayer awareness, the benefits of digital platforms may not be fully realized. These challenges underscore the need for complementary investments in ICT infrastructure and capacity-building initiatives to optimize the performance of electronic tax systems.

Finally, scholars such as Asaolu, Fagbemi, and Oladele (2015) argue that electronic payment systems rarely operate in isolation, as tax reforms are often accompanied by policy adjustments, strengthened enforcement mechanisms, and enhanced taxpayer education. This multilayered reform environment makes it difficult to attribute revenue improvements solely to electronic systems. Nonetheless, the evidence suggests that electronic tax payment platforms remain critical tools in Nigeria's efforts to enhance federal tax revenue generation , despite the moderating influence of infrastructural and institutional constraints.

2.2.6 Electronic Tax Clearance Certification

Electronic Tax Clearance Certification (e-TCC) has emerged as a central component of Nigeria's ongoing digital tax reform, aimed at enhancing transparency, strengthening compliance verification, and eliminating the prevalence of forged or manually manipulated clearance documents. As Eze and Nwosu (2023) explain, the e-TCC system automates the issuance and authentication of tax clearance certificates, allowing taxpayers to obtain verifiable proof of compliance through digital platforms. This transition from paper-based processes to electronic certification reflects broader efforts by the Federal Inland Revenue Service (FIRS) to modernize tax administration and improve service delivery.

In principle, the adoption of e-TCC is expected to contribute significantly to federal tax revenue generation across major tax categories such as Company Income Tax (CIT), Value Added Tax (VAT), and Personal Income Tax (PIT). The logic is that automated clearance systems reduce loopholes, discourage non-compliance, and incentivize participation in the formal tax

ecosystem. Empirical studies broadly support this theoretical assumption. For example, Oloyede, Adegbite, and Oladipo (2025) reported that linking e-TCC issuance to validated electronic remittances enhanced real-time monitoring and minimized discretion in clearance processing. Their study shows that automated verification strengthened transparency and promoted more consistent remittance behaviour, particularly for CIT and VAT.

Further evidence from Ibrahim and Musa (2023) indicates that the migration from manual to electronic clearance improved taxpayer accountability, especially for firms and individuals requiring tax clearance to access public procurement opportunities. Since valid e-TCCs are mandatory for bidding on government contracts, the system indirectly expanded compliance pressure on taxpayers, particularly SMEs and individual contractors operating in urban areas. This linkage between clearance certification and access to economic opportunities increased timely remittances and strengthened federal revenue generation for PIT and CIT.

Complementing these findings, the work of Agbaje, Eze, and Olajide (2024) demonstrates that enterprises with e-TCCs exhibited higher compliance levels with CIT and VAT than those still reliant on manual systems. Their analysis attributes this outcome to the enforcement capabilities embedded within the electronic platform, which automatically cross-checks clearance applications against recorded tax payments. By reducing the possibility of fraudulent certifications and enhancing audit trails, e-TCC adoption serves as both a compliance incentive and a deterrent to tax evasion within the formal sector.

Despite these documented benefits, challenges persist in ensuring equitable adoption across Nigeria's diverse economic landscape. Tyokoso and Eze (2021) observed that the effectiveness of e-TCC remains uneven due to weak digital connectivity and limited institutional presence in remote regions. As a result, the impact of digital clearance systems on PIT and VAT collection from informal traders and micro-entrepreneurs in rural areas remains marginal. This

digital divide limits the uniformity of compliance improvements nationwide and restricts the expansion of the federal revenue base.

Similarly, Hanga, Ahmed, and Yusuf (2020) argue that the exclusion of informal and semi-formal economic actors from e-TCC systems constrains the potential benefits of digital clearance certification. Since many of these taxpayers lack access to digital tools or formal registration pathways, they remain outside the scope of automated verification. This exclusion not only reduces potential PIT and VAT contributions but also perpetuates structural inequities in tax administration outcomes between urban and rural jurisdictions.

Overall, the literature suggests that while e-TCC has had a positive and measurable effect on federal tax revenue generation particularly for CIT and VAT its impact is moderated by infrastructural limitations, regional disparities, and the continued dominance of the informal sector. As Nigeria advances its digital tax transformation, expanding connectivity, increasing taxpayer awareness, and integrating informal sector participants will be essential to unlocking the full revenue potential of electronic tax clearance certification.

2.2.7 Population Growth

Population growth is a crucial demographic variable that shapes a nation's economic environment and, consequently, its capacity to mobilize revenue through taxation. As Todaro and Smith (2015) describe, population growth captures the changes in the size and structure of a country's population over time. These demographic shifts determine the breadth of the tax base, which encompasses all individuals and entities eligible for taxation. In studies assessing the impact of Information and Communication Technology (ICT) tools on federal tax revenue generation in Nigeria, population growth becomes an essential control variable, helping to isolate the true effect of technological reforms.

Economically, population growth exerts a dual influence on tax revenue outcomes. On one

hand, an expanding population increases the number of potential taxpayers, thereby widening the pool of taxable income, consumption, and business activities (Musgrave & Musgrave, 1989). When tax systems are efficient, this expansion can boost collections from both direct and indirect taxes. On the other hand, the rising demand for goods and services driven by population growth stimulates consumption, which can significantly enhance revenues from consumption-based taxes such as Value Added Tax (VAT) (Bird & Zolt, 2008). Through these channels, demographic changes contribute to increases in federal revenue mobilization.

Despite these potential benefits, rapid population growth can introduce substantial challenges for tax administration, particularly in developing countries where institutional capacity remains limited. Bird (2015) notes that as the number of taxpayers grows, the ability of tax authorities to maintain accurate records, enforce compliance, and provide adequate services becomes increasingly strained. Jenkins (1998) and Bird and Oldman (1990) further argue that without commensurate improvements in administrative capacity, expanding the taxpayer base may lead to inefficiencies, compliance gaps, and weakened enforcement—conditions that can undermine even the most sophisticated ICT-based tax systems.

Empirical research reflects the importance of accounting for population growth when evaluating the effectiveness of ICT reforms in tax administration. For instance, Oloyede, Adegbite, and Oladipo (2025) controlled for population growth in their investigation of ICT adoption and federal tax revenue generation, ensuring that observed increases in revenue were not simply the result of demographic expansion. Similarly, Ibrahim and Musa (2023) incorporated population growth as a control variable in their assessment of ICT-driven improvements in tax administration across Northern Nigeria. These studies highlight the need to differentiate between revenue increases attributable to technological innovation and those stemming from demographic pressures.

In fiscal policy analysis, controlling for population growth aligns with broader theoretical

guidance emphasizing the importance of distinguishing between changes due to demographic factors and those arising from policy interventions (Keen & Lockwood, 2010). Failure to do so may lead to misinterpretation of findings, causing researchers or policymakers to attribute revenue improvements exclusively to ICT tools when part of the effect is driven by natural population increases. Thus, incorporating population growth enhances the robustness of empirical models examining tax system performance.

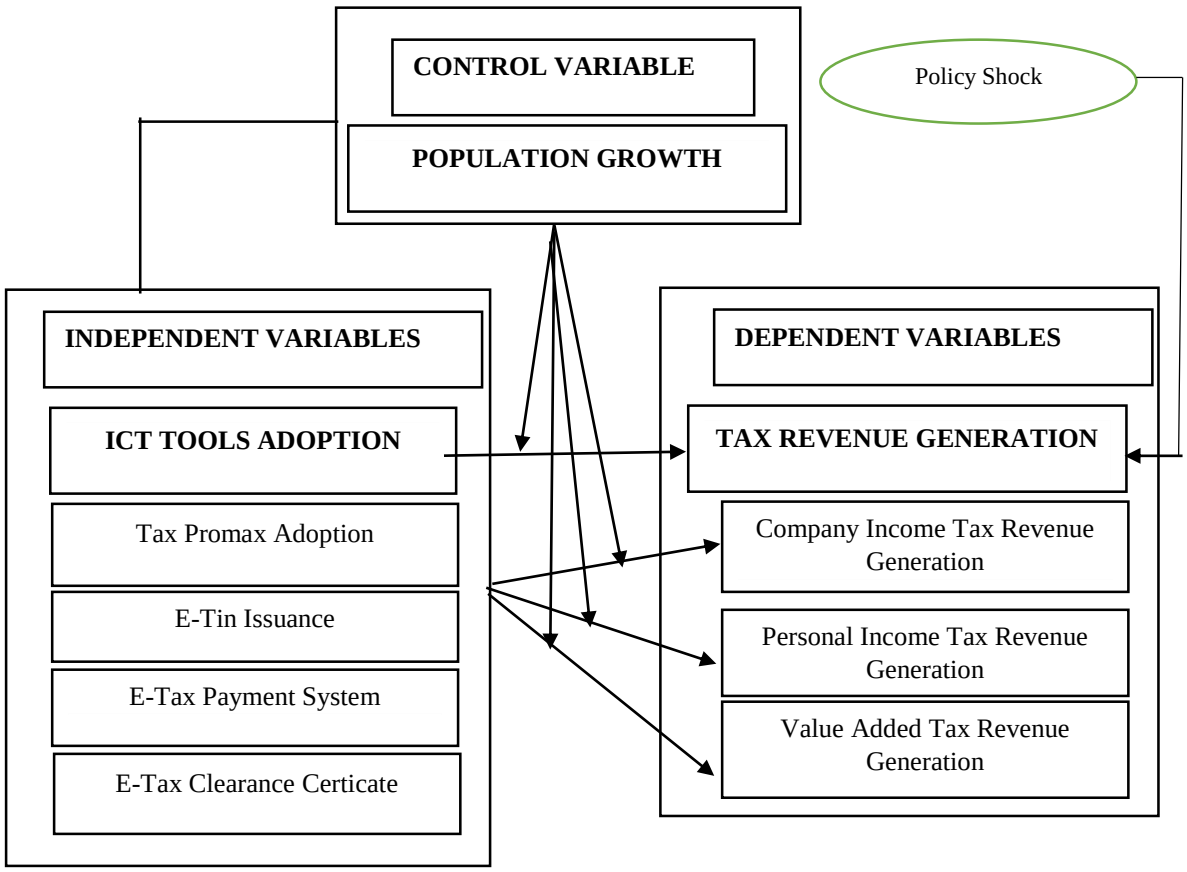
Nigeria's demographic realities make population growth an especially salient factor in tax administration research. With high fertility rates and a predominantly youthful population, the country experiences one of the fastest rates of population expansion globally (National Bureau of Statistics, 2023). These demographic characteristics impose added pressure on tax systems to expand their reach, modernize their operations, and efficiently manage a growing and increasingly diverse taxpayer population.

As Nigeria continues to adopt ICT tools to modernize tax administration, the capacity of these systems to scale effectively will determine their long-term impact on federal revenue generation. Controlling for population growth in empirical analyses ensures that the distinct contributions of ICT innovations such as digital registration, automated payments, and real-time compliance monitoring are accurately captured. This approach strengthens the evidence base supporting the role of ICT in enhancing revenue mobilization amid evolving demographic dynamics.

2.3. Conceptual framework

The conceptual framework of the study is shown in the below diagram;

Fig 2.1 Conceptual Model of the Study



Researcher's Construct (2025).

The conceptual framework for this study illustrates the hypothesized relationship between ICT tools adoption and federal tax revenue generation in Nigeria, with population growth included as a control variable. It provides a logical structure for understanding how digital reforms in tax administration are expected to influence revenue outcomes at the federal level. In essence, the conceptual framework posits that improvements in federal tax revenue generation in Nigeria are a function of how extensively ICT tools are deployed within the tax system. By incorporating population growth as a control, the framework ensures that the effect attributed to ICT is not confounded by demographic expansion. This structure guides the empirical

analysis and provides a basis for testing hypotheses about the effectiveness of digital tax reforms in enhancing Nigeria's revenue generation.

2.4 Empirical Review

Here we present a synthesis of empirical studies relevant to the research topic, categorized according to the key research questions guiding the study. By structuring the review in this manner, the aim is to critically examine how prior research has attempted to address similar issues, identify methodological patterns, highlight consistent findings or divergences, and expose gaps that this study seeks to fill

2.4.1 TaxPro Max and Federal Tax Revenue Generation in Nigeria

Adeagbo, Salami, and Ogunleye (2025) investigated the impact of Tax ProMax on tax revenue collection in Nigeria using data from 179 respondents comprising FIRS staff, corporate taxpayers, consultants, and SME owners in Oyo State. Through regression analysis, the authors found that Tax ProMax significantly improved accountability, reduced tax evasion, and curtailed irregularities in remittance processes. Their findings underscore the potential of digital tools to enhance transparency and efficiency in tax administration. However, the study's reliance on a single-state sample limits its external validity, as Nigeria's tax environment is heterogeneous and characterized by varying administrative capacities across regions. Thus, while insightful, the study does not fully capture nationwide dynamics.

Chukwu and Eze (2024) conducted a mixed-methods investigation into the effect of Tax ProMax on compliance and tax collection across three geopolitical zones: South-East, South-West, and North-Central Nigeria. With data from 550 respondents and complementary FIRS records (2020–2024), the authors used panel regression and thematic analysis to demonstrate that Tax ProMax enhanced tax compliance and reduced revenue leakage. This triangulated approach strengthens the credibility of their findings. However, the study did not examine taxpayers' digital literacy or the quality of system onboarding, both of which are crucial

determinants of the effectiveness of digital tools. This omission leaves important behavioural aspects underexplored.

Peter (2023) examined the effect of Tax ProMax on federal tax revenue using secondary data from FIRS covering 2019–2023. Employing a paired sample t-test, the study compared pre- and post-adoption revenue figures and found a remarkable 62% increase in VAT collections after the system's introduction. This empirical evidence suggests that Tax ProMax may have significantly strengthened revenue mobilization. Nonetheless, the study did not account for other macroeconomic influences such as inflation, exchange rate fluctuations, or concurrent tax reforms which may also explain the observed revenue growth. The lack of control variables weakens causal attribution, leaving open questions about the true magnitude of Tax ProMax's contribution.

Desi and Bingilar (2023) evaluated the influence of Tax ProMax on FIRS revenue remittances in Bayelsa State using survey data collected from 70 FIRS staff. Applying multiple regression techniques, the authors found that Tax ProMax positively and significantly enhanced tax remittance generation. Their results highlight the benefits of digital platforms for administrative efficiency at the state level. However, the small sample size and geographic limitation to Bayelsa a state with distinct economic characteristics reduce the generalizability of the findings. The study's narrow scope therefore limits its relevance for national policy discussions on digital taxation.

Okafor and Ude (2023) analyzed the impact of Tax ProMax and related e-filing systems on tax revenue in Lagos State using FIRS time-series data from 2018–2023. Their regression analysis revealed significant improvements in VAT and CIT collections following the introduction of digital platforms. The findings align with broader literature emphasizing the efficiency gains from electronic tax administration. Nonetheless, the authors did not isolate the specific contribution of Tax ProMax from other simultaneous digital reforms and administrative

changes. This overlap weakens the precision of the study's conclusions, particularly regarding causality.

Adebayo, Mensah, and Boateng (2023) analyzed the impact of Ghana's GITAPS comparable to Nigeria's TaxPro Max on domestic revenue mobilization using a difference-in-differences approach for 2012–2020. The study found significant improvements in VAT and corporate tax collection following system adoption, suggesting that automation can strengthen compliance and widen the tax base. However, the authors did not decompose effects across different income groups or tax categories, limiting the granularity of the findings. This gap makes cross-tax comparisons difficult.

Nwosu and Ekennia (2022) investigated the role of Tax ProMax in reducing tax evasion among SMEs in Enugu State using logistic regression on primary data from 120 SMEs. The study concluded that Tax ProMax significantly curbed evasion, highlighting the platform's potential in strengthening compliance. However, it failed to address adoption barriers commonly faced by SMEs, such as limited digital literacy, informal operations, or inadequate internet access. These constraints may influence the practical applicability of the findings, especially in regions with technologically underserved populations.

Ndlovu and Chikodzi (2022) studied Zimbabwe's Automated Tax Management System (ATMS) using panel regression on taxpayer-level data, showing that ATMS improved federal tax collection efficiency, especially among formal sector firms. The study highlighted how automation can streamline compliance processes and strengthen monitoring. However, low adoption among micro and small enterprises caused by digital illiteracy and unstable internet access substantially reduced the system's aggregate impact. This suggests that digital tools alone cannot guarantee revenue improvements without addressing structural gaps.

Adewale and Mohammed (2022) evaluated Tax ProMax's contribution to VAT efficiency in Lagos and Abuja by surveying 150 respondents and analyzing the data through Structural

Equation Modeling. The study showed that Tax ProMax facilitated real-time VAT remittance and improved compliance. Nevertheless, it excluded informal-sector participants who constitute a large share of tax-eligible economic activity in Nigeria thereby narrowing the representativeness of its conclusions. Moreover, the study did not examine long-term sustainability, leaving unanswered questions about cost-effectiveness and system adaptability.

Fabian and David (2021) explored staff perceptions of Tax ProMax in improving tax remittance in Awka and Onitsha, analyzing responses from 80 FIRS employees using Friedman's ANOVA. The study found that staff believed the system increased efficiency and compliance. While the perception-based approach offers useful insights into employee attitudes, it introduces subjectivity and limits measurable inferences about actual revenue outcomes. Furthermore, its narrow geographic focus restricts its policy applicability. The study thus provides perceptual rather than empirical evidence of system effectiveness.

Ibrahim and Bala (2021) assessed the effect of electronic filing systems, including Tax ProMax, on revenue mobilization in Nigeria using FIRS secondary data from 2015–2021. Through interrupted time-series analysis, they reported significant improvements in tax generation following the introduction of digital platforms. However, the study grouped various e-tax systems together, making it impossible to identify the unique impact of Tax ProMax relative to other tools. This aggregation limits the study's contribution to understanding the specific strengths or limitations of individual digital innovations.

Kareem and Onah (2021) used a qualitative approach to explore taxpayer trust and user experience with Tax ProMax through interviews with 40 taxpayers in Lagos State. Findings revealed improved transparency but persistent concerns regarding system glitches and data privacy, which hindered full adoption. While rich in detail, the exclusive use of qualitative data and small sample size limit the study's external validity. The absence of quantitative

triangulation also limits the ability to assess the broader behavioural or revenue implications of users' experiences.

Kabanda and Mutinda (2021) evaluated Kenya's iTax platform using ARDL cointegration methods applied to quarterly data from 2010–2019. Their results demonstrated a positive long-run relationship between iTax adoption and corporate tax revenue, concluding that digital platforms enhance transparency and lower administrative costs. Despite the system's success, the authors acknowledged infrastructural challenges and unequal regional access, which hinder full adoption. These limitations reduce the platform's effectiveness and highlight the importance of contextual readiness.

Besley and Persson (2014) presented a theoretical discussion on how digital tax systems such as Tax ProMax can enhance tax capacity in developing economies. They argued that automated platforms improve efficiency, transparency, and taxpayer trust factors essential for strengthening revenue administration. However, the analysis remained conceptual and was not empirically tested in the Nigerian context. Additionally, the study did not address real-world implementation challenges such as infrastructural deficits, digital literacy, or administrative resistance.

2.4.2 Taxpayer Identification Number (TIN) Issuance and Federal Tax Revenue Generation in Nigeria

Oloyede, Adegbite, and Oladipo (2025) examined the effect of Tax Identification Number (TIN) adoption on federal tax revenue in Nigeria using secondary data from the FIRS covering 2010–2023. Grounded in Institutional Theory and employing a Difference-in-Differences (DiD) model, the study compared revenue outcomes before and after TIN implementation. Their findings demonstrated a significant positive influence of TIN on federal revenue mobilization, highlighting the role of institutionalized identification systems in strengthening compliance and administrative efficiency. However, the study's reliance on aggregated

national data overlooks substantial state-level differences and sectoral disparities in tax behaviour, limiting the precision of its conclusions and obscuring heterogeneous regional impacts.

Agbaje, Eze, and Olajide (2024) analyzed the role of TIN in enhancing tax compliance and revenue among Nigerian manufacturing firms using panel data from 2010–2022. Guided by Tax Compliance Theory and estimated through Fixed Effects regression, the study found that firms with properly registered TINs exhibited higher compliance and made larger contributions to tax revenue. While the findings validate the compliance-enhancing potential of TINs, the exclusive focus on listed manufacturing firms limits the study's representativeness, since compliance issues in Nigeria are more pronounced in the informal and unregistered business sectors that were excluded from the dataset.

Ibrahim and Musa (2023) evaluated the impact of TIN adoption on revenue performance in five northern Nigerian states using secondary data from 2010–2020. Drawing on Principal-Agent Theory and employing panel regression, the study found that TIN usage significantly improved administrative efficiency and enhanced revenue collection across the region. Nonetheless, the exclusion of informal-sector taxpayers a major segment of the northern economy introduces potential bias and may lead to overestimating the effectiveness of TIN reforms within the broader tax ecosystem.

Okeke and Nwankwo (2022) assessed the influence of TIN adoption on tax revenue in Southeast Nigeria using state revenue data from 2012–2019. Anchored in the Theory of Planned Behavior and analyzed through OLS regression, the study reported a significant positive relationship between TIN utilization and revenue generation. Although the findings support the usefulness of TIN in boosting collection efficiency, the study failed to incorporate enforcement intensity or audit activity a key determinant of compliance thereby weakening causal interpretation of the observed revenue increases.

Mugisha and Ayebale (2022) investigated the effect of mandatory TIN registration on Uganda's tax revenue growth using time-series data from 2008–2020. Their analysis revealed that the expansion of TIN registration correlated positively with increases in both personal income tax and VAT collections, arguing that traceability and taxpayer visibility improved under the TIN regime. However, the study did not control for population growth, which may naturally expand the tax base and thus confound the observed revenue increases, limiting the precision of the attribution.

Tyokoso and Eze (2021) analyzed the effect of TIN adoption on Nigeria's federal tax revenue from 1998 to 2017 using aggregate national data from the CBN Statistical Bulletin. Using a paired sample t-test, they found a statistically significant improvement in revenue after TIN introduction. While the results suggest that TIN enhances revenue generation, the study's reliance on national-level aggregates fails to capture regional variations in compliance and administrative capacity, making the conclusions less informative for sub-national policy development.

Chukwu and Onwubuya (2021) explored how TIN adoption influenced tax evasion and internally generated revenue in Enugu State using data from 2010–2018. Employing Logistic Regression within a Deterrence Theory framework, the study showed that TIN implementation significantly reduced evasion and increased state revenue. Despite its valuable insights, the study's restriction to a single state and the omission of taxpayer awareness or digital literacy considerations limit the broader applicability of its findings and leave important behavioural mechanisms unexplored.

Amegashie and Oteng (2021) analyzed the effect of implementing unique taxpayer identification systems on tax administration in Nigeria between 2010 and 2015 using interrupted time-series analysis. Their results indicated a sharp rise in income tax collections following TIN enforcement, highlighting improvements in audit effectiveness and taxpayer

tracking. However, the relatively short five-year time frame is inadequate for robust time-series inference, raising concerns about the stability and sustainability of the detected effects.

Efanga, Etim, and Udo (2020) conducted a comparative ARDL analysis to determine the effect of TIN on tax evasion in Akwa Ibom State using pre- and post-implementation data. The study revealed that before TIN adoption, the relationship between revenue and evasion was insignificant, whereas after adoption, TIN was associated with significantly improved compliance and higher internally generated revenue. Despite this contribution, the study's focus on a single state constrains generalizability and does not reflect the diverse administrative realities across Nigeria's states.

Mwangi and Kimani (2020) examined the influence of TIN on tax compliance among SMEs in Nairobi using survey data from 400 businesses analyzed through logit regression. The study found that SMEs with TINs displayed higher compliance levels and contributed more revenue, linking these outcomes to enhanced monitoring and traceability by tax authorities. However, the reliance on self-reported compliance introduces potential response bias, raising questions about the accuracy of the reported behaviours and the validity of the results.

Hanga, Ahmed, and Yusuf (2020) evaluated the effect of TIN on internally generated revenue in Adamawa State using data from 2009–2015. Using multiple regression and paired t-tests, the study concluded that TIN adoption significantly improved revenue collection. Nevertheless, the analysis did not account for macroeconomic variables such as inflation, GDP changes, or political disruptions that may have affected revenue within the study period, thereby weakening causal attribution.

Akinleye, Ojo, and Bello (2019) investigated TIN's effect on revenue generation in Ondo, Osun, and Ekiti States using secondary data from 2008–2017 and paired t-tests. Their findings revealed significantly higher revenues post-TIN implementation across the three states. However, the study did not consider variations in tax administrative capacity or differing policy

reforms across the states, which could independently influence revenue and confound the observed effect of TIN.

Olatunji and Oludayo (2018) assessed TIN's impact on revenue generation in Ekiti State from 2006 to 2010 using OLS regression on data from the State Accountant General's Office. The study reported a significant positive effect of TIN adoption on tax revenue. Yet, its short study period and single-state scope limit its robustness, making it difficult to infer broader, long-term implications of TIN on revenue generation.

Asaolu, Fagbemi, and Oladele (2015) examined the impact of tax reforms including TIN introduction on revenue generation in Lagos State from 2012 to 2019 using OLS regression on LIRS data. They found that TIN contributed significantly to increased revenue collection. However, the study did not isolate the effect of TIN from other simultaneous reforms such as e-payment systems and automated audit tools, creating a confounding effect that reduces the precision of attributing revenue gains specifically to TIN adoption.

2.4.3 Electronic Tax Payment Systems and Federal Tax Revenue Generation in Nigeria

Nwabachili, Lawal, and Musoke (2024) conducted a comparative legal and institutional assessment of electronic tax payment systems in Nigeria, Tanzania, and Kenya, evaluating the extent of digital adoption and its implications for tax administration. Drawing entirely on secondary policy documents, legislation, and institutional frameworks, the authors concluded that e-tax systems across these countries remain underdeveloped, largely due to infrastructural barriers, low digital literacy, and unreliable internet services that discourage taxpayer use. While their analysis effectively highlights systemic weaknesses and regulatory gaps, the study is limited by the absence of empirical testing or statistical evidence to validate its claims, resulting in largely descriptive rather than analytic conclusions.

Olatunde, Eze, and Bakare (2024) examined the relationship between electronic tax systems and company income tax revenue using a survey of 158 FIRS staff members in Port Harcourt. Employing Spearman's rank correlation, the study found a positive association between e-tax implementation and increased company income tax collections, suggesting that digital platforms enhance revenue efficiency from the perspective of tax administrators. Despite providing useful insights into staff perceptions, the study relies heavily on subjective responses rather than objective revenue data, thereby limiting its ability to accurately capture the generation of e-tax systems or the experiences of taxpayers themselves.

Musa and Ajayi (2024) investigated the perceived reliability of e-tax systems among tax administrators and corporate taxpayers in Abuja through a mixed-methods approach involving questionnaires and semi-structured interviews. Their findings indicated that stakeholders generally view e-tax systems as beneficial for simplifying tax transactions, though concerns persisted regarding system delays, reconciliation challenges, and occasional technical failures. The study's major limitation stems from its small and geographically concentrated sample of only 100 respondents, which restricts external validity and prevents meaningful generalization to the broader Nigerian tax environment.

Eze and Nwosu (2023) evaluated the effect of e-tax adoption on Internally Generated Revenue across 10 Nigerian states between 2015 and 2021 using panel data and fixed-effects regression. Their analysis demonstrated that e-tax usage significantly improved PAYE tax revenue, indicating that digital tools can strengthen state-level tax administration. However, the study did not account for differences in ICT infrastructure among states an important factor that could affect the efficiency of e-tax systems potentially overstating the uniformity of the observed effects.

In the South African context, Okeke, Moyo, and Sibanda (2023) analyzed the effect of e-tax payment systems on federal tax receipts from 2005 to 2020 using a VAR model. Their results

showed that secure electronic payment channels significantly improved both personal income tax and corporate income tax collections by reducing leakages and enhancing processing efficiency. However, the study did not control for macroeconomic volatility such as exchange rate shocks or business cycle effects which could have influenced tax inflows independently of e-tax reforms. Additionally, structural differences between Nigeria and South Africa limit direct comparability.

Nwankwo, Adegbite, and Bello (2022) explored the effect of e-tax payments on federal tax revenue in Nigeria from 2013 to 2021 using an ex-post facto design supported by secondary data from FIRS and NBS. After confirming stationarity through the Augmented Dickey–Fuller test, the authors applied OLS regression and reported that e-tax adoption significantly improved overall revenue generation. However, the study relied on aggregated national data without distinguishing between specific tax categories or sectors, limiting the ability to understand which revenue streams benefited most from digital payment integration.

Using policy variation in Uruguay, Brockmeyer and Somarriba (2022) assessed how incentives for electronic payments influence firm-level tax compliance. Based on administrative tax records and a difference-in-differences approach, they found that although incentives effectively increased the adoption of electronic payment modes, they did not yield corresponding improvements in compliance. The study's robust methodology and high-quality administrative data strengthen its findings, yet its applicability to Nigeria is constrained by contextual differences in tax structures, enforcement capacity, and technological environments.

Mwenda and Ouma (2022) examined mobile money tax payments and VAT performance in Rwanda using quarterly data and regression analysis. They found that digital tax payments, particularly mobile money, significantly improved VAT collection by enhancing financial inclusion in both rural and urban areas. Nonetheless, the study highlighted persistent operational challenges, including transaction failures and periodic data loss, which undermine

system reliability. These technological weaknesses temper the potential benefits of mobile-based tax payment innovations.

Kouadio and Kouame (2021) analyzed online tax remittance platforms in Côte d'Ivoire using fixed-effects regression on sectoral data from 2010 to 2019. Their findings indicated that digital tax platforms significantly increased corporate tax revenue, with the strongest impacts observed in manufacturing and trade sectors. However, the study's relatively short panel and limited consideration of external economic factors restrict its ability to capture long-term or dynamic effects, thereby narrowing its policy relevance.

Nubia, Oche, and Ayuba (2020) conducted a pre- and post-analysis of e-tax payment adoption in Nigeria using OLS regression to assess its impact on VAT and CIT based on CBN secondary data. Their results showed that e-tax payment had an insignificant effect on tax revenue, suggesting limited benefits of digital payment initiatives during the study period. However, the study's weakness lies in its narrow focus on technological change without considering non-technological determinants such as taxpayer awareness, enforcement strategies, or administrative reforms that might influence compliance and revenue outcomes.

Usman and Abiola (2020) explored factors influencing e-tax payment compliance among SMEs in Lagos using a logistic regression analysis of survey responses from 120 firms. Their findings revealed that awareness and digital literacy significantly drive compliance intentions among SMEs, emphasizing the importance of education and capacity-building initiatives. Nonetheless, the study's reliance on self-reported data and its geographic restriction to Lagos limit the reliability and generalizability of the findings to other SME communities across Nigeria.

Agbo and Omotosho (2019) examined the effect of electronic tax systems on personal income tax collection in Nigeria between 2011 and 2018 using time-series data and regression analysis.

Their study established a weak but positive relationship between e-tax systems and PIT revenue, suggesting limited but emerging benefits of digitization. A major limitation of the study is its failure to incorporate behavioral factors, enforcement mechanisms, or administrative variables that could provide a more comprehensive understanding of compliance dynamics.

Olaoye and Atilola (2018) assessed the impact of e-tax payment adoption on revenue collection in Nigeria from 2012 to 2018 using quarterly data, descriptive analyses, correlation tests, and paired t-tests. They found no significant improvement in CGT, VAT, or CIT collections following digitization, implying that e-tax systems did not immediately enhance revenue generation. The study's principal shortcoming lies in its omission of macroeconomic controls such as inflation, GDP growth, or business cycle fluctuations which may have influenced tax revenues independently of e-tax initiatives.

Okiro (2015) evaluated e-payment systems and government revenue performance in Nairobi City County using data from 18 government departments between 2013 and 2015. Regression analysis revealed that e-payment systems explained approximately 92% of the variation in revenue generation, indicating a strong positive impact on collection efficiency and leakage reduction. Despite these promising findings, the study is context-specific and relies on a simplistic proxy for performance (compliance with budget estimates), limiting its relevance to broader tax systems or more complex fiscal environments.

2.4.4 Electronic Tax Clearance and Federal Tax Revenue Generation in Nigeria

Adesina and Ezeokoli (2025) assessed the impact of electronic tax clearance certification (e-TCC) on federally generated company income tax (CIT) using a difference-in-differences model with data from 2015–2023. Their results revealed that the introduction of e-TCC significantly boosted CIT generation, particularly in the post–TaxPro Max era, with notable reductions in clearance delays and document forgery. The study underscores the role of

automation in strengthening tax administration and enhancing revenue transparency. However, its limited temporal scope and exclusive focus on CIT constrain the generalizability of the findings to other federal tax streams such as VAT, PIT, or customs duties, thereby narrowing its policy applicability.

Musa and Ogundele (2025) examined how electronic tax clearance certificates influence federal revenue using structural equation modelling (SEM) on primary data gathered from 217 FIRS staff and corporate taxpayers in Abuja and Kano. Their findings revealed a strong positive association between e-TCC accessibility and timely federal tax remittances, with respondents reporting improved administrative efficiency and fewer bureaucratic barriers. While the SEM approach provides robust path analysis, the study's heavy reliance on self-reported primary data often susceptible to bias, exaggeration, or incomplete knowledge limits the reliability of its empirical conclusions.

Obiora (2024) explored the role of electronic tax clearance systems in promoting tax enforcement and revenue mobilization using survey data from 150 tax consultants and FIRS staff. Employing a probit regression model, the study found that e-TCC usage enhances fraud detection, reduces tax evasion, and strengthens audit processes. While the results illuminate important administrative benefits, the study's dependence on subjective perceptions rather than verifiable revenue records limits its empirical robustness and weakens the inferential strength of its conclusions regarding actual revenue impacts.

Ibrahim and Suleiman (2023) used time-series data from 2010 to 2022 and an autoregressive distributed lag (ARDL) model to investigate the effect of e-TCC on revenue generation by FIRS. Their analysis indicated that e-TCC had both short-run and long-run positive effects on corporate tax receipts, demonstrating the long-term efficiency gains associated with automation. However, the study is now considered somewhat outdated because it excludes

post-2022 developments—particularly the widespread adoption of TaxPro Max which may have significantly altered revenue dynamics and administrative processes.

Chukwuma (2022) conducted a panel study across six FIRS zones from 2014–2021 and found that e-TCC implementation significantly increased federal revenue, attributing the gains to improved audit trails and enhanced document verifiability. Although the study provides strong evidence of administrative improvements, its failure to control for macroeconomic factors such as inflation, unemployment, or population growth limits its capacity to isolate the true causal effect of e-TCC on revenue growth, potentially overstating the impact of digital reforms.

Maphosa and Ncube (2022) examined how e-tax clearance certificates influence compliance among Zimbabwean firms using survey responses from 300 companies and binary logistic regression. Their findings showed that firms that obtained e-TCCs more frequently were more compliant and contributed higher revenue, partly because e-TCCs were required for bidding on public contracts. However, the study's reliance on survey data raises concerns about response bias, and the absence of administrative tax records limits the credibility and precision of the estimated compliance–revenue relationship.

In Ghana, Agyeman, Frempong, and Nartey (2021) investigated digital clearance systems and VAT growth from 2014–2020, finding that digitized clearance procedures reduced fraudulent claims, improved documentation accuracy, and strengthened VAT revenue generation. While the study effectively demonstrates the administrative benefits of digitization, its exclusion of the informal sector where a substantial portion of Ghana's VAT revenue potential lies limits the comprehensiveness of its conclusions. Furthermore, the results may not be directly applicable to Nigeria due to differences in tax structure and compliance culture.

Ojo and Nwachukwu (2021) assessed perceptions of e-TCC effectiveness using primary data from 184 FIRS desk officers and corporate taxpayers in Lagos. Regression results indicated a strong positive link between e-TCC use and tax compliance, especially in timely filing and

payment. However, the study's exclusive reliance on subjective responses, without cross-checking actual revenue data or administrative records, limits its empirical strength and restricts its value for policymaking or national-level comparative analysis.

Chukwu and Anyanwu (2020) investigated the relationship between e-clearance platforms and personal income tax performance in Kenya using annual time-series data and ARIMA modelling. Their results showed that electronic clearance tools enhanced revenue predictability and minimized losses stemming from administrative inefficiencies. However, the study's failure to control for external factors such as economic growth, wage changes, or policy reforms means that the observed improvements cannot be attributed solely to the adoption of e-clearance systems.

Abubakar and Danjuma (2020) used a vector error correction model (VECM) to examine the effect of automated tax clearance on non-oil federal revenue from 2012–2019. They found a significant long-run positive relationship between e-TCC adoption and increases in PAYE and withholding tax collections. Despite these contributions, the study's coverage was limited to FCT PAYE and withholding taxes, omitting major federal revenue sources such as CIT, VAT, and stamp duties, thereby restricting the scope and generalizability of its findings.

Eze and Iwu (2019) compared revenue performance before and after e-TCC introduction using survey data from staff in three FIRS zones. The study noted improvements in audit efficiency and accountability in the post-implementation era. However, the use of exclusively primary perceptual data—without quantitative revenue time-series or administrative records—raises concerns about reliability and introduces potential bias, limiting the empirical strength and policy usefulness of the study.

Bello and Usman (2018) investigated the effect of ICT tools, including e-TCC, on direct tax collections using multiple regression analysis of data from 2008–2017. They found that e-TCC improved transparency and reduced clearance forgery, contributing to more credible tax

administration processes. Nonetheless, the study lacked robustness checks such as autocorrelation diagnostics, multicollinearity tests, or model stability assessments, weakening the internal validity of the findings. Additionally, the dataset is now outdated in light of newer digital reforms.

Umar and Hassan (2014) performed a quasi-experimental comparison of pre-e-TCC (2005–2009) and post-e-TCC (2010–2014) periods and reported that digital clearance significantly reduced processing time and improved compliance, especially among large firms. Yet, the study did not isolate the effect of e-TCC from concurrent enforcement measures such as stricter audits and compliance monitoring, making it difficult to determine the extent to which revenue improvements were driven by digitalization alone.

2.5 Theoretical Review

This study is anchored on Institutional Theory and Diffusion of Innovation (DOI) Theory to explain how Information and Communication Technology (ICT) influence the effectiveness of tax administration in Nigeria. These theories collectively provide insights into how systemic reforms and technological adoption shape tax compliance, transparency, and revenue generation.

2.5.1 Institutional Theory

Institutional Theory, originally propounded by Philip Selznick in 1957 and later expanded by Meyer and Rowan in 1977 (as cited in Scott, 2014), provides a framework for understanding how organizations operate within a wider system of formal rules, norms, and cultural expectations. According to Scott (2014), institutions shape organizational behavior by exerting social, regulatory, and cognitive pressures that promote conformity and legitimacy. Changes within institutions are often triggered by external factors such as technological advancements, policy reforms, global standards, and societal demands for improved accountability and efficiency.

Within the Nigerian tax administration system, Institutional Theory provides a compelling framework for understanding the adoption of Information and Communication Technology (ICT) tools, including electronic tax filing, TaxPro Max, e-payment platforms, and digital tax clearance certificates. These technological interventions go beyond simple system upgrades; they represent institutional responses to increasing demands for greater transparency, improved taxpayer compliance, and enhanced revenue collection. By implementing ICT tools, tax authorities demonstrate alignment with modern governance standards and international best practices for effective and accountable tax administration.

Empirical evidence supports this theoretical perspective. For instance, Oloyede, Adegbite, and Oladipo (2025) employed Institutional Theory to investigate the effects of Tax Identification Number (TIN) systems and electronic tax platforms on federal tax revenue. Their findings indicate that such institutional reforms significantly enhance tax collection efficiency and compliance levels. Similarly, Ibrahim and Musa (2023) demonstrated that the institutionalization of ICT systems within tax agencies in Northern Nigeria improved taxpayer identification and broadened the taxable population, ultimately strengthening revenue mobilization.

Institutional Theory thus helps illuminate how ICT adoption contributes to transforming tax administration practices in Nigeria. The integration of digital tools facilitates the standardization of processes, curbs discretionary practices, and strengthens internal controls. Over time, these reforms become embedded within organizational routines, supported by legal and regulatory frameworks, thereby enhancing their sustainability and long-term impact.

Furthermore, the theory underscores the role of ICT in promoting legitimacy for tax institutions. As taxpayers encounter more efficient, transparent, and technology-driven services, trust in tax authorities increases, reducing opportunities for corruption and reinforcing voluntary compliance. These institutional shifts are essential in addressing persistent

challenges such as tax evasion, bureaucratic bottlenecks, and weak enforcement mechanisms that have historically constrained revenue generation in Nigeria.

Institutional Theory is therefore particularly relevant to this study, as it provides a lens for examining ICT adoption not merely as a technological improvement but as a structural and institutional transformation. The theory clarifies how technology-driven reforms reshape administrative procedures, enhance accountability, and strengthen revenue governance. The works of Oloyede et al. (2025) and Ibrahim and Musa (2023) further affirm that institutional reforms anchored in ICT adoption are central to increasing the effectiveness of federal tax revenue generation.

Overall, Institutional Theory enriches the understanding of how ICT tools, when embedded within institutional frameworks, can significantly improve tax administration outcomes. It highlights the interplay between technological change, organizational behavior, and policy reform, offering a robust theoretical basis for analyzing federal tax revenue generation in Nigeria.

2.5.2 Diffusion of Innovation (DOI) Theory

The Diffusion of Innovation (DOI) Theory, developed by Rogers (2003), provides a foundational explanation for how new ideas, technologies, and practices spread through a social system over time. According to Rogers, the rate at which an innovation is adopted depends on five key attributes: relative advantage, compatibility, complexity, trialability, and observability. These characteristics shape users' perceptions of an innovation and influence their willingness to integrate it into existing routines. In the context of public sector reforms, the DOI Theory is particularly useful for understanding how technology-driven changes are accepted and sustained across different stakeholder groups.

Applying DOI Theory to Nigeria's tax administration system offers valuable insights into how Information and Communication Technology (ICT) tools such as electronic filing platforms, online payment portals, automated audit systems, and taxpayer self-service applications are progressively adopted by both tax authorities and taxpayers. Adoption rates, however, differ across geographic regions, economic sectors, and taxpayer categories due to variations in digital infrastructure, technological awareness, perceived usefulness, and readiness to embrace new administrative processes. Empirical evidence supports these dynamics. For example, Agbaje, Eze, and Olajide (2024) applied DOI Theory to assess ICT adoption among manufacturing firms, finding that firms with higher levels of digital adoption exhibited better tax compliance behaviour and contributed more significantly to government revenue.

Similarly, Efanga, Etim, and Udo (2020) found that the diffusion of innovations such as the Tax Identification Number (TIN) system and digital tax payment channels in Akwa Ibom State helped reduce tax evasion and enhanced internally generated revenue. Their findings demonstrate that as ICT tools become more visible, easier to use, and better aligned with taxpayer needs, acceptance increases and tax compliance improves. However, DOI Theory also underscores potential barriers to adoption. Some taxpayers may resist ICT innovations if they perceive them as overly complex or incompatible with their capabilities or business operations. Such resistance can slow down reform outcomes and limit the effectiveness of digital tax administration.

Understanding these patterns of acceptance, resistance, and gradual integration is crucial for evaluating the differences between the pre-adoption period of Nigeria's electronic tax administration (1995–2013) and the post-adoption period (2014–2024). These phases reflect distinct stages in the diffusion process, allowing researchers to assess how innovation attributes have shaped taxpayer behaviour and revenue generation over time. DOI Theory thus provides

a structured lens for examining the spread and effectiveness of ICT tools within the federal tax administration framework.

The relevance of DOI Theory to this study lies in its ability to illuminate the factors that promote or impede the adoption of ICT innovations within tax administration processes. By identifying how relative advantage, compatibility, and perceived complexity influence taxpayer and tax official behaviour, the theory helps explain variations in compliance levels, system usage, and ultimately tax revenue outcomes. The application of DOI Theory in prior studies such as Agbaje et al. (2024) and Efanga et al. (2020) further validates its usefulness in examining ICT-driven tax reforms in Nigerian contexts.

When integrated with Institutional Theory, DOI Theory strengthens the conceptual foundation of this study. Institutional Theory explains the structural and regulatory transformations that drive ICT reforms, while DOI Theory clarifies how these reforms are adopted, internalized, or resisted by stakeholders. Together, the theories provide a comprehensive framework for understanding how ICT tools influence federal tax revenue generation in Nigeria. They justify examining the pre- and post-adoption periods of electronic tax administration to determine the extent to which ICT innovations have improved compliance, enhanced efficiency, and ultimately boosted revenue generation.

Overall, the alignment of institutional pressures and innovation diffusion processes forms the basis for evaluating ICT adoption as a catalyst for improved federal tax revenue in Nigeria. This theoretical combination ensures a rich analysis of both the systemic reforms and behavioural changes required for successful digital tax administration.

2.6 Summary of Empirical Studies

A summary of the reviewed empirical studies, highlighting their objectives, methodologies, key findings, and identified weaknesses, is presented chronologically in Table 2.1 to provide a clear synthesis of the literature on ICT and effective tax administration within Nigeria.

Table 2.1: Summary of Empirical Literature

S/N	Author/Year	Objectives	Country	Methodology	Major Findings	Research Gap
1.	Adeagbo, Salami, and Ogunleye (2025)	Impact of Tax ProMax on Tax Revenue Collection	Nigeria	Regression analysis on data from 179 respondents	Tax ProMax improved accountability, reduced tax evasion, curtailed irregularities	Sample limited to Oyo State; lacks nationwide representative coverage
2.	Oloyede, Adegbite, and Oladipo (2025)	Effect of Tax Identification Number (TIN) Adoption on Federal Tax Revenue	Nigeria	Difference-in-Differences on FIRS data (2010–2023)	TIN adoption significantly increased federal tax revenue mobilization	Relied on aggregated national data; overlooked state-level and sectoral differences
3.	Adesina and Ezeokoli (2025)	Impact of Electronic Tax Clearance Certification on Company Income Tax	Nigeria	Difference-in-Differences Model	e-TCC significantly boosted CIT performance, reduced clearance delays and forgery	Limited to CIT and short time frame; findings not generalizable to other tax streams
4.	Musa and Ogundele (2025)	Electronic Tax Clearance Certificates and Federal Revenue	Nigeria	Structural Equation Modeling on survey data	Positive association between e-TCC accessibility and timely federal tax remittance	Heavy reliance on self-reported data; potential bias
5.	Chukwu and Eze (2024)	Effect of Tax ProMax on Compliance and Tax Collection	Nigeria	Mixed methods (panel regression & thematic analysis)	Tax ProMax enhanced compliance and reduced revenue leakage	Did not consider taxpayers' digital literacy and quality of system onboarding
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

6.	Agbaje, Eze, and Olajide (2024)	Role of TIN in Enhancing Tax Compliance and Revenue	Nigeria	Fixed Effects panel regression on manufacturing firms' data (2010–2022)	Proper TIN registration improved compliance and revenue contributions	Focused only on listed manufacturing firms; excluded informal and unregistered sectors
7.	Nwabachili, Lawal, and Musoke (2024)	Comparative Legal and Institutional Assessment of E-tax Systems	Nigeria, Tanzania, Kenya	Secondary analysis of policy documents and legislation	E-tax systems underdeveloped due to infrastructure, digital illiteracy, unreliable internet	No empirical testing; descriptive only
8.	Olatunde, Eze, and Bakare (2024)	Relationship between E-tax Systems and Company Income Tax Revenue	Nigeria	Survey of 158 FIRS staff; Spearman's rank correlation	Positive association between e-tax implementation and company income tax collections	Relies on subjective staff perceptions; lacks taxpayer data
9.	Musa and Ajayi (2024)	Perceived Reliability of E-tax Systems in Abuja	Nigeria	Mixed methods: questionnaires and interviews	E-tax systems beneficial but affected by system delays and technical failures	Small sample size; geographically limited
10.	Obiora (2024)	Role of Electronic Tax Clearance Systems in Promoting Tax Enforcement	Nigeria	Probit regression on survey data	e-TCC strengthens audit, reduces evasion, improves fraud detection	Subjective perceptions; lacks verified revenue data
11.	Ibrahim and Suleiman (2023)	Effect of e-TCC on Tax Revenue Generation	Nigeria	Autoregressive Distributed Lag (ARDL)	Both short- and long-run positive effects on corporate tax receipts	Excludes post-2022 dynamics, especially TaxPro Max impact
12.	Peter (2023)	Effect of Tax ProMax on Federal Tax Revenue	Nigeria	Paired sample t-test on secondary FIRS data	62% increase in VAT collections after Tax ProMax introduction	Did not control for macroeconomic factors and concurrent reforms
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

13.	Desi and Bingilar (2023)	Influence of Tax ProMax on FIRS Revenue Remittances	Nigeria	Survey & multiple regression on 70 FIRS staff	Tax ProMax significantly improved tax remittance performance	Small sample size, limited to Bayelsa State; limited generalizability
14.	Okafor and Ude (2023)	Impact of Tax ProMax and e-filing Systems on Tax Revenue	Nigeria	Regression on FIRS time-series data	Significant improvements in VAT and CIT collections post-digital platforms	Did not isolate Tax ProMax effect from other digital reforms
15.	Adebayo, Mensah, and Boateng (2023)	Impact of Ghana's GITAPS on Domestic Revenue Mobilization	Ghana	Difference-in-differences approach (2012–2020)	System improved VAT and corporate tax collection	Did not analyze effects across income groups or tax categories
16.	Ibrahim and Musa (2023)	Impact of TIN Adoption on Revenue Performance in Northern Nigeria	Nigeria	Panel regression on secondary data (2010–2020)	TIN improved administrative efficiency and revenue collection in northern states	Excluded informal sector taxpayers; potential bias overestimating TIN effectiveness
17.	Eze and Nwosu (2023)	Effect of E-tax Adoption on Internally Generated Revenue	Nigeria	Panel data, fixed-effects regression	E-tax usage significantly improved PAYE tax revenue	Did not control for ICT infrastructure differences across states
18.	Okeke, Moyo, and Sibanda (2023)	Effect of E-tax Payment Systems on Federal Tax Receipts	South Africa	VAR model analysis (2005–2020)	Secure e-payment channels improved income tax collections	Lacked control for macroeconomic volatility; limited comparability with Nigeria
19.	Chukwuma (2022)	e-TCC Implementation and Federal Revenue	Nigeria	Panel study with OLS regression	e-TCC implementation increased federal revenue through improved audit trails	Did not control for inflation, unemployment, or population growth
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

20.	Maphosa and Ncube (2022)	e-TCC Influence on Tax Compliance	Zimbabwe	Survey and binary logistic regression	e-TCC linked to higher compliance and revenue via public contract eligibility	Response bias concerns; lack of admin record verification
21.	Nwankwo, Adegbite, and Bello (2022)	Effect of E-tax Payments on Federal Tax Revenue	Nigeria	Ex-post facto design; OLS regression	E-tax adoption significantly improved overall revenue	Used aggregated national data; limited tax category analysis
22.	Brockmeyer and Somarriba (2022)	Incentives for Electronic Payments and Tax Compliance	Uruguay	Difference-in-differences approach	Incentives increased electronic payment adoption but not compliance	Contextual differences limit applicability to Nigeria
23.	Mwenda and Ouma (2022)	Mobile Money Tax Payments and VAT Performance	Rwanda	Quarterly data regression analysis	Mobile money payments improved VAT collection	Operational challenges reduce system reliability
24.	Okeke and Nwankwo (2022)	Influence of TIN Adoption on Tax Revenue	Nigeria	OLS regression on state revenue data (2012–2019)	Significant positive effect of TIN on revenue performance	Did not include enforcement intensity or audit activity measures
25.	Mugisha and Ayebale (2022)	Effect of Mandatory TIN Registration on Tax Revenue Growth	Uganda	Time-series data analysis (2008–2020)	Expanded TIN registration correlated with increases in personal income tax and VAT	Did not control for population growth affecting tax base
26.	Nwosu and Ekennia (2022)	Role of Tax ProMax in Reducing Tax Evasion among SMEs	Nigeria	Logistic regression on 120 SMEs	Tax ProMax curbed tax evasion among SMEs	Did not address SME adoption barriers like digital literacy, internet access
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

27.	Ndlovu and Chikodzi (2022)	Zimbabwe's Automated Tax Management System and Tax Collection	Zimbabwe	Panel regression on taxpayer-level data	ATMS improved collection efficiency among formal firms	Low adoption among micro and small enterprises due to digital illiteracy and internet issues
28.	Adewale and Mohammed (2022)	Tax ProMax's Contribution to VAT Efficiency	Nigeria	SEM on survey data from 150 respondents	Tax ProMax facilitated real-time VAT remittance and improved compliance	Excluded informal sector participants; no long-term sustainability assessment
29.	Fabian and David (2021)	Staff Perceptions of Tax ProMax in Tax Remittance	Nigeria	Friedman's ANOVA on 80 FIRS employees	Staff perceived increased efficiency and compliance	Subjective perception data; limited geographic scope
30.	Ibrahim and Bala (2021)	Effect of Electronic Filing Systems on Revenue Mobilization	Nigeria	Interrupted time-series analysis	Significant tax performance improvements post e-filing introduction	Grouped different e-tax systems; could not isolate Tax ProMax specific impact
31.	Kareem and Onah (2021)	Taxpayer Trust and User Experience with Tax ProMax	Nigeria	Qualitative interviews with 40 taxpayers	Improved transparency but system glitches, data privacy concerns hinder adoption	Small sample, qualitative only; limits external validity and broader assessment
32.	Kabanda and Mutinda (2021)	Kenya's iTax Platform and Corporate Tax Revenue	Kenya	ARDL cointegration on quarterly data (2010–2019)	Positive long-run relation between iTax adoption and corporate tax revenue	Infrastructure challenges and uneven access limit full adoption
33.	Tyokoso and Eze (2021)	Effect of TIN Adoption on Nigeria's Federal Tax Revenue	Nigeria	Paired sample t-test on national data (1998–2017)	Significant improvement in revenue after TIN introduction	Reliance on national-level aggregates; missed regional compliance variations
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

34.	Chukwu and Onwubuya (2021)	Effect of TIN Adoption on Tax Evasion and Revenue in Enugu State	Nigeria	Logistic Regression (2010–2018)	TIN reduced tax evasion and increased state revenue	Limited to a single state; overlooked taxpayer awareness and digital literacy
35.	Amegashie and Oteng (2021)	Impact of Unique Taxpayer Identification Systems on Tax Administratio n	Nigeria	Interrupted time-series analysis (2010–2015)	Sharp rise in income tax collections following TIN enforcement	Short study period, insufficient for long-term inference
36.	Kouadio and Kouame (2021)	Online Tax Remittance Platforms Effect on Corporate Tax Revenue	Côte d'Ivoire	Fixed-effects regression (2010–2019)	Digital tax platforms boosted corporate tax revenue, especially in manufacturing	Short panel; limited external economic controls
37.	Agyeman, Frempong, and Nartey (2021)	Digital Clearance Systems and VAT Growth	Ghana	Secondary data analysis (2014–2020)	Digitization reduced fraud, improved VAT revenue performance	Excludes informal sector; applicability to Nigeria uncertain
38.	Ojo and Nwachukwu (2021)	Perceptions of e-TCC Effectiveness	Nigeria	Survey and regression analysis	Positive link between e-TCC use and tax compliance	Subjective data; lacking cross-validated revenue records
39.	Chukwu and Anyanwu (2020)	e-Clearance Platforms and Personal Income Tax Performance	Kenya	ARIMA time-series modeling	e-Clearance improved revenue predictability and reduced losses	Did not control for economic growth, wage changes, policy reforms
40.	Abubakar and Danjuma (2020)	Automated Tax Clearance and Non-Oil Federal Revenue	Nigeria	Vector Error Correction Model (VECM)	Long-run positive effect on PAYE and withholding tax collections	Limited coverage; excludes major revenue types like VAT and CIT
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

41.	Nubia, Oche, and Ayuba (2020)	E-tax Payment Adoption and VAT/CIT Revenue	Nigeria	Pre/post OLS regression	E-tax payment had insignificant effect on tax revenue	Did not consider behavioral or enforcement factors
42.	Usman and Abiola (2020)	Factors Influencing E-tax Payment Compliance among SMEs	Nigeria	Logistic regression on surveys	Awareness and digital literacy crucial for compliance	Self-reported data; limited to Lagos SMEs
43.	Efanga, Etim, and Udo (2020)	TIN's Effect on Tax Evasion in Akwa Ibom State	Nigeria	Comparative ARDL analysis (pre and post TIN)	TIN adoption linked to improved compliance and higher revenue	Focused on one state; limited generalizability and administrative diversity
44.	Mwangi and Kimani (2020)	Influence of TIN on Tax Compliance among SMEs	Kenya	Survey and logit regression on 400 SMEs	SMEs with TIN showed higher compliance and revenue contribution	Reliance on self-reported data; potential response bias
45.	Hanga, Ahmed, and Yusuf (2020)	Effect of TIN on Revenue in Adamawa State	Nigeria	Multiple regression and paired t-tests (2009–2015)	TIN adoption significantly improved revenue collection	Did not control for macroeconomic or political factors
46.	Eze and Iwu (2019)	Revenue Performance Before and After e-TCC	Nigeria	Survey data analysis	Post-implementation improvements in audit efficiency and accountability	Perceptual data only; no quantitative revenue records
47.	Agbo and Omotosho (2019)	Effect of Electronic Tax Systems on Personal Income Tax Collection	Nigeria	Time-series regression (2011–2018)	Weak positive relationship noted	Did not incorporate behavioral or enforcement variables
48.	Akinleye, Ojo, and Bello (2019)	TIN's Effect on Revenue Generation in Three Nigerian States	Nigeria	Paired t-tests on regional data (2008–2017)	Revenues significantly higher post-TIN implementation	Did not account for regional tax capacity or policy variations
S/N	**Author/Year**	**Objectives**	**Country**	**Methodology**	**Major Findings**	**Research Gap**

49.	Bello and Usman (2018)	ICT Tools including e-TCC Impact on Direct Tax Collections	Nigeria	Multiple regression analysis	e-TCC improved transparency and reduced forgery	Lacked robustness diagnostics; outdated dataset
50.	Olatunji and Oludayo (2018)	Impact of TIN Adoption on Revenue in Ekiti State	Nigeria	OLS regression on state data (2006–2010)	TIN positively affected tax revenue	Short period and single-state focus limit broader inference
51.	Olaoye and Atilola (2018)	Impact of E-tax Adoption on Revenue Collection	Nigeria	Quarterly data, correlation tests, paired t-tests	No significant immediate effect on CGT, VAT, or CIT collections	Lacked macroeconomic control variables
52.	Asaolu, Fagbemi, and Oladele (2015)	Impact of Tax Reforms including TIN Introduction on Revenue	Nigeria	OLS regression on Lagos State data (2012–2019)	TIN contributed significantly to increased tax collection	Effect of TIN not isolated from other reforms such as e-payment and audit tools
53.	Okiro (2015)	E-payment Systems and Government Revenue in Nairobi City County	Kenya	Regression analysis	E-payment systems explained 92% of revenue variation	Simplistic performance proxy; context-specific
54.	Besley and Persson (2014)	Theoretical Discussion: Digital Tax Systems and Tax Capacity	Kenya	Conceptual study	Automation enhances efficiency, transparency, and trust	Lacked empirical testing and real-world implementation insights
55.	Umar and Hassan (2014)	Pre- and Post-e-TCC Revenue and Compliance	Nigeria	Quasi-experimental comparison	e-TCC reduced processing time and improved compliance	Did not isolate e-TCC effect from other enforcement measures

Source: Researcher′s Compilation (2025)

2.7 Summary of Identified Gaps in Literature

Although substantial research has explored the impact of ICT tools; Tax ProMax, Tax Identification Number (TIN), electronic tax payment system and electronic tax clearance, on federal tax revenue generation in Nigeria and beyond, several methodological weaknesses remain. Many studies rely heavily on cross-sectional designs that limit the ability to draw robust causal inferences or examine long-term effects. Additionally, a significant number of investigations depend on primary data gathered through surveys or interviews with tax officials and taxpayers. While useful, these data sources often suffer from biases such as social desirability, limited sample sizes, and narrow geographic coverage, which undermine the generalizability and objectivity of the findings.

Moreover, many analyses utilize aggregated secondary data without adequately controlling for confounding variables like population growth thereby weakening the attribution of observed effects to the digital tools themselves. Another critical limitation is the outdated and small scope of much of the existing literature, with several key studies covering periods before 2020, failing to capture recent advancements in technology adoption or changes in tax administration practices. This temporal gap reduces the relevance of findings for current policy and practice in an evolving digital landscape. Addressing these methodological and temporal shortcomings is vital for generating more reliable evidence to inform effective tax administration reforms in Nigeria.

CHAPTER THREE

METHODOLOGY

3.1 Introduction

The systematic approach adopted in investigating the effect of information communication technology tools' adoption on federal tax revenue generation in Nigeria is the basis for this chapter. The section focuses on the framework and model specification, sources of research data, and data estimation techniques adopted for the study.

3.2 Research Design

This study adopts the ex-post facto research design. This design determines the cause-effect relationship among variables. Ex-post Facto seeks to find out the factors that are associated with certain occurrence, conditions, events or behaviours by analyzing past events or already existing data for possible casual factors (Okonkwo, 2023). The choice of this design is hinged on the fact that the prior existence of the facts and data used in the study eliminates bias in the data and possible outcomes from the analytical procedures.

3.3 Sources of Data

This study relied entirely on secondary data obtained from reputable government institutions and official records and online data bases. Specifically, data was sourced from the Federal Inland Revenue Service (FIRS) database, the National Bureau of Statistics (NBS) publications, and the Central Bank of Nigeria (CBN) statistical bulletins covering the period from 1995 to 2024. These sources provided comprehensive information on TaxPromax usage, taxpayer identification number (TIN) registrations, electronic tax payments, electronic tax clearance certification, CIT, PIT, and VAT.

3.4 Method of Data Collection

The study used the documentary method of data collection, relying solely on secondary data obtained from official records, publications and websites. Relevant data covering the period from 1995 to 2024 were carefully collected from the sources identified above.

3.5 Method of Data Analysis

The data collected for this study were analyzed using both descriptive and inferential statistical techniques. All analyses were carried out with the aid of STATA 13 econometric software package.

3.5.1 Descriptive Statistics

Descriptive statistic; mean, median, standard deviation, minimum, and maximum values were computed to summarize the characteristics of the variables employed in the study. These measures provided a clear overview of the distributional properties of federal tax revenue generation indicators and the ICT adoption variables, as well as the control variable (population growth) over the study period (1995–2024).

3.5.2 Diagnostic Tests

Prior to the inferential analysis, several diagnostic tests were carried out in STATA 13 to ensure the validity of the results. These included:

Stationarity Tests: ADF unit root test, tests were applied to examine the time-series properties of the variables and confirm the level of stationarity.

Normality Tests: The Shapiro-Wilks normality test was conducted to ascertain whether the time series data set were normally distributed over the study period for each of the variables - ICT adoption variables, federal tax revenue generation, and population growth.

Correlation Analysis: Based on the outcome of the normality test, the study adopted the Spearman Rank (rho) Correlation method to analyse the strength and direction of relationship of the variables under study.

Autocorrelation Analysis: Testing for auto-correlation is essential in time series studies to determine whether the error terms are independent over time. Serial correlation, if present, may compromise the efficiency of estimators, distort standard errors, and lead to misleading inference. In the context of this study, which investigates the influence of ICT adoption in tax administration on federal tax revenue generation in Nigeria, two complementary diagnostic tests were employed: Bartlett's periodogram-based white-noise test and the Portmanteau white-noise test. Both tests assess the null hypothesis that each series is independently and identically distributed (i.i.d.), implying the absence of serial correlation.

Co-integration Test: Cointegration analysis is essential when dealing with non-stationary time series, as it helps determine whether a set of variables share a stable long-run relationship despite short-term fluctuations. For this purpose, the Johansen Cointegration test was employed to examine the long-run equilibrium relationship between the adoption of ICT tools in Nigeria's tax administration and federal tax revenue generation.

3.5.3 Inferential Statistics

To test the hypotheses of the study, the Vector Autoregression (VAR) test and the ARIMA Intervention Analysis were adopted where applicable. These tools were considered suitable given the nature of the dataset collated for each of the variables, subject to the outcome of the diagnostic tests that were conducted.

The regression model incorporated the adoption of ICT tools in Nigeria's tax administration (adoption of TaxPro Max, issuance of Taxpayer Identification Numbers, implementation of

electronic tax payment systems, and adoption of electronic Tax Clearance Certificate systems) as the main explanatory variables, with population growth included as a control variable. In addition, federal tax revenue generation was the dependent variable and it was measured using three (3) measures – company income tax (CIT), personal income tax (PIT) and value added tax (VAT).

3.6 Decision Rule for Test of Research Hypotheses

The decision rule was based on the 5% level of significance. If the p-value of the estimated coefficient ≤ 0.05, the null hypothesis was rejected, indicating that the ICT adoption variable had a significant effect on components of federal tax revenue generation in Nigeria. Conversely, if the p-value > 0.05, the null hypothesis was not rejected, implying no statistically significant effect.

3.7 Model Specification

This study specified an econometric model to examine the effect of ICT adoption on federal tax revenue generation in Nigeria, controlling for population growth. The analysis employed a time series regression framework since the dataset spans over a 30 years period 1995–2024 for Nigeria as a single entity. The choice of this model is further justified by its ability to handle single-country longitudinal data, where observations are dependent across periods, and to incorporate control variables such as population growth to isolate the effect of ICT adoption on revenue. Moreover, by adapting the functional form from Peter (2023), the model aligns with prior empirical studies that investigate the impact of technological interventions on government revenue collection, ensuring comparability and methodological rigor. The functional form of the model adapted from Peter (2023) is expressed as:

FTR= f(TPM, TIN, EPAY, ETCC, POPG)

Where:

FTR = Federal tax revenue generation (proxied by Company Income Tax – CIT, Personal Income Tax – PIT, and Value Added Tax – VAT)

TPM = TaxPro Max (dummy: 0 = 1995–2020, 1 = 2021–2024)

TIN = Taxpayer Identification Number system (dummy: 0 = 1995–2007, 1 = 2008–2024)

EPAY = Electronic Tax Payment system (dummy: 0 = 1995–2005, 1 = 2006–2024)

ETCC = Electronic Tax Clearance Certification (dummy: 0 = 1995–2012, 1 = 2013–2024)

POPG = Population Growth (control variable).

The adoption years stated (2006 for e-payment, 2008 for TIN, 2013 for e-TCC, and 2021 for TaxPro Max) represent the official years each ICT system was introduced in Nigeria. For operationalization, these adoption years serve as cut-off points in coding the dummy variables (0 = pre-adoption; 1 = post-adoption). The econometric models in their linear forms are specified separately for each tax revenue proxy as below:

Model for Company Income Tax (CIT):

$$CIT_t = \alpha 0 + \alpha 1 TPM_t + \alpha 2 TIN_t + \alpha 3 EPAY_t + \alpha 4 ETCC_t + \alpha 5 POPG_t + \epsilon_t \ldots\ldots \quad (I)$$

Model for Personal Income Tax (PIT):

$$PIT_t = \gamma 0 + \gamma 1 TPM_t + \gamma 2 TIN_t + \gamma 3 EPAY_t + \gamma 4 ETCC_t + \gamma 5 POPG_t + \epsilon_t \ldots\ldots\ldots \quad (II)$$

Model for Value Added Tax (VAT):

$$VAT_t = \delta 0 + \delta 1 TPM_t + \delta 2 TIN_t + \delta 3 EPAY_t + \delta 4 ETCC_t + \delta 5 POPG_t + \epsilon_t \ldots\ldots\ldots \quad (III)$$

Model for Federal Tax Revenue (TAXREV):

$$TAXREV_t = \beta 0 + \beta 1 TPM_t + \beta 2 TIN_t + \beta 3 EPAY_t + \beta 4 ETCC_t + \beta 5 POPG_t + \epsilon_t \ldots\ldots\ldots \quad (IV)$$

Model for Policy Impact Analysis:

$TAXREVG_t = \mu\delta 0 + \mu 1 POLICYCHANGE_t + \epsilon_t$…….. (V)

Where:

$\alpha 0, \gamma 0, \delta 0$ = Intercepts for CIT, PIT, and VAT equations respectively.

$\alpha 1 - \alpha 5$, $\gamma 1 - \gamma 5$, $\delta 1 - \delta 5$, $\beta 1 - \beta 5$ = Coefficients of explanatory variables in each model.

TPM	=	TaxPro Max.
TIN	=	Taxpayer Identification Number.
EPAY	=	Electronic Tax Payment.
ETCC	=	Electronic Tax Clearance Certificate.
POPG	=	Population Growth.
POLICYCHANGE	=	Policy Change
t	=	Time (1995–2024).
ϵt	=	Stochastic error term.

The a priori expectations are stated as: $\delta 1, \delta 2, \delta 3, \delta 4 > 0; \delta 5 > 0$

This implies that ICT adoption variables (TaxPro Max, TIN, electronic payment, and electronic TCC) were expected to exert a positive and significant effect on each category of federal tax revenue generation (CIT, PIT, and VAT). Similarly, population growth, as a control variable, is also expected to have a positive effect by expanding the potential tax base.

3.8 Description of Variables

The table below provides the operational definitions, measurement scales, and data sources for each variable included in the study. This operationalization is essential for ensuring clarity, consistency, and empirical relevance in the analysis of how ICT adoption affects federal tax revenue generation in Nigeria.

Table 3.1: Operationalization of Variables

Variable Type	Variable	Proxy/Indicator	Measurement Description	Source	A Priori Expectation
Dependent Variable	Federal tax revenue generation	Company Income Tax (CIT)	Annual CIT revenue collected by the Federal Inland Revenue Service (₦ billions)	Adereti et al. (2011); FIRS Reports	+
		Personal Income Tax (PIT)	Annual PIT revenue collected by the Federal Inland Revenue Service (₦ billions)	Okoye & Ezejiofor (2014); FIRS Reports	+
		Value Added Tax (VAT)	Annual VAT revenue collected by the FIRS (₦ billions)	Adereti et al. (2011); FIRS Reports	+
Independent Variable	ICT Tools for Tax Revenue Generation	TaxPro Max (TPM)	Dummy: 0 = 1995–2020 (pre-adoption); 1 = 2021–2024 (post-adoption)	FIRS (2021)	+
		Taxpayer Identification Number (TIN)	Dummy: 0 = 1995–2007 (pre-adoption); 1 = 2008–2024 (post-adoption)	FIRS (2008); Olaoye et al. (2017)	+
		Electronic Tax Payment (EPAY)	Dummy: 0 = 1995–2005 (pre-adoption); 1 = 2006–2024 (post-adoption)	FIRS (2006);Ojo & Nwachukwu (2021)	+

Variable Type	Variable	Proxy/Indicator	Measurement Description	Source	A Priori Expectation
		Electronic Tax Clearance (ETCC)	Dummy: 0 = 1995–2012 (pre-adoption); 1 = 2013–2024 (post-adoption)	FIRS (2013)	+
Control Variable	Population Growth (POPG)	Population Growth Rate (%)	Annual national population growth rate	World Bank (2024); NBS	±

Source: Researcher's compilation, (2025)

CHAPTER FOUR

DATA PRESENTATION, ANALYSIS AND INTERPRETATION OF RESULTS

4.0 Introduction

This chapter presents the data, results, and analyses carried out to examine the effect of Information Communication Technology (ICT) tools' adoption on federal tax revenue generation in Nigeria for the period 1995–2024. The analyses were conducted in line with the research design and econometric techniques outlined in Chapter Three. Both descriptive and inferential statistics were employed, with the aid of STATA 13 software, to summarize the properties of the data and test the study hypotheses with results presented in American Psychology Association (APA) table standard.

4.1 Data Presentation

The study utilized annual time series and panel data covering the period 1995 to 2024, obtained from the Federal Inland Revenue Service (FIRS) reports and publications, Central Bank of Nigeria (CBN) Statistical Bulletins and reports, and National Bureau of Statistics (NBS) publications. The dataset captures the components of federal tax revenue; Company Income Tax (CIT), Personal Income Tax (PIT), and Value Added Tax (VAT), which serve as the dependent variables. The independent variables are proxies for ICT tools adoption, namely: TaxPro Max (TPM), Taxpayer Identification Number (TIN), Electronic Payment (EPAY), and Electronic Tax Clearance Certificate (ETCC), all of which are captured as binary indicators based on their year of introduction. Population growth rate (POPG) was included as a control variable to account for demographic influences on tax revenue mobilization.

The data were structured into a panel format to allow for efficient estimation and robust inference. All variables were organized on an annual basis to reflect the consistency of federal tax reporting, while ICT adoption variables were coded 0 for pre-adoption years and 1 for post-

adoption years. This coding enabled the models to capture the structural shifts associated with each ICT innovation.

A detailed presentation of the dataset, including descriptive statistics for all variables, is provided in the subsequent sections, while the full data series are attached as Appendix I for reference and verification.

4.2 Results

4.2.1 Descriptive Statistics

Table 4.1: Summary of Descriptive Statistics of the Variables of the Study

Source: Researcher's Computation, 2025.

Variable	Obs	Mean	Std. Deviation	Minimum	Maximum
LCIT	30	13.3195	1.037585	11.918	14.914
LPIT	30	11.42323	0.6418576	9.83	12.246
IVAT	30	13.31677	1.041726	11.88	14.728
TPM	30	0.1333333	0.3457459	0	1
TIN	30	0.5666667	0.5040069	0	1
EPAY	30	0.6333333	0.4901325	0	1
ETCC	30	0.4	0.4982729	0	1
POPG	30	2.582	0.240336	2.09	2.8

Table 4.1 presents the descriptive statistics for the variables employed in examining the influence of the adoption of ICT tools in Nigeria's tax administration on federal tax revenue generation. The dependent variable is measured using company income tax (CIT), personal income tax (PIT), and value added tax (VAT). These variables have been expressed in their logarithmic forms to stabilize variance and improve distributional properties. The independent variables capturing ICT-related reforms include the adoption of TaxPro Max (TPM), implementation of Tax Identification Number (TIN), introduction of electronic tax payment system (EPAY), and electronic tax clearance certificate (ETCC). Population growth rate (POPG) serves as the control variable.

The results show that LCIT has a mean value of 13.3195 with a standard deviation of 1.0376, indicating moderate variability in company income tax revenue over the 30-year period. The minimum (11.918) and maximum (14.914) values suggest substantial growth in corporate tax revenue across the study period. Similarly, LPIT has a mean of 11.4232 and a standard deviation of 0.6419, implying relatively lower dispersion compared to LCIT. This suggests that personal income tax revenue exhibited more stability over time. Value added tax (IVAT) displays a mean of 13.3168 with a standard deviation of 1.0417, indicating a variability pattern similar to that of LCIT, which is expected given their shared sensitivity to macroeconomic conditions and compliance behaviour.

The ICT-related variables (TPM, TIN, EPAY, and ETCC) are binary indicators reflecting periods before (0) and after (1) the adoption of each tool. TaxPro Max (TPM) has a mean of 0.1333, indicating that it was implemented only in the later years of the dataset. TIN has a mean of 0.5667, showing that the tax identification system was operational for more than half of the study period. EPAY has the highest mean among the ICT tools (0.6333), suggesting early and sustained adoption of electronic tax payment mechanisms by the Federal Inland Revenue Service (FIRS). ETCC, with a mean of 0.4000, indicates that electronic tax clearance certification had shorter adoption coverage relative to TIN and EPAY.

The control variable, population growth rate (POPG), has a mean of 2.582% and a standard deviation of 0.2403, with values ranging between 2.09% and 2.80%. The low variability suggests that demographic changes remained relatively stable, although consistently high population growth may have implications for tax base expansion and long-term revenue generation.

Overall, the descriptive statistics reveal upward trends in federal tax revenue components, reflected in relatively high mean values and moderate dispersion across LCIT, LPIT, and

IVAT. Meanwhile, the ICT variables show staggered adoption patterns, which is essential for understanding their differential impacts on tax revenue generation. The stability of the population growth rate further complements the model by serving as an appropriate control for macro-demographic effects on fiscal performance.

4.2.2 Normality Test

Table 4.2: Shapiro-Wilk Test for Normality

Source: Researcher's Computation, 2025.

Variable	Obs	W	V	Z	Prob>Z
LCIT	30	0.88833	3.549	2.619	0.00441
LPIT	30	0.91857	2.588	1.966	0.02463
IVAT	30	0.87291	4.040	2.887	0.00195
TPM	30	0.64499	11.284	5.011	0.00000
TIN	30	0.99493	0.161	-3.774	0.99992
EPAY	30	0.97882	0.673	-0.818	0.79346
ETCC	30	0.98251	0.556	-1.214	0.88755
POPG	30	0.81532	5.870	3.660	0.00013

Table 4.2 presents the Shapiro–Wilk normality test results for all variables used in assessing the influence of ICT adoption in Nigeria's tax administration on federal tax revenue generation. The test evaluates whether each variable is normally distributed, which is important for determining the suitability of parametric statistical techniques and for informing subsequent econometric modeling decisions.

The results indicate that the log-transformed company income tax (LCIT) has a W-statistic of 0.8883 with a corresponding p-value of 0.0044, suggesting a statistically significant departure from normality at the 5% level. Similarly, log personal income tax (LPIT) and value added tax revenue (IVAT) both exhibit significant non-normality, with p-values of 0.0246 and 0.0019, respectively. These findings imply that the three major federal tax revenue components in their levels deviate from a normal distribution, a typical pattern for macroeconomic and fiscal time-

series data where structural breaks, policy changes, and economic cycles introduce skewness and kurtosis.

Among the ICT-related variables, the adoption of TaxPro Max (TPM) shows strong evidence of non-normality ($p < 0.0001$). This is expected, given that TPM is a binary dummy variable taking values of 0 before adoption and 1 after adoption. In contrast, the implementation of the Tax Identification Number (TIN), Electronic Tax Payment (EPAY), and Electronic Tax Clearance Certificate (ETCC) show high p-values (0.9999, 0.7935, and 0.8876, respectively), indicating no significant departure from normality. Although these variables are also binary in nature, their distribution appears more balanced across the sample period, which explains the absence of significant normality violations.

The control variable, population growth rate (POPG), shows a W-statistic of 0.8153 and a p-value of 0.00013, indicating a strong departure from normality. This is not unusual, as demographic indicators in developing economies often change slowly over time and may exhibit structural shifts tied to census adjustments, migration patterns, and socio-economic trends.

Overall, the normality test results reveal that most revenue variables and some ICT variables do not follow a normal distribution at conventional significance levels. This outcome further justifies the use of log transformations, robust time-series techniques, and inferential methods that do not strictly require normality, such as the VAR and ARIMA models. Moreover, the presence of structural changes aligns with the study's central focus on evaluating the impact of ICT adoption reforms over time, suggesting that deviations from normality may reflect underlying policy shifts rather than statistical anomalies.

4.2.3 Correlation Analysis

Table 4.3: Spearman Correlation

Variable	LCIT	LPIT	IVAT	TPM	TIN	EPAY	ETCC	POPG
LCIT	1.0000							
LPIT	-0.4456* 0.0136	1.0000						
IVAT	0.9924* 0.0000	-0.4478* 0.0131	1.0000					
TPM	-0.2266 0.2286	0.5891* 0.0006	-0.2266 0.2286	1.0000				
TIN	-0.3536 0.0552	0.8588* 0.0000	-0.3614* 0.0497	0.3430 0.0635	1.0000			
EPAY	-0.2198 0.2432	0.8351* 0.0000	-0.2198 0.2432	0.2984 0.1092	0.8701* 0.0000	1.0000		
ETCC	-0.8490* 0.0000	0.8490* 0.0000	-0.8490* 0.0000	0.4804* 0.0072	0.7140* 0.0000	0.6213* 0.0002	1.0000	
POPG	0.7304* 0.0000	-0.4272* 0.0186	0.7239* 0.0000	-0.5904* 0.0006	-0.1830 0.3330	-0.0841 0.6586	-0.6775* 0.0000	1.0000

Source: Researcher's Computation, 2025.

Table 4.3 presents the Spearman correlation coefficients for the variables used in examining the influence of ICT tools' adoption on federal tax revenue generation in Nigeria. The Spearman correlation technique was employed due to the presence of non-normal distributions in several variables, as revealed in the normality tests earlier reported. The analysis provides insights into the strength and direction of monotonic relationships among federal tax revenue indicators (LCIT, LPIT, IVAT), ICT adoption variables (TPM, TIN, EPAY, ETCC), and the control variable (POPG).

The results show that the log of company income tax (LCIT) is strongly and positively correlated with the log of value added tax (IVAT) ($\rho = 0.9924$, $p < 0.01$), suggesting that these two components of federal tax revenue tend to move together over time, likely reflecting common macroeconomic and administrative drivers. Conversely, LCIT exhibits a moderate negative correlation with LPIT ($\rho = –0.4456$, $p < 0.05$), implying that periods of rising personal

income tax revenue are associated with relatively lower corporate tax payments. LCIT also shows strong negative associations with ETCC ($\rho = -0.8490$, $p < 0.01$), indicating that increased implementation of electronic tax clearance certification may coincide with enhanced enforcement efforts that uncover non-compliance or irregularities in corporate tax filings.

For VAT (LVAT), the pattern mirrors that of LCIT as LVAT is negatively correlated with LPIT ($\rho = -0.4478$, $p < 0.05$) and strongly negatively correlated with ETCC ($\rho = -0.8490$, $p < 0.01$). However, LVAT is positively correlated with POPG ($\rho = 0.7239$, $p < 0.01$), suggesting that population expansion may contribute to increased consumption tax revenue due to a growing taxable base.

With respect to ICT adoption variables, LPIT demonstrates statistically significant positive correlations with TPM ($\rho = 0.5891$, $p < 0.01$), TIN ($\rho = 0.8588$, $p < 0.01$), EPAY ($\rho = 0.8351$, $p < 0.01$), and ETCC ($\rho = 0.8490$, $p < 0.01$). This indicates that personal income tax revenue appears highly responsive to the adoption of ICT tools, consistent with the individual-level compliance enhancements associated with digital identification, automated payment channels, and electronic clearance verification.

TIN and EPAY also show a very strong positive association ($\rho = 0.8701$, $p < 0.01$), reflecting their complementary implementation within Nigeria's tax administration. Similarly, ETCC exhibits strong positive correlations with TIN ($\rho = 0.7140$, $p < 0.01$) and EPAY ($\rho = 0.6213$, $p < 0.01$), indicating that broader ICT reforms tend to be adopted together rather than in isolation.

The control variable, population growth rate (POPG), displays strong positive correlations with both LCIT ($\rho = 0.7304$, $p < 0.01$) and IVAT ($\rho = 0.7239$, $p < 0.01$), reflecting the underlying demographic expansion that drives economic activity, corporate profits, and consumption. However, POPG demonstrates significant negative correlations with LPIT ($\rho = -0.4272$, $p <$

0.05), TPM ($\rho = -0.5904$, $p < 0.01$), and ETCC ($\rho = -0.6775$, $p < 0.01$), suggesting that population pressures may not translate into proportional increases in personal income tax collection or the implementation of certain ICT-driven administrative reforms.

Overall, the correlation matrix reveals notable interdependencies among tax revenue components and ICT adoption indicators. The strong associations between ICT tools and PIT revenue highlight the potential effectiveness of digital technologies in improving individual compliance. Meanwhile, the negative correlations between ETCC and corporate/VAT revenues may reflect transitional enforcement effects associated with tightening compliance requirements. These insights provide a useful foundation for the subsequent econometric estimations that assess the causal influence of ICT adoption on federal tax revenue generation.

4.2.4 Unit Root Test

Table 4.4: Augmented Dickey-Fuller (ADF) Test

Variable	Test Statistics	5% Critical Value	P-Value	Remark
LCIT	-1.328	-2.989	0.6163	Non-Stationary
LPIT	-3.881	-2.989	0.0022	Stationary
IVAT	-1.247	-2.989	0.6529	Non-Stationary
TPM	-0.334	-2.989	0.9205	Non-Stationary
TIN	-1.114	-2.989	0.7094	Non-Stationary
EPAY	-1.295	-2.989	0.6317	Non-Stationary
ETCC	-0.776	-2.989	0.8260	Non-Stationary
POPG	1.696	-2.989	0.9981	Non-Stationary

Source: Researcher's Computation, 2025.

To ensure the validity of the time-series estimations and avoid spurious regression outcomes, the Augmented Dickey–Fuller (ADF) test was conducted to determine the stationarity properties of all variables used in the study. The test examined the order of integration of the federal tax revenue variables as well as ICT adoption indicators alongside measure of the control variable.

Table 4.4 presents the ADF test statistics, alongside the 5% critical values, and the associated p-values. Evidently, the results indicate that LPIT is the only variable that is stationary at level, with an ADF test statistic of –3.881, which is more negative than the 5% critical value (–2.989), and a corresponding p-value of 0.0022. This confirms rejection of the null hypothesis of a unit root for LPIT, implying that personal income tax revenue is stable around its mean and does not contain a stochastic trend in its level form.

In contrast, all other variables including LCIT, IVAT, TPM, TIN, EPAY, ETCC, and POPG exhibit non-stationarity at level, as evidenced by test statistics that are less negative than the critical value and p-values that are substantially higher than the 0.05 significance threshold. Specifically, LCIT has an ADF statistic of –1.328 (p = 0.6163), while both TPM and ETCC show very weak test statistics of –0.334 (p = 0.9205) and –0.776 (p = 0.8260), respectively. The control variable POPG also demonstrates strong evidence of non-stationarity (ADF = 1.696; p = 0.9981), confirming that population growth exhibits a persistent upward trend during the study period.

The presence of mixed integration orders with LPIT being stationary at level (I(0)) while other variables are non-stationary at level suggests the need for further stationarity testing at first difference or the adoption of more robust tools in testing the study's hypotheses.

4.2.5 Test for Autocorrelation

Table 4.5: Auto-Correlation Test Outcome

Variable	Bartlett's periodogram-based white-noise test	Prob >B	Portmanteau white-noise test	*Prob >B*
LCIT	2.7646	0.0000	88.4864	0.0000
LPIT	2.3184	0.0000	88.2014	0.0000
IVAT	2.8840	0.0000	95.0491	0.0000

TPM	2.2693	0.0001	29.5907	0.0054
TIN	2.8889	0.0000	108.2522	0.0000
EPAY	2.8632	0.0000	98.8386	0.0000
ETCC	2.8287	0.0000	104.6715	0.0000
POPG	3.0237	0.0000	92.2933	0.0000

Source: Researcher's Computation, 2025.

The results of the tests for autocorrelation are presented in Table 4.5. Accordingly, it is evident that across all measures of the federal tax revenue indicators (LCIT, LPIT, IVAT), and ICT adoption measures (TPM, TIN, EPAY, ETCC), alongside the control variable (POPG), the results consistently show very low p-values (Prob > B), all below the 5% significance threshold. This outcome indicates that the null hypothesis of no serial correlation is rejected for all the variables under consideration. Both the Bartlett's and Portmanteau statistics show strong evidence that the series exhibit significant auto-correlation.

The presence of statistically significant auto-correlation in all variables suggests that the behaviour of each series is influenced by its past values. This is not uncommon in economic and administrative datasets, particularly in fiscal variables such as company income tax (CIT), personal income tax (PIT), value-added tax (VAT), and population growth. Equally, ICT adoption variables (such as TPM, TIN, EPAY, and ETCC) tend to have gradual effects over time, reflecting ongoing administrative implementation and taxpayer compliance adjustments.

The significant auto-correlation implies that the series are dynamic, meaning that past performance or levels influence current outcomes. The implication of this outcome is that the standard Ordinary Least Square (OLS) regression method may be inappropriate without correction, as the presence of serial correlation violates one of its key assumptions. Also, parameter estimates may be inefficient, and the test of hypotheses using the OLS approach becomes invalid if serial correlation is ignored.

Given the consistent evidence of auto-correlation, it becomes necessary to adopt estimation methods that account for serially correlated error terms. Appropriate remedial measures adopted in this study are relevant autoregressive models (VAR and ARIMA) since the data structure justifies their adoption.

By addressing auto-correlation adequately, the study ensures that statistical inference regarding the impact of ICT adoption on federal tax revenue generation is both reliable and valid.

4.2.6 Test for Cointegration

Table 4.6: Johansen Tests for Cointegration

Source: Researcher's Computation, 2025.

Maximum Rank	Parms	LL	Eigenvalue	Trace Statistics	5% Critical Value
0	3	23.288005	-	29.2998*	29.68
1	8	30.947484	0.41036	13.9809	15.41
2	11	36.37284	0.31213	3.1302	3.76
3	12	37.937929	0.10232	-	-

The Johansen cointegration test was employed to examine the long-run equilibrium relationship between the adoption of ICT tools in Nigeria's tax administration and federal tax revenue generation. The result in this regard as depicted in Table 4.6 reveal that the trace statistics from the Johansen test indicate that at maximum rank 0, the trace statistic is 29.2998, which is slightly below the 5% critical value of 29.68. This result provides weak evidence to reject the null hypothesis of no cointegration, suggesting the potential presence of a long-run equilibrium relationship among the variables. At maximum rank 1, the trace statistic (13.9809) is less than the critical value (15.41), implying that the null hypothesis of at most one cointegrating vector cannot be rejected, while at maximum rank 2, the trace statistic (3.1302) is below the critical value (3.76), indicating the absence of additional cointegrating relationships beyond the first. Collectively, these findings suggest that there is likely one long-run cointegrating relationship linking federal tax revenue measures with ICT adoption and population growth.

This long-run association indicates that changes in ICT adoption measures influence federal tax revenue not only contemporaneously but also over time, reflecting the gradual and cumulative effect of ICT implementation on tax collection efficiency. From a policy perspective, the result underscores the importance of strategic investments in ICT tools as a means of sustaining improvements in revenue generation. Econometrically, the existence of a long-run relationship further justifies the use of a more robust tool in testing the formulated hypotheses for this study.

4.3 Test of Hypotheses

The Vector Autoregressive (VAR) model was estimated to examine the influence of ICT tools' adoption on federal tax revenue generation in Nigeria, with the key measures of tax revenue being Company Income Tax (CIT), Personal Income Tax (PIT), and Value Added Tax (VAT). The ICT adoption variables include TaxPro Max (TPM), Tax Identification Number (TIN), Electronic Tax Payment (EPAY), and Electronic Tax Clearance Certificate (ETCC), while Population Growth Rate (POPG) was included as a control variable. The results of the VAR estimation are presented in Table 4.7 – 4.10 for the test of hypotheses one to four whereas the ARIMA Intervention Analysis was deployed to test hypothesis five of this study.

4.3.1 Test of Hypothesis One

Table 4.7: Results of Model I and Test of Hypothesis I

Source: Researcher's Computation via STATA 13.0 * significant at 5% level

Variables	Symbol	Coefficient	Std. Err.	t-Statistics	P>(t)
Constant	_CONS	12.39466	.9854888	12.58*	0.000
Company Income Tax	CIT	.0861718	.0750327	1.15	0.251
TaxPro Max	TPM	.3335322	.1823204	1.83	0.067
Taxpayer Identification Number	TIN	.2679116	.1530261	1.75	0.080
Electronic Tax Payment	EPAY	.5831376	.1448926	4.02*	0.000
Electronic Tax Clearance Certificate	ETCC	-2.427313	.1745308	-13.91*	0.000
Population Growth	POPG	.0749379	.3741065	0.20	0.841

Log Likelihood				8.443	
RMSE				0.20764	
R-Squared				0.9696	
Chi2				925.5371*	
P>Chi2				0.0000	

The results of the test of hypothesis one as depicted in Table 4.7 indicate that the constant term is positive and highly significant (12.3947, p = 0.000), reflecting the baseline level of tax revenue when all explanatory variables are held at zero. Among the ICT adoption variables, Electronic Tax Payment (EPAY) exhibits a strong and positive impact on federal tax revenue, with a coefficient of 0.5831 and a t-statistic of 4.02 (p = 0.000), indicating that the implementation of electronic tax payment systems significantly enhances CIT revenue collection. Similarly, the adoption of TaxPro Max (TPM) and the Tax Identification Number (TIN) have positive coefficients of 0.3335 and 0.2679, respectively, and are marginally significant at the 10% level (p = 0.067 and 0.080), suggesting that these ICT tools contribute positively to revenue generation, although their effects are not strongly conclusive at the 5% significance level.

In contrast, the Electronic Tax Clearance Certificate (ETCC) shows a significant negative coefficient of -2.4273 (t = -13.91, p = 0.000), indicating that, contrary to expectations, its implementation is associated with a reduction in CIT tax revenue generation. This may reflect transitional inefficiencies or compliance bottlenecks associated with the adoption of ETCC during the study period. The coefficients for Company Income Tax (CIT) and Population Growth Rate (POPG) are positive but statistically insignificant, suggesting that, within the model, their direct effect on aggregate revenue is limited.

The VAR model demonstrates a high overall goodness-of-fit, with an R-squared of 0.9696, indicating that approximately 97% of the variation in CIT revenue generation is explained by the independent variables. The model's chi-square statistic ($\chi^2 = 925.5371$, $p = 0.000$) confirms

the overall statistical significance of the model, while a low root mean square error (RMSE = 0.2076) indicates good predictive accuracy.

In practical terms, these results suggest that ICT tools' adoption in Nigeria's tax administration has a positive and significant influence on company income tax revenue, particularly through electronic tax payment systems, which enhance efficiency and compliance. The marginal effects of TPM and TIN further emphasize the role of digitalization in improving tax administration, although the negative coefficient of ETCC highlights the need for careful implementation and complementary capacity-building measures. Overall, the VAR analysis confirms the hypothesis that the adoption of ICT tools in Nigeria's tax administration contributes meaningfully to CIT revenue generation, with certain tools yielding more immediate and measurable benefits.

4.3.2 Test of Hypothesis Two

Table 4.8: Results of Model II and Test of Hypothesis II

Source: Researcher's Computation via STATA 13.0 * significant at 5% level

Variables	Symbol	Coefficient	Std. Err.	t-Statistics	P>(t)
Constant	_CONS	2.891068	.5665243	5.10	0.000
Personal Income Tax	PIT	.7426976	.0499557	14.87	0.000
TaxPro Max	TPM	0.724618	.062207	1.16	0.244
Taxpayer Identification Number	TIN	-.09308	.0551266	-1.69	0.091
Electronic Tax Payment	EPAY	.2357652	.0574931	4.10	0.000
Electronic Tax Clearance Certificate	ETCC	.0774433	.050772	1.53	0.127
Population Growth	POPG	-.0068897	.1116677	-0.06	0.951
Log Likelihood				39.08832	
RMSE				0.072173	
R-Squared				0.9877	
Chi2				2329.898	
P>Chi2				0.0000	

The results of the estimation with respect to hypothesis two are presented in Table 4.8. As observed, the constant term is positive and statistically significant (coef. = 2.8911, p = 0.000),

indicating a strong baseline level of PIT revenue independent of the explanatory variables. The coefficient for PIT itself is highly positive and statistically significant (coef. = 0.7427, p = 0.000), confirming the strong autoregressive behaviour of PIT, whereby past PIT generation strongly predicts current PIT outcomes. This is consistent with the behaviour of tax revenue series, which typically exhibit persistence due to economic activity cycles and compliance patterns.

Among the ICT adoption variables, Electronic Tax Payment (EPAY) shows a positive and highly significant relationship with PIT revenue (coef. = 0.2358, t = 4.10, p = 0.000). This indicates that the deployment and utilisation of electronic tax payment platforms have substantially enhanced PIT collection, likely through improved convenience, reduced leakages, and strengthened compliance monitoring. This finding aligns with the expectation that digital payment systems streamline tax administration and foster greater voluntary compliance.

TaxPro Max (TPM) also exhibits a positive coefficient (0.7246) but is statistically insignificant at the 5% level (p = 0.244), suggesting that while TPM may contribute to administrative efficiency, its effect on PIT generation during the study period was not strong enough to be conclusive. Similarly, the Electronic Tax Clearance Certificate (ETCC) shows a positive but statistically insignificant coefficient (0.0774, p = 0.127), indicating that the ETCC system may not yet have matured sufficiently to exert a measurable impact on PIT revenue.

In contrast, the Taxpayer Identification Number (TIN) variable has a negative coefficient (–0.0931) and is marginally significant at the 10% level (p = 0.091). This suggests that during the implementation period, the TIN system may have encountered transitional challenges that temporarily dampened PIT revenue generation, possibly due to the revalidation of taxpayer records or increased detection of previously non-compliant taxpayers who required additional time to regularize their filings. The control variable, Population Growth Rate (POPG), is

negative and entirely insignificant (coef. = –0.0069, p = 0.951), indicating that population dynamics did not exert a measurable influence on PIT revenue within the period studied.

The diagnostic indicators demonstrate an excellent overall model fit. The high R-squared value of 0.9877 suggests that approximately 98.8% of the variation in PIT revenue is explained by the independent variables. The model's chi-square statistic ($\chi^2 = 2329.898$, p = 0.000) confirms its overall statistical significance, while the low root mean square error (RMSE = 0.0722) indicates strong predictive accuracy.

Succinctly, the VAR results show that ICT adoption significantly influences Personal Income Tax revenue in Nigeria, with electronic tax payment demonstrating the most robust and positive impact. Other ICT tools such as TPM and ETCC show potential but statistically inconclusive effects, while the TIN system reflects transitional influence that may stabilize positively over a longer horizon. Overall, the findings support the conclusion that the digital transformation of Nigeria's tax administration plays an important role in strengthening PIT revenue generation.

4.3.3 Test of Hypothesis Three

Table 4.9: Results of Model III and Test of Hypothesis III

Source: Researcher's Computation via STATA 13.0 * significant at 5% level

Variables	***Symbol***	***Coefficient***	***Std. Err.***	***t-Statistics***	***P>(t)***
Constant	_CONS	12.64443	.9553505	13.24	0.000
Value Added Tax	VAT	.0922837	.0746596	1.24	0.216
TaxPro Max	TPM	.4255568	.1812451	2.35*	0.019
Taxpayer Identification Number	TIN	.1757658	.1453125	1.21	0.226
Electronic Tax Payment	EPAY	.4954995	.1379793	3.59*	0.000
Electronic Tax Clearance Certificate	ETCC	-2.401923	.1712063	-14.03*	0.000
Population Growth	POPG	-.0200523	.360871	-0.06	0.956
Log Likelihood				9.787223	
RMSE				0.198235	
R-Squared				0.9725	
Chi2				1026.65*	
P>Chi2				0.0000	

The Vector Autoregressive (VAR) estimation results presented in Table 4.9 provide evidence on the extent to which the adoption of ICT tools in Nigeria's tax administration influences Value Added Tax (VAT) generation. The model exhibits a strong overall fit, as indicated by an R-squared value of 0.9725, suggesting that approximately 97% of the variations in VAT are jointly explained by the independent variables alongside population growth rate. The model's robustness is further confirmed by a significant Chi-square statistic ($\chi^2 = 1026.65$, $p < 0.01$), while the RMSE of 0.198235 indicates good predictive accuracy.

The coefficient of TaxPro Max (TPM) is positive and statistically significant at the 5% level ($\beta = 0.4256$, $t = 2.35$, $p = 0.019$). This implies that the deployment of the TPM platform has contributed meaningfully to VAT generation, reinforcing the assertion that enhanced automation, streamlined filing processes, and improved taxpayer compliance mechanisms generate measurable efficiency gains in tax administration. Similarly, the implementation of Electronic Tax Payment (EPAY) shows a positive and highly significant relationship with VAT ($\beta = 0.4955$, $t = 3.59$, $p < 0.001$). This result suggests that the shift toward electronic payment channels has strengthened VAT collection by reducing leakages, enhancing transparency, and minimizing administrative bottlenecks associated with manual tax remittance.

Conversely, the coefficient of the Electronic Tax Clearance Certificate (ETCC) is negative and statistically significant ($\beta = -2.4019$, $t = -14.03$, $p < 0.001$). This indicates that the rollout of ETCC appears to exert an adverse influence on VAT within the estimated model. The negative sign may reflect implementation challenges, transitional disruptions, taxpayer resistance, enforcement gaps, or inconsistencies in certificate issuance procedures. It may also signal a temporary decline in compliance levels during the early adoption phase of ETCC reforms. These dynamics suggest that ETCC has not yet translated into improved VAT outcomes and may require policy refinement, capacity strengthening, or better system integration.

The adoption of Taxpayer Identification Number (TIN) exerts a positive but statistically insignificant effect on VAT ($\beta = 0.1758$, $t = 1.21$, $p = 0.226$), implying that although unique taxpayer identification enhances tax administration theoretically, its practical influence on VAT generation during the study period remains weak or slow to materialize. This may be attributed to incomplete taxpayer registration coverage, data harmonization issues, or limited enforcement of TIN-based compliance requirements. Additionally, the coefficient of VAT in the dynamic structure of the VAR model is positive but not significant ($\beta = 0.0923$, $p = 0.216$), suggesting a weak autoregressive effect of past VAT values on current VAT generation under the ICT-driven system.

The control variable, population growth rate (POPG), exhibits a negative and insignificant relationship with VAT ($\beta = –0.0201$, $p = 0.956$). This indicates that demographic expansion did not contribute meaningfully to VAT generation during the period, possibly due to structural economic constraints, high informality, or low productivity growth that limit the tax base expansion typically expected from population increases.

Overall, the VAR results provide support for the conclusion that the adoption of ICT tools has joint significant influence on VAT generation in Nigeria. This outcomes highlight the need for efficient implementation strategies, enhanced system integration, and sustained capacity building to fully harness the potential of ICT-driven tax reforms for improving VAT administration in Nigeria.

4.3.4 Test of Hypothesis Four

Table 4.10: Results of Model IV and Test of Hypothesis IV

Source: Researcher's Computation via STATA 13.0 * significant at 5% level

Variables	*Symbol*	*Coefficient*	*Std. Err.*	*t-Statistics*	*P>(t)*
Constant	_CONS	12.74138	.9665647	13.18	0.000
Tax Revenue	TAXREV	.0973415	.0751204	1.30	0.195
TaxPro Max	TPM	.348849	.1741891	2.00	0.045
Taxpayer Identification Number	TIN	.2322706	.1431803	1.62	0.105
Electronic Tax Payment	EPAY	.5341313	.1359149	3.93*	0.000
Electronic Tax Clearance Certificate	ETCC	-2.289776	.1651136	-13.87*	0.000
Population Growth	POPG	.0054847	.35257	0.02	0.988
Log Likelihood				10.33196	
RMSE				0.194546	
R-Squared				0.9701	
Chi2				942.2777*	
P>Chi2				0.0000	

The Vector Autoregressive (VAR) estimation for Hypothesis Four assesses how the adoption of ICT tools in Nigeria's tax administration influences federal tax revenue generation (TAXREV). The model exhibits a strong explanatory power, as shown by an R-squared value of 0.9701, indicating that approximately 97% of the variations in federal tax revenue are jointly accounted for by the ICT indicators and the control variable. The overall model significance is confirmed by the Chi-square statistic ($\chi^2 = 942.28$, $p < 0.01$), suggesting that the independent variable collectively exert a statistically meaningful influence on tax revenue generation. Furthermore, the RMSE of 0.194546 reflects a high degree of fit and predictive reliability.

The coefficient of TaxPro Max (TPM) is positive and statistically significant at the 5% level ($\beta = 0.3488$, $t = 2.00$, $p = 0.045$). This indicates that the introduction and use of TPM have contributed positively to federal tax revenue by improving automation, reducing human

interface in tax administration, and enhancing the efficiency of returns filing and payment processing. The implementation of Electronic Tax Payment (EPAY) also demonstrates a strong, positive, and highly significant influence on tax revenue ($\beta = 0.5341$, $t = 3.93$, $p < 0.001$). This result reinforces the argument that electronic payment channels have reduced revenue leakages, minimized fraud, improved revenue remittance timelines, and strengthened transparency in the tax collection system.

In contrast, the Electronic Tax Clearance Certificate (ETCC) variable shows a negative and statistically significant effect on federal tax revenue ($\beta = -2.2898$, $t = -13.87$, $p < 0.001$). This suggests that the implementation of ETCC, within the period under review, may have encountered operational challenges, transitional inefficiencies, or compliance disruptions that hindered its expected positive impact on revenue generation. The negative coefficient indicates that ETCC did not effectively support tax revenue enhancement during the study period, possibly due to issues such as system integration lapses, administrative bottlenecks, low taxpayer adaptability, or challenges in enforcing ETCC requirements.

The Taxpayer Identification Number (TIN) exhibits a positive but statistically insignificant effect on tax revenue ($\beta = 0.2323$, $t = 1.62$, $p = 0.105$). Although TIN theoretically strengthens taxpayer tracking and broadens the tax net, its practical contribution appears to be limited within the study window, likely due to incomplete taxpayer data integration, low enforcement of TIN-linked compliance, or persistent informal sector activities. The TAXREV autoregressive component is positive but not statistically significant ($\beta = 0.0973$, $p = 0.195$), indicating a weak persistence effect of past revenue levels on current revenue outcomes under the ICT-driven environment.

The control variable, population growth rate (POPG), shows a positive but statistically insignificant relationship with tax revenue ($\beta = 0.0055$, $p = 0.988$). This suggests that

population expansion did not translate into increased federal tax revenue, possibly due to structural unemployment, widespread informality, and relatively slow growth in taxable economic activities relative to demographic trends.

Overall, the VAR results for the test of hypothesis four offer support for the conclusion that ICT tools' adoption exert joint significant influence on federal tax revenue in Nigeria; thus, affirming the need for enhanced system optimization and strengthened enforcement mechanisms to fully leverage ICT tools for sustainable federal tax revenue.

4.3.5 Test of Hypothesis Five

The ARIMA intervention model was estimated to examine whether the adoption of ICT tools in tax administration from 2006 onward significantly improved federal tax revenue generation in Nigeria. The model incorporated an intervention (dummy) variable representing the policy change, coded as *0* for the pre-ICT period (1995–2005) and *1* for the post-ICT era (2006–2024). The dependent variable was the differenced log of tax revenue (*D.ltaxrev*), allowing the model to capture changes in the growth rate of revenue rather than absolute levels. Table 4.11 presents the results in this regard.

Table 4.11: Results of Model V and Test of Hypothesis V

Variable	Coefficient	OPG Std. Err.	t-Statistics	P>(t)
Tax Revenue				
Policy Change				
D1	.2444299	2.888635	0.08	0.933
Constant	-.0508471	.1984513	-0.26	0.798
ARMA				
ar				
L1.	.8385198	.4963639	1.69	0.091
Ma				
L1.	-.9999941			
/sigma	.4878005	.1097821	4.44	0.000
Log Likelihood			-20.96423	
Wald chi2(2)			2.91	
Prob>chi2			0.2336	

Source: Researcher's Computation via STATA 13.0 * significant at 1% level; ** at 5% level

As indicated in table 4.11, the overall model fit indicates that the ARIMA structure is appropriate, as shown by the significant sigma parameter, but the intervention effect itself is statistically insignificant. The constant term is statistically insignificant, with a coefficient of −0.0508 (p = 0.798). This indicates that, apart from the intervention policy, the underlying change in tax revenue growth does not show a statistically meaningful direction or trend when differenced. The insignificance of the constant suggests that the growth rate of tax revenue fluctuated without a stable baseline trend during the sample period.

The AR(1) term is positive (0.8385) and marginally significant at the 10% level (p = 0.091), implying that tax revenue growth exhibits some degree of persistence over time. This means that past changes in tax revenue moderately influence current changes. Such persistence is typical in macroeconomic fiscal variables, especially in developing economies where revenue patterns tend to follow administrative, economic, or structural cycles. The near-unit root MA(1) parameter (−0.9999) reflects model identification constraints and suggests the differencing was likely needed to stabilize the series.

The sigma parameter (σ = 0.4878) is statistically significant at the 1% level, indicating that the model has a meaningful error structure and that residual variations are well estimated. This strengthens the reliability of the ARIMA component even though the policy coefficient is insignificant.

The coefficient of the policy variable (policychange D1.) is 0.2444, which is positive, suggesting that ICT adoption may have been associated with a slight increase in tax revenue growth. However, the standard error is extremely large (2.8886), producing a z-value of 0.08 and a p-value of 0.933. This implies that the policy effect is not statistically significant, meaning the model cannot confirm that the adoption of ICT tools had a measurable impact on tax revenue growth. The wide 95% confidence interval (−5.41 to +5.91) further supports this

uncertainty, as it includes both large negative and large positive values. Therefore, based on this ARIMA intervention output, the data do not provide econometric evidence that ICT adoption significantly changed revenue generation in terms of growth within the studied period.

Overall, the results indicate that although ICT reforms were implemented in the Nigerian tax system, this particular model does not detect a statistically significant before-and-after effect on tax revenue growth. This does not necessarily mean ICT reforms were ineffective; rather, it suggests that other factors such as oil price volatility, structural bottlenecks, enforcement challenges, tax compliance behaviour, and macroeconomic instability may have overshadowed or diluted the measurable impact of ICT tools on the growth rate of tax revenue before and after the implementation of the various ICT tools adopted in tax administration in the country.

4.4 Discussion of Findings

The findings of this study provide comprehensive empirical evidence on the extent to which the adoption of ICT tools in Nigeria's tax administration influences revenue generation across key tax categories namely: Company Income Tax (CIT), Personal Income Tax (PIT), Value Added Tax (VAT), and aggregate tax revenue. Across the VAR models estimated, the results consistently show that ICT adoption exerts a statistically meaningful influence on tax administration efficiency and revenue generation, although the magnitude and direction of effects vary across specific ICT tools and tax types. These findings contribute to the growing body of literature demonstrating that ICT-based tax reforms enhance transparency, reduce leakages, strengthen compliance enforcement, and improve administrative efficiency within tax systems (Awasthi & Engelschalk, 2018; Okunogbe & Pouliquen, 2022).

4.4.1 Effect of ICT Tools on Company Income Tax Revenue

The findings relating to how Company Income Tax (CIT) revenue is influenced by the various ICT tools deployed in the administration of taxation in Nigeria reveal a differentiated pattern. The analysis shows that electronic tax payment (EPAY) exerts the strongest positive and statistically significant influence on CIT revenue generated throughout the study period. This underscores the central role of digital payment platforms in strengthening tax compliance and enhancing revenue generation. EPAY simplifies the payment process for corporate taxpayers by reducing transactional friction, eliminating the need for physical interaction with tax officials, and shortening processing time. These improvements align with existing evidence that digitised payment systems limit opportunities for rent-seeking, create robust electronic audit trails, and enhance transparency within the revenue collection process (Bird & Zolt, 2008; Luttmer & Singhal, 2014). The significant impact of EPAY therefore suggests that when payment channels are reliable, secure, and user-friendly, corporate taxpayers are more likely to comply voluntarily, leading to increased remittances.

Furthermore, TaxPro Max (TPM) and the Tax Identification Number (TIN) systems both show positive, though relatively marginal, effects on CIT revenue. These results indicate that the progressive incorporation of electronic filing, automated tax computation, return processing, and taxpayer registration has contributed to improvements in revenue administration. TPM, in particular, streamlines filing procedures, facilitates real-time data processing, and enhances taxpayer–administrator interaction. Similarly, the TIN system strengthens the accuracy and integrity of the taxpayer database, reduces duplication, and improves identification of corporate taxpayers. These findings are consistent with empirical evidence from other African countries. For instance, Asmah *et al.* (2025) document similar positive effects of e-filing and digital taxpayer management tools on corporate tax performance in Ghana, while Moore *et al.* (2018) also confirm that digital identification and automated filing systems enhance tax mobilisation in developing countries. The alignment with prior studies reinforces the argument that

digitisation of core tax functions beyond payment processes supports a more efficient and responsive tax administration system.

However, the results also indicate a significant negative effect of the Electronic Tax Clearance Certificate (ETCC) on Company Income Tax revenue. This counterintuitive outcome suggests that during the study period, the ETCC system may have faced implementation challenges that inhibited its effectiveness. Possible explanations include system integration problems, occasional downtimes, delays in certificate processing, or taxpayer difficulties in navigating the digital interface. Additionally, as with many digital transformation initiatives in developing economies, transitional frictions may arise when legacy systems coexist with new digital platforms. Similar dynamics have been observed in Ethiopia and other emerging economies, where Mascagni, Mengistu, and Woldeyes (2021) report that early phases of e-tax reforms through ICT deployment often produce mixed short-term outcomes due to adjustment costs, capacity constraints, and uneven adoption across taxpayer segments. In the Nigerian context, the negative effect of ETCC may reflect these transitional inefficiencies, signalling the need for improved system harmonisation, enhanced taxpayer support services, and capacity strengthening within the revenue authority.

Overall, this result suggests that while ICT tools are generally beneficial to tax administration, their effectiveness depends on the maturity of implementation, system reliability, and the ability of both taxpayers and administrators to adapt. The findings therefore highlight EPAY as a transformative component of the digital tax ecosystem, while TPM and TIN show promise but require continuous optimisation. The negative performance of ETCC underscores the importance of sustained investment in system integration, user experience design, and administrative capacity to ensure that digital reforms translate into measurable revenue gains.

4.4.2 Effect of ICT Tools on Federal Personal Income Tax Revenue

The results of the analysis for Federal Personal Income Tax (PIT) revenue demonstrate that electronic tax payment (EPAY) remains a strong and significant positive predictor of PIT generation in Nigeria. This finding underscores the central importance of digital payment platforms in reducing compliance costs for individual taxpayers while simultaneously promoting voluntary compliance with enhanced level of transparency amidst reduction in transaction costs traditionally associated with tax payment. This outcome aligns with earlier studies, such as Obert et.al. (2018); and Castro and Scartascini (2015), which emphasize that when taxpayers perceive the cost and inconvenience of complying as low, the likelihood of remittance increases substantially. Consequently, the strong association between EPAY and PIT suggests that sustained adoption and improvement of digital payment infrastructures can substantially enhance compliance behaviour among individuals, particularly in contexts where administrative bottlenecks previously discouraged consistent filing and payment.

In contrast, the results show that the Taxpayer Identification Number (TIN) exerts a marginally negative, though weakly significant, effect on PIT revenue. While this finding may initially appear counterintuitive, it is consistent with documented evidence from other developing countries implementing large-scale taxpayer database reforms. D'Arcy (2011) notes that during the initial transition to unique taxpayer identification systems, several administrative and operational challenges emerge. These include the harmonisation of previously fragmented taxpayer records, identification of duplicate or inactive accounts, and cleansing of inflated taxpayer rolls. As these verification exercises take place, short-term revenue generation may temporarily decline because the system exposes previously unreported non-compliance and eliminates dormant taxpayers who had artificially inflated the tax base. In the Nigerian context, the introduction and expansion of the TIN system likely triggered similar disruptions. The short-term negative effect on PIT revenue thus reflects the adjustment period required before the long-term benefits of improved taxpayer identification can fully materialise.

The analysis further reveals that TaxPro Max (TPM) and electronic Tax Clearance Certificate (ETCC) both exert positive but statistically insignificant effects on PIT revenue. This suggests that while these tools may contribute to the administrative strengthening of PIT processes, their measurable impact on revenue is not yet substantial within the study period. Several explanations are plausible. First, PIT collection in Nigeria, particularly at the federal level, relies heavily on the Pay-As-You-Earn (PAYE) system administered through employers and state internal revenue services. As such, federal digital tools like TPM and ETCC may have a more limited direct influence on individual-level compliance compared to their influence on corporate taxpayers. Second, the implementation of TPM and ETCC may still be in their developmental phases with regard to personal income taxpayers. Adoption by individuals tends to lag behind that of corporate entities because individuals generally have less administrative capacity, lower digital literacy, or reduced incentives to adopt new tax technologies. Third, the effectiveness of these tools in improving PIT revenue may require stronger monitoring and enforcement mechanisms, improved taxpayer education, and greater system integration between federal and state tax authorities.

Overall, the findings suggest that while EPAY has proven to be a transformative tool in promoting PIT compliance, the benefits of TPM, TIN, and ETCC for PIT collection are still evolving. The mixed results highlight the importance of addressing implementation challenges, strengthening taxpayer sensitisation programmes, and enhancing interoperability between different components of the national digital tax ecosystem. For Nigeria to achieve substantial and sustained improvements in Federal PIT generation, ICT tools must be supported by robust institutional frameworks, effective enforcement strategies, and continuous capacity development for both taxpayers and tax administrators.

4.4.3 Effect of ICT Tools on VAT Revenue

The Vector Autoregressive (VAR) estimation results for Value Added Tax (VAT) revenue reveal that TaxPro Max (TPM) and electronic tax payment (EPAY) exert strong and statistically significant positive effects on VAT revenue in Nigeria. This indicates that the integration of digital automation into VAT revenue generation processes, particularly through TPM, enhances the efficiency and transparency of VAT administration by streamlining filing procedures, improving audit capacity, and enabling the real-time reconciliation of transactions.

Similarly, the EPAY system facilitates swift and secure payment of VAT liabilities, reducing administrative delays and eliminating manual bottlenecks that often create opportunities for evasion or under-remittance. These findings are consistent with global empirical evidence showing that the deployment of electronic filing and payment platforms is strongly associated with improved VAT outcomes (Buljan, 2019; de Paula & Scheinkman, 2010). Studies from other emerging economies, such as Brazil, South Africa, and Rwanda, reinforce this view by demonstrating that digital VAT systems reduce compliance costs, minimise discretion in tax administration, and increase the traceability of consumption tax transactions. Hence, the positive and significant coefficients on TPM and EPAY suggest that Nigeria's transition to a technology-driven VAT system is contributing meaningfully to improved accuracy, efficiency, and enforcement of VAT obligations.

In contrast, the results indicate that the electronic Tax Clearance Certificate (ETCC) exhibits a negative and statistically significant effect on VAT revenue. This pattern, though undesirable, is not uncommon in the early phases of digital tax reforms in developing economies. Empirical evidence from Moore, Prichard, and Fjeldstad (2018) highlights that newly introduced e-clearance systems often encounter operational challenges such as system downtimes, inadequate taxpayer awareness, delays in integration with existing administrative platforms, and inconsistencies in data validation procedures. Such transitional frictions can temporarily

compromise revenue generation by increasing taxpayer frustration, encouraging non-compliance, or creating gaps in administrative enforcement. In the Nigerian context, the negative coefficient on ETCC may reflect similar implementation weaknesses, such as limited interoperability between ETCC and VAT reporting systems, insufficient digital literacy among taxpayers, or resistance from intermediaries affected by reduced opportunities for manual processing. These short-term challenges are typical as tax authorities move towards full automation but are expected to diminish as systems mature and administrative capacity strengthens.

Furthermore, the Taxpayer Identification Number (TIN) shows an insignificant effect on VAT revenue, suggesting that the potential benefits of taxpayer identification reforms have not yet translated into measurable improvements in VAT collections. This finding is consistent with observations in the tax literature that challenges in linking TIN registration to actual VAT compliance are more pronounced in economies characterized by large informal sectors (Joshi, Prichard, & Heady, 2013). In Nigeria, a substantial proportion of retail and service-based VAT activities occur in informal or semi-formal sectors where businesses may not be properly registered or monitored through the TIN system. This limits the administrative ability to track VAT-liable transactions and enforce compliance effectively. Additionally, many micro and small enterprises subject to VAT thresholds lack adequate incentives or capacity to register for TIN, further weakening the effectiveness of identification systems in the VAT domain. The insignificant effect of TIN therefore reflects structural constraints within the broader tax ecosystem, including limited enforcement coverage, inadequate taxpayer education, and weak linkage between registration databases and actual economic activities.

Overall, the results point to a differentiated impact of ICT tools on VAT revenue generation. While TPM and EPAY clearly demonstrate strong positive effects, reinforcing the value of

digital automation and electronic payments, the negative effect of ETCC and the insignificant effect of TIN highlight the need for improved system integration, stronger enforcement mechanisms, and targeted interventions aimed at the informal sector. Strengthening administrative capacity, enhancing interoperability across digital platforms, and improving compliance monitoring are essential for maximizing the long-term benefits of ICT-driven VAT reforms in Nigeria.

4.4.4 Effect of ICT Tools on Aggregate Tax Revenue

The results of the Vector Autoregressive (VAR) analysis for aggregate tax revenue (TAXREV) reveal a pattern that closely aligns with the behaviour observed in the disaggregated tax components (Company Income Tax, Federal Personal Income Tax, and Value Added Tax). Notably, electronic tax payment (EPAY) and TaxPro Max (TPM) emerge as the most influential and consistently positive predictors of overall revenue generation. Their strong statistical significance underscores their centrality as core ICT-driven innovations that have strengthened Nigeria's tax administration framework. EPAY, in particular, enhances the reliability and transparency of the revenue collection process by minimising manual handling of funds, reducing leakages, and ensuring prompt remittances. TPM, on the other hand, integrates critical administrative functions such as automated assessment, e-filing, real-time revenue tracking, and taxpayer service delivery. Together, these tools enhance efficiency, standardise reporting processes, and improve data management; thus, leading to measurable improvements in aggregate tax revenue.

These findings are consistent with global and regional evidence underlining the transformative impact of digitalisation on public revenue systems. Studies such as Gaspar et.al. (2016), and Nose et.al. (2025), have highlighted that the adoption of advanced electronic payment systems and integrated tax administration platforms significantly increases tax capacity, reduces

compliance burdens, and fosters voluntary compliance. The Nigerian context, as revealed by this study, appears to affirm these broader global trends.

However, the VAR results also indicate that the electronic Tax Clearance Certificate (ETCC) continues to exhibit a persistent and statistically significant negative effect on aggregate tax revenue. This trend, observed consistently across all models in the study, suggests that the introduction of the e-TCC system may have encountered significant operational and institutional bottlenecks during the study period. Poor system integration, inadequate taxpayer sensitisation, limited interoperability between ETCC and other digital tax platforms, and transitional administrative challenges may have collectively undermined the efficiency of the system. These findings are consistent with the experiences of several low- and middle-income countries documented in the literature. Okunogbe and Sontoro (2023), for example, report that initial attempts at implementing digital tax reforms often experience short-term declines in administrative effectiveness due to coordination failures, technology adoption lags, and resistance from both taxpayers and frontline administrators. In this context, the negative coefficient for ETCC may reflect the early-phase learning curve and adjustment costs associated with digital transformation in Nigeria's tax sector.

Additionally, the analysis shows that the population growth rate (POPG) remains insignificant across all model specifications, implying that demographic expansion did not lead to corresponding increases in taxable activities or federal revenue mobilisation. This disconnect may be attributable to structural economic factors such as high rates of unemployment, low levels of formal sector participation, and pervasive informality, which limit the taxable capacity of the expanding population. Similar findings have been reported in previous empirical studies on Nigeria and other Sub-Saharan African economies. Bati (2025) observed that population growth in the region often outpaces economic productivity, resulting in limited contributions

to the tax base. The insignificant effect of population growth in the present study therefore underscores the structural disconnect between demographic change and economic formalisation within Nigeria's tax system.

Overall, the findings illustrate a nuanced but compelling narrative: while advanced ICT tools such as EPAY and TPM are significantly enhancing federal tax revenue generation, challenges in the implementation of ETCC and broader structural constraints continue to moderate the full potential of ICT-driven reforms. Strengthening system integration, deepening administrative capacity, and addressing structural economic barriers are therefore essential for translating digital reforms into sustained long-term gains in Nigeria's fiscal performance.

4.4.5 Pre- and Post-ICT Adoption Differences in Tax Revenue Growth

The ARIMA intervention analysis offers critical insights into whether the introduction of ICT tools in Nigeria's tax administration produced a statistically meaningful shift in tax revenue growth over time. By comparing the pre-ICT period (1995–2005) with the post-ICT adoption period (2006–2024), the model assesses whether digital reforms generated a structural break in the revenue growth trend. Although the intervention coefficient was positive; suggesting some improvement in revenue levels following ICT implementation, the association was not statistically significant at the 0.05 significance level. This outcome indicates that while ICT tools may have enhanced administrative processes, they did not independently account for, or significantly alter the long-run trajectory of tax revenue growth within the study period.

This finding underscores the complex and multifaceted nature of tax revenue generation in resource-dependent economies such as Nigeria. Because Nigeria's fiscal landscape is strongly shaped by oil revenue cycles, sharp fluctuations in global oil prices frequently overshadow the effects of improvements in tax administration. Periods of oil boom tend to inflate overall government revenues, thereby diluting the measurable influence of ICT-driven tax reforms;

whereas, periods of oil price collapse often precipitate fiscal constraints, recessionary pressures, and revenue volatility that ICT alone cannot offset. The analysis, therefore, supports the argument advanced by Adeusi et al. (2020), Owamagbe (2025), and Lawa *et al.* (2025), who maintain that structural factors, rather than administrative improvements alone, remain the dominant drivers of Nigeria's tax revenue generation.

Similarly, evidence from other developing economies reinforces this interpretation. Prichard (2015) and Moore *et al*. (2018) note that digital reforms, though effective in improving procedural efficiency and reducing corruption, do not automatically translate into sustainable long-term revenue growth when broader structural conditions such as high informality, weak enforcement mechanisms, macroeconomic instability, and institutional weaknesses remain unresolved. In many low- and middle-income countries, ICT adoption tends to deliver short- to medium-term administrative gains but falls short of yielding long-term macro-fiscal improvements unless accompanied by deeper institutional reform.

Despite the absence of a statistically significant long-term growth effect, the findings from this study confirm that ICT adoption has nonetheless produced meaningful and measurable improvements in Nigeria's tax administration. Electronic payment systems (EPAY) and the TaxPro Max (TPM) platform consistently emerge as strong positive contributors to compliance enhancement, revenue remittance accuracy, and administrative transparency. These systems reduce the scope for discretion and leakages, streamline processes, and improve tax data integrity. Their consistent significance across different models suggests that they are central pillars of Nigeria's contemporary digital tax reform architecture.

However, the persistent negative impacts associated with the electronic Tax Clearance Certificate (ETCC) and the lack of a significant structural change in long-term revenue growth expose several challenges that continue to hinder the full realisation of ICT benefits. These

include weak institutional capacity, inadequate taxpayer sensitisation, fragmentation across tax databases, limited interoperability, infrastructure constraints, and inconsistent political support for digital reforms. Without addressing these systemic issues, the fiscal returns from ICT-driven reforms are likely to remain constrained.

Overall, the results align with global evidence emphasising that ICT adoption is necessary but not sufficient for achieving lasting improvements in revenue generation. As argued by Maiti and Khari (2025), Bassey et.al. (2022) and Bird and Zolt (2008), digitalisation must be embedded within a broader reform ecosystem that includes strengthened governance structures, enhanced enforcement frameworks, improved taxpayer education, harmonised data architecture, and macroeconomic stability. Only through such an integrated, multi-dimensional approach can ICT-driven reforms translate into durable and sustained growth in tax revenue in Nigeria.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.0 Introduction

This chapter presents the summary of the study's findings, conclusion, recommendations, contributions to knowledge, and implications for further studies. It draws directly from the hypotheses tested in Chapter Four and is aligned with the objectives of the study on the effect of ICT tools adoption on federal tax revenue generation in Nigeria.

5.1 Summary of Findings

The findings from this study are summarized below;

i. The adoption of ICT tools in Nigeria's tax administration significantly influence Company Income Tax revenue.
ii. The adoption of ICT tools in Nigeria's tax administration significantly affects Federal Personal Income Tax revenue.
iii. The adoption of ICT tools in Nigeria's tax administration exerts significant effect on Value Added tax revenue
iv. The adoption of ICT tools in Nigeria's tax administration has significant joint influence on tax revenue generation.
v. Tax revenue growth does not exhibit persistence before and after the adoption of ICT tools in Nigeria's tax administration.

5.2 Conclusion

This study established that ICT tools adoption (TaxPro Max, TIN, electronic tax payments, and e-TCC) significantly and positively influences federal tax revenue generation in Nigeria; although the growth rate of the cumulative revenue generated by the federal government through tax did not exhibit persistence before and after the adoption of ICT tools in the country.

The outcome of the analyses confirmed that the deployment of TaxPro Max strengthened accountability and minimized revenue leakages the issuance of TIN reduced evasion and widened taxpayer coverage; electronic tax payment systems improved efficiency in revenue remittance; while e-TCC enhanced compliance and transparency in tax administration. Taken together, these outcomes demonstrate that ICT adoption has transformed federal tax administration and contributed meaningfully to fiscal sustainability in Nigeria. Despite these findings, the ARIMA intervention analysis shows no statistically significant difference between the pre-ICT (1995–2005) and post-ICT (2006–2024) periods in terms of tax revenue growth. This implies that the adoption of ICT alone does not adequately explain changes in Nigeria's tax revenue generation over the study period.

In line with these, it is therefore conclusive that while we argue that ICT tools adoption is a critical driver of improved revenue generation and fiscal capacity in Nigeria, its continued implementation remains vital for sustaining non-oil revenue generation. Importantly, the study's outcome also suggests that despite the importance of ICT tools in driving improvements in tax revenue generation, other factors such as oil price volatility, structural bottlenecks, enforcement challenges, tax compliance behaviour, and macroeconomic instability may possibly overshadow or dilute the measurable impact of ICT tools on the growth rate of tax revenue before and after the implementation of the various ICT tools adopted in tax administration in the country.

5.3 Recommendations

This study there recommends as follows:

i. The Federal Inland Revenue Service (FIRS) should further deepen the integration of ICT platforms such as TaxPro Max and electronic payment systems into corporate tax

administration. Expanding the use of automated audits and real-time monitoring mechanisms will help minimize revenue leakages, enhance reporting accuracy, and improve the efficiency of company income tax remittances.

ii. The government should strengthen the enforcement of the Tax Identification Number (TIN) system by expanding digital taxpayer registration and intensifying ICT-based compliance awareness campaigns. This will improve coverage of the informal sector and enhance personal income tax compliance through simplified and user-friendly online filing platforms.

iii. FIRS should scale up the adoption of digital invoicing, electronic receipt verification, and automated VAT reconciliation systems. These measures will reduce under-reporting, close compliance gaps, and enhance the accuracy and transparency of value-added tax collection at points of sale.

iv. A comprehensive national tax digitalization strategy should be institutionalized to harmonize ICT tools across federal and state tax authorities. Such a framework would ensure interoperability of tax databases, facilitate information sharing, and promote a unified, technology-driven tax administration system capable of maximizing revenue generation.

v. The government should complement ICT-driven tax reforms with broader institutional and macroeconomic measures, including strengthening enforcement mechanisms, improving governance structures, addressing structural inefficiencies, and promoting macroeconomic stability. These measures are necessary to ensure that ICT adoption translates into sustained and long-term improvements in tax revenue performance.

5.4 Contributions to Knowledge

This study has therefore made the following contributions to knowledge;

i. The study provides empirical evidence that the integration of ICT platforms particularly TaxPro Max and electronic payment systems significantly improves corporate tax administration in Nigeria. By focusing specifically on company income tax (CIT), the study extends existing literature by demonstrating sector-specific revenue gains arising from digital tax reforms within a developing economy context.

ii. The findings confirm that, within Nigeria's tax administration system, ICT-driven mechanisms such as the Tax Identification Number (TIN) and online filing platforms directly enhance personal income tax (PIT) revenue generation. This contribution highlights the critical role of digital taxpayer identification and onboarding in improving individual-level tax compliance.

iii. The study advances knowledge by empirically demonstrating that ICT-enabled VAT administration processes including electronic invoicing and automated reconciliation significantly improve value-added tax (VAT) collection efficiency. This provides new evidence on the effectiveness of digital tools in strengthening consumption tax revenue in emerging economies.

iv. By employing Vector Autoregression (VAR) analysis, the research contributes to the fiscal digitalization literature by showing that the combined adoption of multiple ICT systems produces synergistic effects on national tax revenue. This finding affirms that integrated digital tax ecosystems yield greater revenue outcomes than isolated technological interventions.

v. The study makes a novel methodological contribution through the application of ARIMA intervention analysis, revealing that ICT adoption alone does not automatically ensure sustained long-term tax revenue growth. The findings demonstrate that macroeconomic instability, structural constraints, and taxpayer compliance behavior can moderate or overshadow the long-run revenue impacts of digital tax reforms.

5.5 Implications for Further Studies

Given the limitations of this study pointed out in chapter one, future studies should consider;

i. Expanding the scope to cover state-level internally generated revenue (IGR) and comparative analysis across geopolitical zones.

ii. Employing longitudinal panel data beyond 2024 to capture the sustained impact of ICT adoption reforms across countries in Sub-Saharan Africa.

iii. Investigating the interaction effects between ICT adoption and macroeconomic variables (GDP growth, inflation, and exchange rates) on revenue generation.

iv. Conducting qualitative studies on taxpayers' behavioural responses to ICT-based tax platforms, particularly within the informal sector.

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APPENDICES

Appendix I:

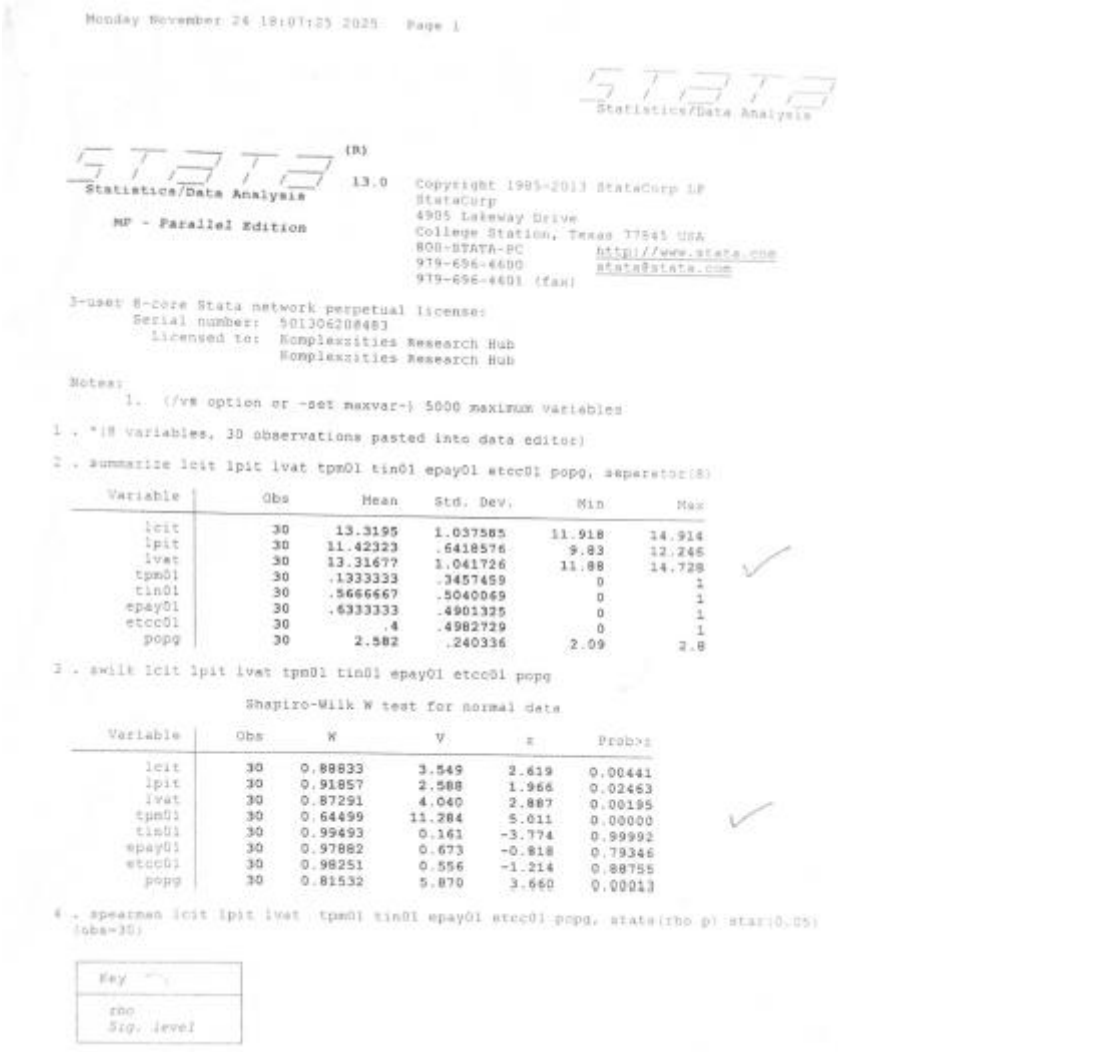
Data on Tax Revenue Generation and ICT Adoption in Nigeria (1995–2024)

Year	LCIT	LPIT	LVAT	LTaxRev	TPM (0/1)	TIN (0/1)	EPAY (0/1)	ETCC (0/1)	POPG (%)	policy	post trend
1995	13.340	9.830	13.317	13.630	0	0	0	0	2.64	0	0
1996	13.342	10.333	13.491	13.724	0	0	0	0	2.61	0	0
1997	13.415	10.494	13.531	13.778	0	0	0	0	2.6	0	0
1998	13.522	10.475	13.567	13.847	0	0	0	0	2.61	0	0
1999	13.665	10.568	13.673	13.970	0	0	0	0	2.61	0	0
2000	13.709	10.656	13.767	14.040	0	0	0	0	2.67	0	0
2001	13.837	10.840	13.963	14.206	0	0	0	0	2.72	0	0
2002	13.950	11.000	14.036	14.296	0	0	0	0	2.74	0	0
2003	14.060	11.143	14.135	14.400	0	0	0	0	2.76	0	0
2004	14.114	11.184	14.197	14.459	0	0	0	0	2.77	0	0
2005	14.147	11.147	14.251	14.503	0	0	0	0	2.77	0	0
2006	14.389	11.389	14.346	14.669	0	0	1	0	2.76	1	1
2007	14.440	11.564	14.462	14.752	0	0	1	0	2.77	1	1
2008	14.513	11.591	14.584	14.852	0	1	1	0	2.78	1	1
2009	14.522	11.593	14.604	14.866	0	1	1	0	2.78	1	1
2010	14.779	11.626	14.683	15.034	0	1	1	0	2.79	1	1
2011	14.845	11.642	14.413	14.982	0	1	1	0	2.8	1	1
2012	14.914	11.709	14.728	15.132	0	1	1	0	2.8	1	1
2013	12.013	11.821	11.954	12.414	0	1	1	1	2.77	1	1
2014	12.067	11.837	11.984	12.450	0	1	1	1	2.71	1	1
2015	12.014	11.809	11.880	12.387	0	1	1	1	2.64	1	1
2016	11.918	11.832	11.891	12.359	0	1	1	1	2.54	1	1
2017	12.081	11.917	11.988	12.478	0	1	1	1	2.47	1	1
2018	12.154	11.963	12.045	12.538	0	1	1	1	2.43	1	1
2019	12.217	11.994	12.075	12.582	0	1	1	1	2.31	1	1
2020	12.150	12.047	12.185	12.608	0	1	1	1	2.19	1	1
2021	12.229	12.096	12.316	12.700	1	1	1	1	2.13	1	1
2022	12.319	12.152	12.400	12.779	1	1	1	1	2.1	1	1
2023	12.382	12.199	12.561	12.882	1	1	1	1	2.09	1	1
2024	12.538	12.246	12.476	12.914	1	1	1	1	2.1	1	1

Source: FIRS, NBS, CBN Statistical Bulletin, World Bank reports, IMF-Nigeria, Federal Office of Statistics' bulletins (Annual Abstract of Statistics), reports, publications and websites and Researcher's Compilation.

Appendix II:

Detailed Regression Output From Stata



```
Monday November 24 18:07:25 2025   Page 1

  ___  ____  ____  ____  ____ (R)
 /__    /   ____/   /   ____/
___/   /   /___/   /   /___/   13.0   Copyright 1985-2013 StataCorp LP
  Statistics/Data Analysis            StataCorp
                                      4905 Lakeway Drive
      MP - Parallel Edition           College Station, Texas 77845 USA
                                      800-STATA-PC        http://www.stata.com
                                      979-696-4600        stata@stata.com
                                      979-696-4601 (fax)

3-user 8-core Stata network perpetual license:
       Serial number:  501306208483
         Licensed to:  Complexities Research Hub
                       Complexities Research Hub

Notes:
      1.  (/v# option or -set maxvar-) 5000 maximum variables

1 . *(8 variables, 30 observations pasted into data editor)

2 . summarize lcit lpit lvat tpm01 tin01 epay01 etcc01 popg, separator(8)

    Variable |        Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
        lcit |         30     13.3195    1.037585     11.918     14.914
        lpit |         30    11.42323    .6418576       9.83     12.245
        lvat |         30    13.31677    1.041726      11.88     14.728
       tpm01 |         30    .1333333    .3457459          0          1
       tin01 |         30    .5666667    .5040069          0          1
      epay01 |         30    .6333333    .4901325          0          1
      etcc01 |         30          .4    .4982729          0          1
        popg |         30       2.582    .240336       2.09       2.8

3 . swilk lcit lpit lvat tpm01 tin01 epay01 etcc01 popg

                    Shapiro-Wilk W test for normal data

    Variable |   Obs        W           V           z       Prob>z
-------------+--------------------------------------------------
        lcit |    30    0.88833      3.549       2.619    0.00441
        lpit |    30    0.91857      2.588       1.966    0.02463
        lvat |    30    0.87291      4.040       2.887    0.00195
       tpm01 |    30    0.64499     11.284       5.011    0.00000
       tin01 |    30    0.99493      0.161      -3.774    0.99992
      epay01 |    30    0.97882      0.673      -0.818    0.79346
      etcc01 |    30    0.98251      0.556      -1.214    0.88755
        popg |    30    0.81532      5.870       3.660    0.00013

4 . spearman lcit lpit lvat tpm01 tin01 epay01 etcc01 popg, stats(rho p) star(0.05)
(obs=30)

+-----------+
| Key       |
|-----------|
|    rho    |
| Sig. level|
+-----------+

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             |     lcit      lpit      lvat     tpm01     tin01     epay01     etcc01      popg
-------------+------------------------------------------------------------------------------
        lcit |   1.0000
             |
             |
        lpit |  -0.4456*  1.0000
             |   0.0136
             |
        lvat |   0.9924* -0.4478*  1.0000
             |   0.0000   0.0131
             |
       tpm01 |  -0.2266   0.5891* -0.2266   1.0000
             |   0.2286   0.0006   0.2286
             |
       tin01 |  -0.3536   0.8588* -0.3614*  0.3430   1.0000
             |   0.0552   0.0000   0.0497   0.0635
             |
      epay01 |  -0.2198   0.8351* -0.2198   0.2984   0.8701*  1.0000
             |   0.2432   0.0000   0.2432   0.1092   0.0000
             |
      etcc01 |  -0.8490*  0.8490* -0.8490*  0.4804*  0.7140*  0.6213*  1.0000
             |   0.0000   0.0000   0.0000   0.0072   0.0000   0.0002
             |
        popg |   0.7304* -0.4272*  0.7239* -0.5904* -0.1830  -0.0841  -0.6775*  1.0000
             |   0.0000   0.0186   0.0000   0.0006   0.3330   0.6586   0.0000
```

```
. dfuller lcit, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -1.328             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6163

. dfuller lpit, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -3.881             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0022

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. dfuller lvat, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -1.247             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6529

. dfuller tpm01, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -0.334             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.9205

. dfuller tin01, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -1.114             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7094

. dfuller epay01, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -1.295             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.6317

. dfuller etcc01, lags(0)

Dickey-Fuller test for unit root                    Number of obs   =        29

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)           -0.776             -3.723              -2.989             -2.625
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.8260
```

. dfuller popg, lags(0)

Dickey-Fuller test for unit root — Number of obs = 29

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	1.696	-3.723	-2.989	-2.625

MacKinnon approximate p-value for Z(t) = 0.9981

```
. wntestb lcit, table

Cumulative periodogram white-noise test
---------------------------------------
 Bartlett's (B) statistic  =     2.7646
 Prob > B                  =     0.0000

. wntestb lpit, table

Cumulative periodogram white-noise test
---------------------------------------
 Bartlett's (B) statistic  =     2.3184
 Prob > B                  =     0.0000

. wntestb lvat, table

Cumulative periodogram white-noise test
---------------------------------------
 Bartlett's (B) statistic  =     2.8840
 Prob > B                  =     0.0000
```

```
. wntestb tpm01, table

Cumulative periodogram white-noise test
---------------------------------------
Bartlett's (B) statistic  =     2.2693
Prob > B                  =     0.0001

. wntestb tin01, table

Cumulative periodogram white-noise test
---------------------------------------
Bartlett's (B) statistic  =     2.8889
Prob > B                  =     0.0000

. wntestb epay01, table

Cumulative periodogram white-noise test
---------------------------------------
Bartlett's (B) statistic  =     2.8632
Prob > B                  =     0.0000

. wntestb etcc01, table

Cumulative periodogram white-noise test
---------------------------------------
Bartlett's (B) statistic  =     2.8287
Prob > B                  =     0.0000

. wntestb popg, table

Cumulative periodogram white-noise test
---------------------------------------
Bartlett's (B) statistic  =     3.0237
Prob > B                  =     0.0000

. wntestq lcit

Portmanteau test for white noise
--------------------------------
Portmanteau (Q) statistic =    88.4864
Prob > chi2(13)           =     0.0000

. wntestq lpit

Portmanteau test for white noise
--------------------------------
Portmanteau (Q) statistic =    88.2014
Prob > chi2(13)           =     0.0000

. wntestq lvat

Portmanteau test for white noise
--------------------------------
Portmanteau (Q) statistic =    95.0491
Prob > chi2(13)           =     0.0000

. wntestq tpm01

Portmanteau test for white noise
--------------------------------
Portmanteau (Q) statistic =    29.5907
Prob > chi2(13)           =     0.0054
```

```
. wntestq tin01

Portmanteau test for white noise
---------------------------------------
Portmanteau (Q) statistic =   108.2522
Prob > chi2(13)           =     0.0000

. wntestq epay01

Portmanteau test for white noise
---------------------------------------
Portmanteau (Q) statistic =    98.8386
Prob > chi2(13)           =     0.0000

. wntestq etcc01

Portmanteau test for white noise
---------------------------------------
Portmanteau (Q) statistic =   104.6715
Prob > chi2(13)           =     0.0000

. wntestq popg

Portmanteau test for white noise
---------------------------------------
Portmanteau (Q) statistic =    92.2933
Prob > chi2(13)           =     0.0000
```

```
. var lcit, lags(1/1) exog(tpm01 tin01 epay01 etcc01 popg)

Vector autoregression

Sample:  1996 - 2024                    No. of obs      =         29
Log likelihood =    8.443               AIC             =  -.5995172
FPE            =   .0535213             HQIC            =  -.0038462
Det(Sigma_ml)  =   .0327074             SBIC            =   .2305197

Equation           Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
lcit                   7     .20764   0.9696   925.5371   0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lcit         |
        lcit |
         L1. |   .0861718   .0750327     1.15   0.251    -.0608896    .2332332
             |
        tpm01 |   .3335322   .1823204     1.83   0.067    -.0238092    .6908737
        tin01 |   .2679116   .1530261     1.75   0.080    -.0320141    .5678372
       epay01 |   .5831376   .1448926     4.02   0.000     .2991533     .867122
       etcc01 |  -2.427313   .1745308   -13.91   0.000    -2.769387   -2.085239
         popg |   .0749379   .3741065     0.20   0.841    -.6582974    .8081731
        _cons |   12.39466   .9854888    12.58   0.000     10.46314    14.32618
------------------------------------------------------------------------------
```

```
. var lpit, lags(1/1) exog(tpm01 tin01 epay01 etcc01 popg)

Vector autoregression

Sample:  1996 - 2024                            No. of obs      =         29
Log likelihood =  39.08832                      AIC             =  -2.212987
FPE            =  .0064663                      HQIC            =  -2.109624
Det(Sigma_ml)  =  .0039516                      SBIC            =  -1.88295

Equation              Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
lpit                      7   .072173   0.9877   2329.898   0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lpit         |
        lpit |
         L1. |   .7426976   .0499557    14.87   0.000     .6447862    .8406091
             |
       tpm01 |   .0724618    .062207     1.16   0.244    -.0494617    .1943854
       tin01 |   -.09308    .0551266    -1.69   0.091    -.2011262    .0149662
      epay01 |   .2357652   .0574931     4.10   0.000     .1230809    .3484496
      etcc01 |   .0774433    .050772     1.53   0.127    -.0220868    .1769546
        popg |  -.0068897   .1116677    -0.06   0.951    -.2257543    .2119749
       _cons |   2.891068   .5665243     5.10   0.000     1.780701    4.001435
------------------------------------------------------------------------------
```

```
. var lvat, lags(1/1) exog(tpm01 tin01 epay01 etcc01 popg)

Vector autoregression

Sample:  1996 - 2024                            No. of obs      =         29
Log likelihood =  9.787223                      AIC             =  -.1922223
FPE            =  .0487826                      HQIC            =  -.0888588
Det(Sigma_ml)  =  .0298116                      SBIC            =   .1378146

Equation              Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
lvat                      7   .198235   0.9725   1026.65   0.0000

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
lvat         |
        lvat |
         L1. |   .0922837   .0746596     1.24   0.216    -.0540465    .2386139
             |
       tpm01 |   .4255568   .1812451     2.35   0.019     .0703229    .7807906
       tin01 |   .1757658   .1453125     1.21   0.226    -.1090414     .460573
      epay01 |   .4954995   .1379793     3.59   0.000     .2250651     .765934
      etcc01 |  -2.401923   .1712063   -14.03   0.000    -2.737481   -2.066364
        popg |  -.0200523   .3608714    -0.06   0.956    -.7273464    .6872419
       _cons |   12.64443   .9553505    13.24   0.000     10.77197    14.51688
------------------------------------------------------------------------------
```

ARIMA regression

Sample: 1996 - 2024 | Number of obs = 29
Wald chi2(2) = 2.91
Log likelihood = -20.96423 | Prob > chi2 = 0.2336

D.ltaxrev	Coef.	OPG Std. Err.	z	P>|z|	[95% Conf.	Interval]
ltaxrev						
policychange						
D1.	.2444299	2.888635	0.08	0.933	-5.41719	5.90605
_cons	-.0508471	.1984513	-0.26	0.798	-.4398045	.3381104
ARMA						
ar						
L1.	.8385198	.4963639	1.69	0.091	-.1343355	1.811375
ma						
L1.	-.9999941	.	.	.	.	.
/sigma	.4878005	.1097821	4.44	0.000	.2726316	.7029695

Note: The test of the variance against zero is one sided, and the two-sided confidence interval is truncated at zero.

Vector autoregression

Sample: 1996 - 2024 | No. of obs = 29
Log likelihood = 10.33196 | AIC = -.2297904
FPE = .0469839 | HQIC = -.1264269
Det(Sigma_ml) = .0287124 | SBIC = .1002466

Equation	Parms	RMSE	R-sq	chi2	P>chi2
ltaxrev	7	.194546	0.9701	942.2777	0.0000

ltaxrev	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
ltaxrev						
ltaxrev						
L1.	.0973415	.0751204	1.30	0.195	-.0498918	.2445749
tpm01	.348849	.1741891	2.00	0.045	.0074446	.6902534
tin01	.2322706	.1431803	1.62	0.105	-.0483577	.5128989
epay01	.5341313	.1359149	3.93	0.000	.2677429	.8005197
etcc01	-2.289776	.1651136	-13.87	0.000	-2.613393	-1.966159
popg	.0054847	.35257	0.02	0.988	-.6855397	.6965092
_cons	12.74138	.9665647	13.18	0.000	10.84695	14.63581

```
. regress ltaxrev tpm01 tin01 epay01 etcc01 popg
```

Source	SS	df	MS	Number of obs =	30
				F(5, 24) =	118.05
Model	26.80004	5	5.360008	Prob > F =	0.0000
Residual	1.0897149	24	.045404787	R-squared =	0.9609
				Adj R-squared =	0.9528
Total	27.8897549	29	.961715686	Root MSE =	.21308

ltaxrev	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
tpm01	.4678311	.1986862	2.35	0.027	.0577629	.8778994
tin01	.2548693	.1785216	1.43	0.166	-.1135811	.6233198
epay01	.6068981	.1667	3.64	0.001	.2628461	.95095
etcc01	-2.407709	.1606717	-14.99	0.000	-2.739319	-2.076098
popg	.3132449	.3722517	0.84	0.408	-.4550447	1.081535
_cons	13.23748	1.000377	13.23	0.000	11.1728	15.30216